

Brad Hokanson · Gregory Clinton
Karen Kaminski *Editors*

Educational Technology and Narrative

Story and Instructional Design

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Preface

One of the oldest technologies that humans use in structuring information is stories and narrative. If we adopt the view that any communication of a sequence of events is a simple kind of story, then the narrative element in language is as old as human communication itself. Today, stories are used for communication, for instruction, and for shaping the minds of learners in all fields. Perhaps because of their ability to entertain and amuse, they tend to be welcome methods of instruction and often have substantial impact.

Within the field of instructional design and educational technology, there is a need to effectively convey and express ideas and theories to a broad audience, one that includes students of instructional design, instructional design practitioners, and teachers. Narrative provides a facilitating vehicle for this discourse in our field. Similarly, there is a need to represent the content of instructional design effectively; for example, if we are designing a course about the nature of creativity, we can draw upon the stories told by known innovators about how important ideas came about in their experience.

Narrative, or storytelling, is often used as a means for understanding, conveying, and remembering the events of our lives. Our lives become a series of stories as we use narrative to structure our thinking. More importantly, we use stories to teach, train, socialize, and develop values in others. In professions, organizations, and corporations, stories are often used as a form of knowledge management to pass on the values and knowledge cherished by the community. There is power for leadership, learning, and motivation in the use of stories and narrative, a concept that is recognized in business, medicine, and education. The goal of the 2016 Association for Educational Communications and Technology (AECT) Research Symposium was to examine stories and narrative in instructional design.

For the symposium, and this subsequent publication, proposals relating to the use in education of narrative and story were solicited from the membership of the Association for Educational Communications and Technology. Received written submissions were reviewed by a team of reviewers and the symposium leaders (listed below).

The selected authors were asked to develop their proposal ideas into full-length chapters, each of which were reviewed by the other symposium participants.

All authors gathered for an in-person symposium held in July 2016 in Bloomington, Indiana, to participate in additional discussions and development. Steve Peters presented a keynote on the first day of the symposium, focusing attention on story as a broadly used form of communication. The ensuing discussions of the writings were rich, intense, and engaging and formed the basis for subsequent drafts and shared reviews by all authors. Divergent experiences during the symposium, including a visual-thinking-focused excursion to Indiana University's Eskenazi Museum of Art [<https://artmuseum.indiana.edu/>], also enriched and balanced the discussion.

The authors and teams of authors used the symposium to develop their best ideas and explorations, interacting with each other on a detailed and professional level, to form the chapters of this book. This experience has been essential to the development of this volume.

The in-person sessions of the symposium were structured using the methods of participatory leadership from the Art of Hosting movement; this is a significant departure from conventional academic conferences, moving from concurrent paper presentations to iterative small group discussions around each written piece. Authors worked together in a “Pro Action Café” format of structured discussions. In our use of Pro Action Café, each chapter author hosted three intense discussions, each with four or five other discussants.

Steve Peters, who served as a keynote speaker on the first day of the symposium, begins this publication with an essay on the spirit of storytelling.

Glenda Gunter, Robert Kenny, and Samantha Junkin outline the “imperative” of narrative, exploring the nature of story in terms of what can be defined and building a compelling case for the recognition and conscious deployment of story as an integral component of instruction.

Andrew Tawfik, Matthew Schmidt, and Fortunata Msilu examine the use of stories and narrative to support problem solving. They tie narrative and communication to case-based reasoning and to better understanding of learning environments.

Jaitip Nasongkhla and Ana Donaldson present the use of stories and narrative as a means to strengthen a university network in Thailand. Tying together significantly different regional backgrounds of Thailand by university academics provides an intriguing investigation in the development of an open learning object.

Colin Gray writes on the narrative qualities of design argumentation, examining design presentations and critiques as a *design argument*, one which explores design rationale and the inherent process.

Hedy Lim presents an examination of scenario-based workplace training as storytelling, recognizing the tacit and implicit knowledge that can be efficiently distributed through narrative and story. She notes that stories are an inviting form of teaching, pulling the learner into building experience and expertise. Stories are central to human experience and can be effectively used to convey value and meaning.

Yi Jin, Nadia Jaramillo Cherrez, Autumn N. Cartagena, and Wei Wang examine the use of narrative and storytelling to build connections between faculty

and instructional designers. Formalized storytelling was seen as an effective strategy to integrate roles and project understanding.

Michael Smith and Jeffery Evans see storytelling as transdisciplinary, one which can be effectively used to integrate knowledge into a meaningful whole.

Karen Kaminski, Paula Johnson, Shelly Otis, Dwayne Perry, Tracy Schmidt, Mindy Whetsel, and Haley Williams examine their own narrative and reflective design practice. Integrated into a master of education curriculum, this story-based element has proven to be effective for both learners and faculty.

Paige Hale and Matthew Schmidt examine the value of story and narrative in interventions for individuals with autism spectrum disorder. Tied to high-level use of technology and advanced data gathering, they make a strong connection between narrative and technology.

Kathryn M. Wozniak examines adult learners and their use of narrative identities to self-regulate and develop their metacognitive skills.

Heather Tillberg-Webb and Ned Collier bridge disciplines, connecting architecture and education in their qualitative research on narrative and innovative learning spaces.

In *Show and Tell: The Steps to Keeping the End in Mind*, **Cindy Cash** examines the use of narrative to support online career development. Storytelling is presented as a powerful constructivist approach to educating learners.

Marisa Exter, Ali Ashammari, Todd Fernandez, Anthony Randolph, Catherine Cartier, Yu-ung uo, Steven Lancette, and Blake Nemelka present their narratives from a course on educational software design. Recognizing beautifully imperfect opportunities to learn about educational software design, the effort chronicles the authors' own experiences.

Ora Tanner and Yiping Lou recognize the heightened interest achieved through narrative and apply this concept for learning in the sciences. They developed a content-specific narrative for a digital science game and report their efforts in this writing.

Ted Frick, Cesur Dagli, Kyungbin Kwon, and Kei Tomita present the story of their work with tutorials on plagiarism in online courses.

Yiping Lou and Lucille Moon-Michel examine the use of scenario-based science learning for middle and high school students. They recognize story and narrative as supported by activity theory.

Amy M. Grincewicz describes stories as an efficient way of storing, retrieving, and conveying information and describes work to create an online program using narrative. She describes the integration of the phases of a story in the design process.

Amy Bradshaw examines the implicit stories embedded within the discourse of the field of instructional design and technology. Our own narrative patterns shape the goals and thinking of the profession, and often these patterns contain hidden messaging to the effect that certain issues are better left unaddressed. Our narratives should be made more explicit and more just.

An emphasis on designing for experience is found in leisure and recreation studies, and this perspective is brought to bear on instructional designers by **Michael Matthews**. Designers can create learning experiences that utilize a narrative arc.

Similarly, where we come from – the precedents of our work – is carried forward by the narratives of instructional design. **Elizabeth Boling and Colin Gray** examine narrative as a tool for designing, a means to learn from design experience and to advance the capability of our work.

A description of storytelling as used to promote creativity and critical thinking is authored by **Albert Akyeampong**. Both skills are an important aspect of the college experience for the millennial generation, an age group that is immersed in digital storytelling.

Finally, in keeping with the age of data visualization and analysis, **Phillip Harris and Donovan Walling** examine new cognitive aspects of learning activity, shedding light on how we come to know and educate.

As with previous symposia, the 2016 Summer Research Symposium in Bloomington, Indiana, gathered a diverse range of individuals who shared their ideas and directions and, from the discussions, helped shape the eventual form of this publication. Unlike the collections of articles published in many journals, this collection of work is collaborative and interactive, developed through personal interaction and trust. The authors are those who should be lauded for the work, for their explorations and representations shape both their own writing and the work of their peers.

The resultant publication and the Summer Research Symposium would not be possible without the support of the Association for Educational Communications and Technology. Executive Director Phil Harris has consistently been a strong supporter of the symposia as well as the engaging and collaborative process that is used.

Additionally, Jason Huett, George Veletsianos, Amie Norden, Jody Lawrence, John Cowan, and Karen Kaminski assisted us with the initial review of proposals, setting the tone early on for authors and their contributions. We thank them all for their work of the early stages. Brad Hokanson, Greg Clinton, and Karen Kaminski all serve as editors for the book.

Stephen Peters has again been of great value for his editorial help.

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The Spirit of Storytelling

Stephen Peters

Abstract Storytelling is the “magic sauce” to teach reading and writing skills and to build enthusiasm for literacy as well as for other educational goals. Although narrative is ubiquitous in advertising, game design, electronic educational tools, etc., technological sophistication cannot finally replace the face-to-face human connections established by traditional oral storytelling in education generally. The spirit of storytelling is found within the memorable and enlivening connections between the teller and listener, and our challenge as educational designers is to cultivate the places where that spirit can shine through.

Keywords Storytelling • Connections • Technology • Spirit

It was a pleasure to come and give a brief talk at the opening of the Association for Educational Communication and Technology Summer Seminar this year. Though I'd read many of the papers these summer seminars have produced in recent years, I am not a researcher or scholar, not even an academic really, so my orientation is a bit different. As a professional storyteller and educator, however, this particular collection is heartening as well as validating of the work I have done for the last 30 or so years: teaching reading and writing skills to children by teaching them how to write stories.

I conduct a 5-day program leading students through exercises using sensory detail, simile, characterization, dialogue, dramatic structure, scene, setting, etc. to spin their original characters into complete drafts of stories. The magic sauce is that I tell the kids stories to model how these narrative elements work and to excite them to write with spirit.

Make no mistake, it's the storytelling that makes the difference at any level. Course evaluations from my long-ago days as a graduate assistant at Penn State and from my 20 years on the community faculty at Metro State in St. Paul attest to the

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fact that the stories I tell to illustrate the points I want to make are one of the primary elements that stand out to and work for my students.

This should ring a bell with many educators because we tend to be storytellers, though we don't often identify as such.

In my own case, it was long after Penn State that I finally identified myself as a storyteller. I'd quit a job I didn't like very much to try my hand at writing fiction, and that first year all I'd succeeded in doing was to decorate the wall next to my desk with rejection slips. Then I'd moved to Minneapolis and won some grants and awards and published in some good places. Though those grants and awards fanned my ego and encouraged me to continue writing, they didn't go nearly far enough to pay the bills, and so—just for the money—I joined a roster of artists visiting schools to teach their art forms: painters, playwrights, poets, performing storytellers, clowns, and fiction writers. It was a little like joining a traveling circus without the animals—just for the money and just until the wider world recognized my brilliance as a writer of short fiction.

I figured it was only a matter of time.

I'm still waiting.

And while I was waiting, I became a storyteller.

In a very real sense, of course, as a writer of fiction, I was already that. After all, advertising, marketing, and PR types identify as storytellers, as do software and website developers, game designers, and the creators of electronic educational tools.

But what I am talking about here is that I became a face-to-face, in the present moment, inventing, revising, and reacting to a live audience, traditional, oral storyteller. And that—as with many, many wonderful life changes—happened pretty much by accident.

I was working with a bunch of fourth graders, and I wanted to show them how using the five senses helps to bring a story alive, and I thought, "I'll tell these little disease vectors about the time when I was five years old and fell into a hole in the back yard. But I won't tell it the way it really happened. I'll embellish it as I'm going along and we'll see what happens." We all wing it from time to time. No big deal. That's where lots of our best stuff come from, and that's what I did that day.

So I'm standing there telling this thing, making it up as I'm going along, and I'm about three-quarters of the way to where I think the climax ought to be and I think, "Wow, I wonder what the climax even is?"

I had no idea. And I look out over the class, and I see 27 9- and 10-year-olds staring at me and expecting something great. I had nothing.

The thing is, though, that, somehow, I did think of something, and I've told that same story at least a thousand times since that day. I have never been tired of it or of the other stories I've developed. That's because every time I tell that or one of my other stories, the story and the situation will show me something different, maybe about how I should change the story in that particular moment for that audience. A good story is a little bit different every time you tell it.

And stories work. They establish instant rapport as well as, in my work, demonstrating the elements of narrative that my kids can then employ as both writers and readers. Further, the energy and immediacy of a told story helps to motivate students

to write with spirit, to take chances, and to surprise themselves with what pops out of their imaginations and onto the paper.

With all due respect to the many wonderful and useful creations reinventing and extending how we deliver stories, I sincerely question whether technology can ever genuinely replace the warmth and intimacy of one living, breathing, suffering, or celebrating human being telling a story to another. No matter how technologically sophisticated we become, we must do our best to stay as close as possible to that experience.

Folklorist, poet, and Irish nationalist James Stephens famously wrote, “The head does not hear anything until the heart has listened. The heart knows today what the head will understand tomorrow.”

Someone else, I forget who, has said that the shortest distance to someone’s heart is a story. Sounds glib, doesn’t it? Easy to say. “The shortest distance to someone’s heart is a story.”

But think about when you fell in love. Money, status, or physical attractiveness can keep us coming back—maybe even trap us in a relationship—but deep love is something entirely different. It’s a knowing.

In his TED talk on storymaking, filmmaker Andrew Stanton quotes a piece of paper Fred Rogers used to always carry in his pocket. It goes something like “There isn’t anyone you couldn’t learn to love once you’ve heard their story.”

We know storytelling is powerful. We know face-to-face, in the present moment, traditional oral storytelling builds relationships: parent to child, lover to beloved, teacher to student.

In its intensity and compression of imagery, storytelling is a kind of poetry. It makes a memorable, enlivening connection between teller and listener. It *leaves* a memorable, enlivening impression *on* both the teller and listener. And it matters.

We are educators, people called to help prepare and guide those who come after them. The stories we tell our students and the ones we help them tell and—long after they are gone from us—to live, matter. We buy based on story. We vote based on story. We learn, understand, heal, change, grieve, love, hate, and exclude based on story. Storytelling matters because it has consequences. The spirit of storytelling respects and attends to this, not out of some misguided and fear-based caricature like “political correctness” but out of the recognition of how easily the story—and therefore our humanity—can be abused. We need to only look to the purveyors of the *Big Lies* and conspiracy fantasies—the Alex Jones of the world or the nasty office gossip down the hallway—to see how easily the spirit can be poisoned.

We need, as Amy Bradshaw so aptly writes in these pages, to “mind the stories we tell.” We do need to take care not to perpetuate injustice through the stories we pass on. I would contend that the spirit I am talking about fits the callings of educators perfectly.

The steep hill for all of us to climb as we design the instruction we offer our students is to ask ourselves how we can bring that spirit into the content we want our students to take away—and then to act creatively on whatever fragment of an answer story offers us in the memorable and enlivening connections between sender and receiver: between parent and child, lover and beloved, and teacher and student.

Storytelling is a kind of poetry. “The heart knows today what the head will understand tomorrow.”

As we walk into our classrooms, perhaps clutching a stack of 3-by-5 cards with our lecture notes on them or carrying under both arms our newest, snazziest technological tool, how much of that spirit can we bring with us?

How we deliver stories may change or extend itself—plays, movies, electronic gaming, VR goggles, etc.—but the story itself doesn’t change much. The working parts are the same—a character, scenes, dialogue, a dramatic arc, etc. You know the list.

But if we as tellers and makers breathe our sense of calling into whatever delivery system we use, then theme—i.e., values, a message, a positive force, and spirit—will emerge like the invisible power from the visible working parts of a machine.

So, as the readers and the authors of this collection go about applying and adapting the research and ideas of this book, no matter the content, no matter how stories are used or delivered, I challenge them all to look for the places they can find to make the memorable, enlivening spirit of storytelling shine through.

The Narrative Imperative: Creating a Storytelling Culture in the Classroom

Glenda A. Gunter, Robert F. Kenny, and Samantha Junkin

Abstract One who studies the history of learning recognizes that story is the one of the oldest and most elemental forms of knowing. Story and storytelling precede the art of writing, with the earliest forms of story consisting of the combination oral speech, gestures, and facial expressions. For thousands of years, storying has "... evolutionarily rewired the human brain to be predisposed to think in terms of story and to use story structure to create meaning and to make sense of events and other's actions" (Haven K (2007) *Story proof: The science behind the startling power of story*. Greenwood Publishing, Westport, p.27). Unfortunately, the use of story as a knowledge acquisition tool has declined significantly in many Western cultures during what had become known as the "modern period" and has given rise to a shifting away from story and replacing it with a focus on scientific inquiry Boa-Ventura et al. (2012). Many attribute this transformation to Gutenberg's printing press when story (especially oral story) as a way of becoming "learned" was perceived to be inferior or backward and a primitive form of entertainment fit only for children, the illiterate, and the uneducated (Bradt KM (1997) *Story as a way of knowing*. Sheed & Ward, Kansas City; Ong W (1982) *Orality and literacy: the technologizing of the word*. Methuen, London).

Initiated, perhaps, by early successes in psychotherapy and aided by the advent of digital media technologies, we seem to be entering a postmodern era in which story has begun to re-elevate itself from an art form into an emerging change agent that can transform imagination into action (Coles, 1989). Story is enjoying a modest revival with educators because it relates well to constructivist ideas about teaching and learning. Educators who are somewhat reluctant to change are beginning to understand that story is a valid way of knowing things – a "narrative epistemology" as Bradt (*Story as a way of knowing*. Sheed & Ward, Kansas City, 1997, p. xi)

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referred to it. Many educators correlate story constructs to Bruner's ideas about situated cognition, where embedding context in situational (i.e., story) environments helps learners retain and understand information for longer periods of time and with deeper meaning (Bruner, 1990). Situating what is to be learned in terms of story helps learners select, arrange, and organize things in manageable chunks Riessman (1993). Because story requires one to suspend his or her beliefs in order to buy into a premise, a learner is already conditioned to accept change – a necessary precondition to learning. As suggested by some, evaluating story as a valid learning engine is much more complex than simply situating content (Haven K (2007) *Story proof: The science behind the startling power of story*. Greenwood Publishing, Westport).

Keywords Story and cognition • Digital narrative • Story culture • Integrating Integrating story into STEM

Environmental Scan

One who studies the history of learning recognizes that story is the one of the oldest and most elemental forms of knowing. Story and storytelling precede the art of writing, with the earliest forms of story consisting of the combination oral speech, gestures, and facial expressions. For thousands of years storying has "...evolutionarily rewired the human brain to be predisposed to think in terms of story and to use story structure to create meaning and to make sense of events and other's actions" (Haven, 2007, p.27). Unfortunately, the use of story as a knowledge acquisition tool has declined significantly in many Western cultures during what had become known as the "modern period" and has given rise to a shifting away from story and replacing it with a focus on scientific inquiry. Many attribute this transformation to Gutenberg's printing press when story (especially oral story) as a way of becoming "learned" was perceived to be inferior or backward and a primitive form of entertainment fit only for children, the illiterate, and the uneducated (Bradt, 1997; Ong, 1982).

Initiated, perhaps, by early successes in psychotherapy and aided by the advent of digital media technologies McLuhan (1965), we seem to be entering a postmodern era in which story has begun to re-elevate itself from an art form into an emerging change agent that can transform imagination into action (Coles, 1989). Story is enjoying a modest revival with educators because it relates well to constructivist ideas about teaching and learning Clandinin & Connelly (2000). Educators who are somewhat reluctant to change are beginning to understand that story is a valid way of knowing things – a "narrative epistemology" as Bradt (1997, p. xi) referred to it. Many educators correlate story constructs to Bruner's ideas about situated cognition, where embedding content in situational (i.e., story) environments helps learners retain and understand information for longer periods of time and with deeper meaning (Bruner, 1990). Situating what is to be learned in terms of story helps learners select, arrange, and organize things in manageable chunks. Because story

requires one to suspend his or her beliefs in order to buy into a premise, a learner is already conditioned to accept change – a necessary precondition to learning. As suggested by some, evaluating story as a valid learning engine is much more complex than simply situating content (Haven, 2007).

Introduction: What a Story Is

There exists a standardized testing description of a story – a character; a plot; a scene; a conflict; a beginning, middle, and end; a “rising action”; and a resolution (corestandards.org). This description helps make students better consumers of stories but is nowhere near an operational one that enables students to learn how to tell/create or learn from. The descriptive definition makes a story a thing. In order to get the reader to buy into our premise that integrating story/narrative into the curriculum is a valid exercise, we suggest that one agrees with the idea that a story is not a “thing” but a process – a way of thinking, internalizing, and eventually learning. The concepts of story and literature are equivalent, but are not the same and are often confused. Certainly, literature is mostly made up of stories. Conversely, stories can (and do) exist outside of literature. For example, one can tell his or her personal story. A story is often the backdrop for effective history lessons and can even be related in small bits and pieces using as little as 144 characters as has been shown repeatedly on frameworks such as Twitter.

In short, one cannot avoid talking about how the various forms of media have influenced what a story is, considering the fact that story should not be thought about in terms of it being a *thing* but a *process of thinking*, communicating, and learning. If one agrees with the premise that story equals learning, then it follows that the media that one uses to communicate a story plays a significant role in and affects that process. Various forms of storytelling (we use this term in order not to confuse its method of delivery from story constructs in their purest form) are presented in order to better make the case for one’s buying into the premise that story is a process and is infused in many aspects of one’s life and is utilized as a learning tool to teach and contextualize – from Aesop’s Fables to the Bible. This is why it is so unfortunate that fiction and literature have been downplayed and confused in many of the implementations of Common Core State Standards in the United States.

We suggest strongly that people have a deep-rooted intuitive sense for story and that story is a contextualizer and a learning engine. In this chapter we intend to demonstrate how story is useful in many disciplines, including those that might not seem as obvious, namely, math, engineering, and science, among others.

Story Generation

Most students have learned the basic descriptive elements of a story. While these help describe what it has in it (again using the “story is a thing” analogy), they are not prescriptive in that they do not demonstrate how a story is actually generated. First, there is the basic character, plot/themes, and setting (background scenery) triad that is often taught in schools Tobias (2012). They need no further explanation except to say that often what is not taught about these is that there are standard constructs for each.

Story Elements

Perhaps a more precise argument for using story as a learning tool revolves around the foundational enablers that push story from being a thing into it being a framework that can be applied to teaching and learning. Branigan (1992) explored the basic concepts of narrative theory and its relation to film and in conjunction with literary analysis. He brought together theories from linguistics and cognitive science and applies them to the screen *to describe the story invention process*. According to Branigan story invention boils down to *four basic elements*:

1. *Time and place* – As noted previously, all lists of essential story elements almost always describe a setting or background in which in the story takes place. This is the means by which the author organizes temporal and spatial data. The main character’s life appears to be moving along, and his or her background is explained. Time must always pass. In short films and narratives, only those moments that create the crucial “test” or pose the essential conflict to the main character are shown so that the storyline/through line does not become overly complicated and confusing. In a classical story, the “disruption” occurs in the second act, but sometimes it occurs immediately, and the scenarios/backgrounds are described through a series of flashbacks. This is known as the Goddard effect (Wakeman, 1988).
2. *Cause and effect* – This is that important moment in which the disruption occurs. This aspect sets the plot. The central character usually faces a decision, whether to succumb to the conflict or to fight. In other words, a conflict is not a conflict unless the character notices it and makes some type of *judgment* about it. Most often, this conflict/challenge cannot be overcome unless the character goes through a transformation or change and that requirement may also compel the character to go against his or her natural inclinations or morals. In storytelling parlance this is often referred to as the disruption. Recall that moment in the song by John Lennon (*Beautiful Boy*) that describes life as that which happens while you are making other plans.

This is the key difference between introducing the elements of story in the abstract and teaching students how to actually construct/create/invent stories.

According to Laycoff (1996) every language in the world has a way in its grammar to express direct causation – a local application of force that has a local effect in place and time. For example, when one drinks a glass of water, the direct causation of it being gone is that you did it. Direct causation is also that element that provides the teachable moment. Once students understand this concept, they begin to learn the importance of critically reading/viewing/listening for causation, which helps transcend story into any genre, whether fiction or nonfiction and making it a useful element in multiple disciplines.

Indirect causation is less discernable and implies a higher thinking skill. Discovering causation on either level can be intimidating and makes comprehension more difficult if there is more than two or three being implied in a storyline. Causation is a significant element that needs to be embedded in the story in conjunction with two additional constructs that will provide a means to effectively measure the relative teaching efficacy of a story.

3. A central character is the one who notices the cause/disruption and is the one required to make some *judgment* (to create the reaction or “effect”). To borrow a term from the video game industry to describe how developers program their characters, each “allowable action” is limited to the main character’s personality strengths/flaws, which makes central conflict and serves to limit (or expand upon) the amount of transformation that needs to take place. A story is not a story without developing a confrontation between life and the main character’s limitations/strengths. In order for a story to teach judgments about the cause and effect correlations and their impact on a known circumstance and/or a main character type needs to be clearly demonstrated because it is what makes a story outcome more or less predictable. Predictability is key to a story becoming a teaching engine.
4. Because all stories need both a teller and a listener, storytellers need to decide on how they are going to *communicate the story*. This is crucial and leads to the *credibility* of the story and demonstrates how it is possible to know these events and acts in a supporting role in the audience suspending its disbelief (Laurel, 1993).

Establishing Significance

Mandler (1984) describes schema theory as a system of thinking about something in terms of organized patterns that group information into related categories so it can be analyzed. Schemata can also be described as preconceived ideas as demonstrated through organized pattern recognition. The mental structure surrounding one’s preconceived ideas is what creates a framework that represents some aspect of the world and a means to perceive it, collect it, and finally organize it as new information. Story schema adds a bonus of also influencing attention to motivate the learner to transform that information into knowledge. Jean Mandler (1984) supports

this notion of knowledge acquisition through an analysis of story schema using three prescriptive, semantic elements.

- A *proposition* refers to Kintsch's schema analysis – a method that involves breaking down a text/narrative into its most basic elements to make meaning (the so-called predicate-argument schema (Kintsch & Keenan, 1973); Kintsch & van Dijk, 1978). In semantic linguistics this suggests that an argument is more likely to be retained if the outcome is predictable. It is the framework by which Branigan's (1992) judgment occurs. The character predicts what he or she must do in response to the conflict or disruption based on his or her personality (i.e., "allowable actions" in gameplay parlance). Given that the main character is able to overcome his or her shortcomings/emotions, etc., the outcome is predicated on a personal prediction as to the best possible actions. A tragedy occurs when that character is unable to overcome his or her weaknesses or circumstances.
- A *causal chain analysis* like that described by Branigan is a predictable outcome that is based on the principles/elements of nature or circumstances. In the classroom, this principle directly relates to the academic principles that are being taught for the scientific disciplines, or an ethical argument, and is what helps to map immediate recall. In a story this is often referred to as the "moral." While there are often unintended, random consequences, these, too, can become "teachable moments." In many disciplines casual chain analysis correlates to critical thinking or to brainstorming.
- A *story constituent* is the part of the construct Mandler refers to as "story grammar" that connects causality through context and provides long(er)-term recall because it is the tool that provides the reader/audience the ability to filter out nonessential "sentences" scenes (i.e., to read critically). This also directly relates back to Branigan.

People are more likely to notice things that fit into a schema and reinterpret contradictions to the schema as exceptions (or distorting them to fit), as long as the subject-predicate is strongly correlated as noted by Kintsch and van Dijk (1978), making the ending of the story or the results of the through line believable or credible, as noted by Branigan (1992), and helps search for (and create) meaning even when the subject-predicate is not initially obvious. Credibility and predictability are at the core of the so-called teachable moments and endings presented in a story, even those epic finishes where outcomes may not fit what was predicted to happen.

Schemata can help in understanding the world even in rapidly changing environments. People can often organize new perceptions into schemata if those situations do not require too complex of a thought process. Even the more complex situations can be quickly internalized when using schema, once thought becomes more automatic through repetition, as is demonstrated in the redundancy that often accompanies children's stories and fables. Examples of schemata include academic rubrics, social schemas, stereotypes, social roles, scripts, worldviews, and archetypes (which explain their use in film school). In story the standard (i.e., archetypical) constructs

of plot, character, genre, adding causal chain analysis, and tight propositional analysis are the building blocks of story as a teaching engine.

To take this further, Mandler's (1984) combining Kintsch & Keenan (1973) and Kintsch & van Dijk (1978) semantic analysis and Branigan's (1992) and merged with Ifenthaler's later ideas about cognition (2011) story components appears to suggest that if the above three elements "...could be amalgamated into a comprehensive system, it should provide a [learning] theory of great predictive power" (p. 73). In short, we are suggesting that a well-thought-out curriculum based on these three story creation elements has unlimited potential in the classroom.

Unless a story contains the elements as described above, it may fall into a story category but not necessarily one of educational value. The truth is that not all stories are created equal nor are they all good stories. Most have some of the necessary elements but not all. We intend to build these elements into a story validation index that classroom instructor can utilize to assess the educative value of a story. In other words, we are moving from describing a story to quantifying their efficacy as a teaching medium using finite terms.

Character Development and Transformation

A significant part of creating a properly conceived learning environment is motivating the learner. While some stories are intrinsically motivating (such as personal stories about "self"), we recognize that even properly formatted stories are not universally inspiring. A significant element in drawing in listener/viewer/reader into story is to create empathy for its main character(s). This important aspect makes a story more credible. There are certain criteria used to develop a character's profile that need to be present to create this sense of self-identification. These are referred to as the transformational aspects of the character's development. This same function is directly related to a storyteller making the story's cause and effect element come alive and become believable to enhance the listener/viewer/reader's ability to suspend his or her disbelief (Laurel, 1993).

Through the use of a non-example, the idea of transformation can easily be explained. While the concept of time passing is present (first you do this, then this, etc.), a recipe is not a story because the sequence is not based on cause and effect, nor is there an element of character development. In this respect there is no need for the reader to suspend any disbelief. A recipe is a good example of a catalog. In a story some person or objectification of a person undergoes a measurable change or transformation based on his or her judgment about how to react to a causal event. It is the struggle that the character goes through that is at the core of the story creation. This moment in the story equates to the concept of the "moral of the story" – shorthand for its teachable moment, and an evaluation of the result or consequence of the decision that the character makes. Cause and effect and value judgments can strongly correlate to a classroom experiment in a science, a formula math class, or a historical event in a social studies class. Effective transformations tend not to be

random but planned and need to tie back to the story's through line. The transformation can be overtly stated or implied, based on the storyteller's creative decisions.

As has been shown above, a story can become a powerful tool in the acquisition, transferal, and/or sharing of knowledge, especially when it is tied to short-term and long-term cognition. Jerome Bruner (1990) describes narrative as a non-neutral (i.e., personalized) account of experience that is based on a person's natural desire to communicate meaning. We suggest that Bruner's definition of narrative curriculum is narrower than what we are implying. We ascribe Bruner's approach to being a particular branch of storytelling within a broader construct. Bruner's approach does meet one of the key requirements of Branigan's (1992) tetrad: It places the narrative on a timeline and assumes "an experience of time" (emphasis on "experience") rather than just referring to time in a historical sense. This is the basic difference between cataloging events and narrating them using judgments/analyses about causal chains. Bruner's approach does capture the emotion of the moment, making the event (and the learning of it) active rather than passive, which is an essential element for motivating the learner to acquire knowledge. While Bruner's ideas are certainly tied to narrative storytelling, what appears to be missing are the causal chain (Mandler) analysis and a story's predictive components.

Science Meets Fiction: Theory into Practice

As stated earlier, there has been a shift away from story in all areas of education but especially in the areas of STEM and those academic areas that are based on scientific inquiry. The question is why? Some correctly understand that STEM is really about focusing on processes, not specific disciplines. Science, math, and engineering are based on finding solutions to problems. Educators are beginning to understand the importance of story as a perfect partner for innovating and building science and math solutions.

Papadimitriou (2003), a distinguished professor and engineer at University of California – Berkley, stated two reasons why using narrative in learning situations is fundamental. First and foremost, "...narrative richness is an essential precondition for the self (i.e., there can be no narration without narrator)." This is because we think of ourselves almost exclusively in terms of our mental autobiography. Second, stories are in a certain intrinsic sense interesting in that they are attractive fodder to stimulate memory. Everything else being equal, we are much more likely to remember a story than a logical argument.

Stories combined with other engaging learning strategies create content that is difficult to forget. We suggest that integrating storying into lessons adds the dimension of design that proponents of STEAM are asking to be included. Narrative becomes the "art" aspect of science and technology teaching. We agree with those who suggest that one reason so many students may be turning away from the STEM is the lack of embedding artistic empathy in the disciplines. Initiatives such as the World Science Festival have renamed events to address this, adding titles such as

“Science & Story: The Art of Communicating Science across All Media.” Some scientists have recognized that science is a story, and intertwining it into STEM provides the motivation for and conceptualization of the need to dig deeper.

Situated Demonstration Cases

We make our point about story and STEM through a couple of case studies. In both examples we assume that the teacher/instructor has first taught the basic elements of story creation, story schema, and character development. While the specific examples were randomly directed at STEM topics, their construct as problem-based learning cases is representative to any interdisciplinary area.

Situated Case #1 Embedding a Story into an Engineering Class

The following story is an example of embedding story into an engineering class in which the protagonists are faced with design decisions. The story situates the problems and attempts to create the need. The story and related lesson contain all three elements found in our story index: the story constituent, a causal chain, and a proposition.

The teacher/instructor begins by presenting the class with a backstory to contextualize a series of problem-solving *design challenges*:

In 1931 in the midst of the Great Depression, Roger Wilson headed out west by train with his mom and sisters in search of work. He had been working with his father, Herman, who had recently passed away from a fatal fall off the roof of a house. Like many people, he could not find work as a bricklayer in rural Alabama but was encouraged because he had heard about a new government project that was located on the border of Nevada. The local Blount County newspaper posted an advertisement from the Bureau of Reclamation calling for “practical engineers” to help create one of the largest structures in the world. The Bureau was one of the few agencies that were offering jobs. The local newspaper said that the proposed structure would control the massive floods and retain the water supply for many different areas and use the massive power of water flow to create electricity with water using something called hydroelectric power. Roger was fascinated with this since he had heard that hydroelectric power could create electricity from something called hydropower. He considered himself a “practical engineer.” While he had no formal education in engineering, he did know that if you could control flowing water, you could create waterpower or hydropower. Many criticized the government for this venture stating that, first, it was an impossible task and the entire initiative was not even based on limited formal engineering design but rather on trial and error and, second, because no project of this size and scope had ever been attempted before.

For Roger and his family, this meant food on the table and generally a better life. They made the long trip to Black Canyon on the Colorado River only to encounter many others who had the same idea. To stand out, he quickly learned that he must work hard and demonstrate that he learned something new every day. He was hired on as a mason. As most of the men were not trained engineers, they were forced to learn brand new skills to understand the construction process and to solve what turned out to be thousands of problems almost daily. The Hoover Dam is still considered one of the most comprehensive examples of the practicing trial and error methods for testing out engineering theories and putting them into

practice. No one knew, for example, the best method for diverting water flow, or if concrete could support a structure of this size and scale, or which physical shape for the dam would best suit the need.

The solutions to the myriad of problems presented while building the dam are classic examples of using feedback loops in engineering brainstorming sessions. It also ties directly with state standard and others provided for the engineering industry.

Design Challenge #1 [Rationale: Storytelling as a tool for knowledge sharing]

The Colorado River was one of the most powerful water flows – it was massive. One of the first things the practical engineering group had to deal with was how to divert the water flow and use its power.

Students are broken into groups and are asked to decide on the best possible solution to the water diversion problem. Through math and physics algorithms, they predict which solution works best; then using examples they “try out” their solutions. The groups get back together and present their possible alternatives. The class then is able to read the rest of the story that explains what the actual solution was and then note the “deltas” in their solutions as compared to the actual one. In this case the students are able to, through the storyline, correlate the problem and its predicted results.

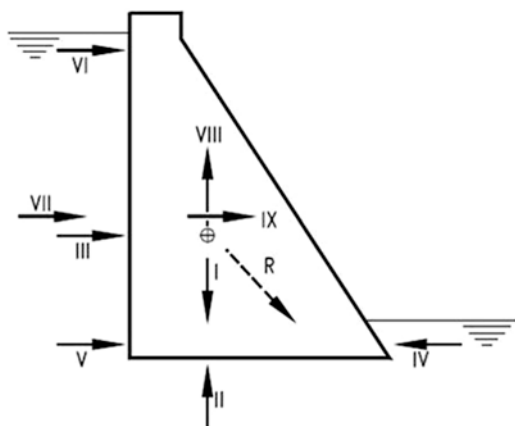
Design Challenge #2 [Rationale: Comparing and contrasting]

The story continues...Once the teams of men successful developed strategies and diverted the water flow, there were other issues to overcome and many problems to solve. Among the many other challenges included determining the best physical shape to use in building the dam. Roger and his group brainstormed various alternatives. After much trial and error, they discovered that a shape similar to the trapezoid would work best.

This time the instructor allows the students to see the final result. The storyline helps them “connect the dots.” Their task would be to create an explanation as to why the trapezoid would work best. Knowledge building is hierarchical and is revealed through the resolution of the story. Abstract knowledge derived from within one particular context may be found to explain phenomena in other areas. In this case the students are asked to prove an abstract theory that demonstrated the physical characteristics of physical shapes that have since been proven to work in a specific applied situation which uses evidence-based practices (Smith, 1998).

The teacher/instructor then asks the student to integrate in narrative format using story through lines examples of the impact the hypothetical failures might have on the main character’s situations. In short they would alter the story based on the proposed solutions that did not work. Each student group investigates the characteristics of each shape and consensus is reached. The idea is to provide a continuum of theories that are commensurate with/corresponding to others. When possible, explanation and contexts of the problems should be unified and explanatory frameworks used for the subsequent story-based solutions. It is well known in instructional design that developing knowledge in a horizontal fashion offers opportunities that serve as clues and help to personalize the inquiry Fig. 1.

Fig. 1 Final design drawing for the dam



The storyline continues, and stopping points are determined with the idea that each challenge is created based on the level of students in the class.

Situated Case #2 Mathematics in Action

The lesson starts with a teacher/instructor who notices that their students are enthusiastic about the Hunger Games books and movies and recognizes the motivational opportunity that this phenomenon presents and decides to integrate the story to teach some abstract math that the students were struggling with. Several mathematical lessons are developed.

The Hunger Games is a series of American adventure novels that have created a complete franchise grossing over \$2.9 billion worldwide through its movies, books, and merchandise. This captivating story is about 12 districts that were a part of the fictional country of Panem – the ruins of what was once North America. Every year the government forced each of its 12 districts to send one teenage boy and girl to compete until only one survivor remained in the Hunger Games: a nationally televised event.

The story follows a teenager named Katniss Everdeen who volunteered to replace her sister, who was chosen for the 74th Hunger Games. Katniss soon finds herself in the arena fighting for her life while becoming entangled in a love story.

Each lesson looks at the games from a different perspective, and the students are asked to use their mathematical skills to answer questions and problems that are posed to help them formulate an opinion. In some cases, the students are asked to rewrite the episodes' endings based on mathematical calculations. Each lesson starts with a brief background about what happened and direct quotes from the book to help set the stage for the mathematical concepts being introduced.

When the students watched the movie, the lessons are presented at certain critical moments. For example, as soon as Katniss gets on the train in the movie, it is paused, and a lesson on distance is introduced. Students use data from the book to plug into a mathematical formula to calculate the answer. The lessons are very straightforward, and the students do not have to think very critically about the problems.

Students are challenged to use their critical thinking skills to find answers to more complex questions, and they are asked to formulate *opinions and inferences* – one of the State Standards for ELA and geometry. For example, while teaching the distance lesson, using quotes from the book, students are asked to figure out how far away from the Capitol the games take place from their own hometown using the variables of rate and time. Once students find the distance, they are asked to determine where on the globe the Capitol of Panem was located if the train hypothetically started out in their home city. Students are asked to research and make calculations to formulate their answers.

Students are then asked to put themselves in Katniss's position and determine whether they would risk running away from the Capitol to get back to her home district (District 12) and to explain their response. Students use their mathematical calculations to decide a risk/reward factor (using percentages) to help Katniss overcome her fear of being caught. Based on their decisions, the students are asked to rewrite the ending of the episode to determine the credibility/predictability of the one actually written by the author.

Each lesson requires students to challenge the propositional conclusions of the story episodes. The propositional elements of a story are the *allowable actions* based on the descriptions of the main character's previous actions and personality. Propositional analyses provide some predictability in terms of argument Kintsch and van Dijk (1978). Instead of using Katniss's character traits, students use mathematics to determine possible outcomes. These comparisons help students critically analyze the literary value of the storyline. More often than not, Katniss's decisions will be the same as the mathematical calculations the students make. In the lesson about slopes, in the book Katniss states:

The ground slopes down. I don't particularly like this. Valleys make me feel trapped. I want to be high, like in the hills around District 12, where I can see my enemies approaching. But I have no choice but to keep going.

At this particular point in the story, Katniss had just begun to participate in the games and was looking for water. She had to constantly be self-aware and try to stay hidden. While working together, students have to calculate what kind of possible slopes Katniss and her enemies (called *tributes* in the story) would scale while she looked for water and the kind her pursuers would use when chasing her.

In essence, this lesson becomes gamified in that the students are asked to make the same decisions as if they were taking on the role of Katniss inside a role playing game. Students are required to assume that Katniss would end up at the bottom of the slope to find water, making her an easy target. Students are provided two different slope problems to determine the angle of the slope, the position of Katniss and that of her pursuers, and whether she would be safe. After graphing various slopes, students begin to recognize that horizontal slopes are the safest when trying to stay hidden. Students are then asked to explain how it is different from what Katniss intended and why their responses were safer. The lesson demonstrates that if Katniss thought out the process mathematically, she could have a better chance at surviving, which would actually change the propositional conclusion of the storyline. All of

these calculations demonstrate mathematically Kintsch and van Dijk's (1978) propositional analysis as well as the predictability of the results that enhance the story's construct as a teaching tool.

The class is then asked to extend the storyline using some hypothetical scenarios. What if Katniss did not pay attention to the slope while searching for water? They are asked to hypothesize what might happen in the story. The students are able to provide various answers like "the other tributes would see her" or "someone could throw something to kill her." Last, they are asked whether at the beginning of the games and Katniss did not have her bow and arrow to protect her and if another tribute saw her, how would she defend herself and what are her chances of living?

Again based on Mandler's story constituents, students are able to observe how this hypothetical scenario might change the outcome of the book. Using these scenarios students are changing the story schema – the mental structures consisting of sets of expectations about the way in which the story proceeds. The story schema enables the reader to form a coherent representation of the storyline. The story they create is in concert with Mandler's principles. Through mathematical equations the students learn probability and predictability and adjust the story through lines in the process.

Conclusion: Story and Cognition

Most would agree that today's educational system (and society in general) is often described using the term *information overload*. Nathan Shedroff (2001) describes the hierarchical differences among data, information, and knowledge – with the latter as the process of making what is observed meaningful and useful. While we pay attention to all three, what is most significant is to discover that story is one of the most useful tools to share knowledge because of what is retained and enduring. Until recently, story has been shown as a tool that is most used for sharing simpler and more general information. In Western cultures, traditions in managing knowledge until recently have been shaped by a line of thinking that gives preference to our working with knowledge in an abstract form rather than that gained from direct experimentation or observation. Most personal experiences are immediately intellectualized and transformed into the abstract. This is demonstrated by the preference/desire of some of our youth to live in virtual worlds rather than actually deriving experiences from reality (Kimura, 2000).

Educators are beginning to realize that not all information can be abstracted and correctly categorized into knowledge for long-term memory through deduction alone. Of the two types of processes, we use to transform information into useful knowledge (i.e., direct observation and correlating with previous experiences), the former is not always the most efficacious means because our logical, deductive powers cannot always be trusted and are less enduring even though they appear to have the most power because we are often more able to express them using words (Sole & Wilson, 2002). Intuitive knowledge, on the other hand, while more enduring,

is less transparent and controllable. Sharing knowledge through story often appears to rely upon intuition and experience and is, therefore, less obvious as a learning tool in educational settings.

What we have attempted to demonstrate in this chapter through our presentations, background “story proof” research, and situated cases, is that once we discovered that a story construct and culture actually exist, we were able to conclude that story can be clearly and empirically demonstrated as a useful tool to share even more abstract forms of knowledge. In brain research it is often noted that story tends to simultaneously activate multiple regions of the brain and multiple sensory memories, making learning and knowledge acquisition more meaningful and enduring (Sole & Wilson, 2002). Our *story-teaching index* is our attempt to quantify and qualify those constructs to effectively evaluate their use in specific and finite terms and to add credibility to our push to change the culture in our classrooms to include story as a foundational instructional tool.

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Stories as Decision Scaffolds: Understanding Nonlinear Storytelling Using Case-Based Reasoning and Educational Design Research

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Abstract Case-based reasoning (CBR) is a theoretical approach to understand how narratives support problem-solving. In many game-based learning environments, nonlinear storytelling is a popular approach to unfold the problem-solving experience. For this study, we developed a game-like, case-based learning environment that utilized nonlinear, narrative elements to present cases and facilitate decision-making. The study presented here explored learners' general perceptions of the learning environment, with a specific focus on usability. Evaluation results identified themes related to problem representation, perspective taking, decision-making, retention, and retrieval/reuse. Implications for case-based reasoning and educational design research are discussed.

Keywords Case-based reasoning • Case library learning environments • Decision-making • Usability • Design-based research • Educational design research

Introduction

Instructional strategies such as anchored instruction, experiential learning, and problem-based learning often focus pedagogy around a central case (Belland, 2014; Dabbagh & Dass, 2013). Such cases can provide realistic accounts of events and problems, allowing learners to vicariously experience levels of complexity and uncertainty that are often absent in traditional classrooms (Kim & Hannafin, 2009;

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Kolodner, 1991). In case-based reasoning (CBR), learners engage in meaning-making by studying related cases that are typically presented as narrative stories. Case-based learning theory suggests that cases can facilitate learning by focusing attention on concrete details, providing context, and representing experience in a narrative format (Kolodner, Dorn, Owensby, & Guzdia, 2012; Schank, 1999).

Storytelling is an important component of CBR theory. Considered to be the oldest and most natural form of sense-making, stories are a “means [by] which human beings give meaning to their experience of temporality and personal actions” (Polkinghorne, 1988, p. 11). When learners process expertise through narratives, they better connect and organize skills, knowledge, memory, etc. within a broader context (Bruner, 1990). From a problem-solving perspective, stories represent a means to synthesize information and reframe understanding as a cohesive whole (Jonassen & Hernandez-Serrano, 2002; Schank, 1999). Narratives are further beneficial in supporting problem-solving because they help to elicit causality and aid decision-making.

There are many implications of CBR to the design of learning environments. Specifically, learners are provided access to a set of digitized stories (a *case library*) that are carefully annotated to model problem-solving and suggest parts of solutions. As an instructor leverages these cases, he/she can distribute scaffolding between the facilitator and case library to support learners as they are solving problems, reflecting, making sense of what they are encountering, and deriving explanations (Tawfik & Kolodner, 2016).

As the field of education seeks to understand how to integrate CBR to support problem-based learning (PBL), specific questions should be answered to ascertain its efficacy as a learning model. One important aspect relates to how learners apply the CBR process. According to CBR theory (Jonassen, 2011a; Kolodner, 1991; Schank, 1999), individuals retrieve and reuse a case based on the assigned meanings of the experience. That is, they identify relevant cases and apply the lessons learned in order to solve extant, related problems. To date, much of the research on case libraries is approached from a qualitative perspective in which learners reflect on the merits of case libraries after a PBL module. However, it remains unclear under what conditions a learner might retrieve and reuse certain elements of a case. While research has documented positive responses to cases, further research is warranted to ascertain how cases are best applied within a learning environment.

The purpose of the qualitative pilot evaluation reported in this chapter was to explore participants’ perceptions of a prototype, game-like, narrative-driven, case-based learning environment from the perspectives of ease of use and general system usage. Our research was guided by the following questions: (1) How do participants perceive the ease of use of the prototype learning environment? (2) What is the nature of learners’ experiences while using the prototype learning environment? The chapter is structured by focusing initially on the theoretical foundations of CBR and the need for additional design-based research to guide case library systems design. We then explore a specific example and report findings from learners’ evaluation of cases embedded within a game-like, nonlinear learning environment.

Conceptual Framework

Case-Based Reasoning

According to theorists of decision-making, experts make decisions by pattern matching, forward-directed reasoning, and storytelling (Lipshitz, Klein, Orasanu, & Salas, 2001). Storytelling in particular helps to frame an experience and anticipate outcomes (Jonassen, 2011b). From a learning perspective, case-based reasoning (CBR) is an analogical reasoning model to understand the link between storytelling and encoding memory for future problem-solving. Specifically, stories in the form of cases help both to interpret situations and to subsequently inform a solution to a new problem. CBR posits that when a learner is presented with a new problem in CBR, he/she will recall similar cases from memory. If he/she recognizes a case as being relevant (a process known as *similarity assessment*), the individual will reuse the case. If not, he/she will revise his/her understanding to solve a new problem. The new experience is then stored within one's mental case library and available for reuse. From the perspective of generating solutions, CBR asserts that stories help to focus learners' attention on important causal elements of an experience (Ferguson, Bareiss, Birnbaum, & Osgood, 1992; Jonassen & Hernandez-Serrano, 2002; Kim & Hannafin, 2011). Moreover, they help to provide decision scaffolds about what actions should be taken next (Dabbagh & Dass, 2013).

Case retrieval and adding to one's mental case library are especially powerful for learning because they serve as triggers to update memory (see Fig. 1). *Case indices*, which serve as labels to the case, enable one to determine the appropriate case applicable for a given context. After one has encoded a case in memory, one can later access the index to find the appropriate case in memory. A strong index is important because it helps the learner to view a situation as being relevant beyond merely surface characteristics (Kolodner & Guzdial, 2000). These indices can label the case in terms of characteristics of the context and lessons learned about why specific variables are important. The final aspect of CBR is the *case processor*. The case processor facilitates the processing that results from indexing experiences, retrieving relevant cases from memory, applying the lessons learned from the case to the extant situation, and re-indexing older cases in light of new experiences (Kolodner, Owensby, & Guzdial, 2004). However, this processing aspect is difficult for novices because they tend to focus on surface level or irrelevant details. This could result later in erroneous retrieval and reuse of a case. Indeed, research shows there are many variations that might impact how cases are indexed, retrieved, and reused within memory (Alfieri, Nokes-Malach, & Schunn, 2013). Another area that learners struggle with is the ability to apply the most appropriate case to a given problem. Research suggests that while learners naturally retrieve cases to solve problems, they do not leverage necessarily the most appropriate cases (Kolodner, 1991). A key issue, therefore, relates to the indexing and retrieval of cases, that is, making sure that the right cases are available for the learner at the right time to aid decision-making.

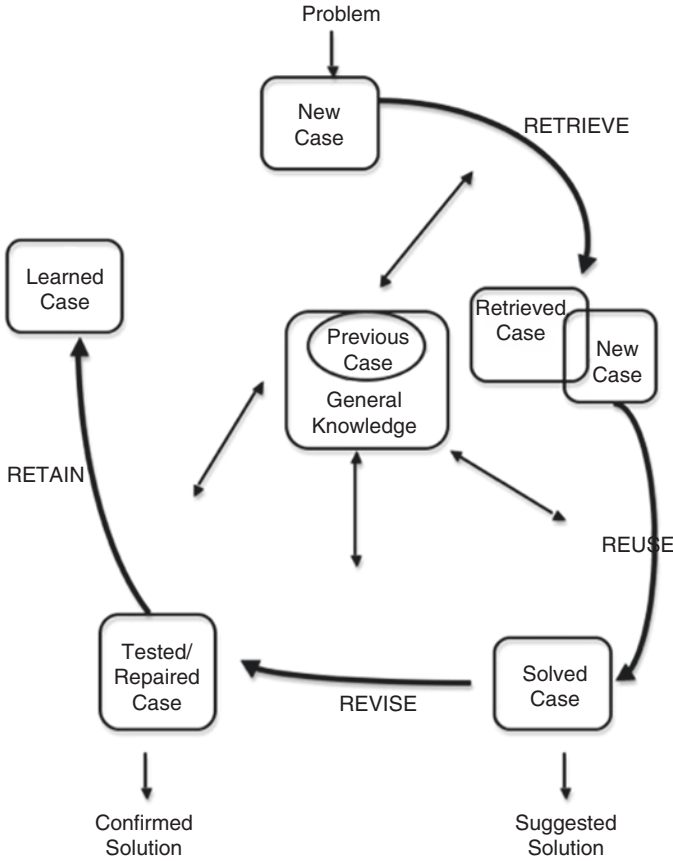


Fig. 1 Diagram of case-based reasoning processes: retrieve, reuse, revise, and retain

Case Library Systems Design Considerations Learners often begin problem-solving processes through means-end analyses. Rather than focusing efforts on schema construction, they focus efforts on reducing the distance between problem space and goals (Renkl, 2014). By schema construction, we refer to the processes associated with incorporating new knowledge into one’s mental models. This engenders significant cognitive load, especially when a novice is unfamiliar with the content. CBR theorists posit that stories and cases are especially beneficial when learners have little knowledge or background for a given topic (Renkl, 2014). Moreover, CBR systems are thought to provide *vicarious experiences* to help overcome experience gaps and supplement prior knowledge (Jonassen, 2011a; Kolodner et al., 2012). Through CBR systems, learners are able to make better decisions about their problem-solving because the CBR system is populated with cases that depict how others encountered similar problems. Over time, learners are able to generate abstractions of principles from the contextualized cases (Braithwaite & Goldstone, 2015).

Cases are highly contextualized by place and context, so case library systems should incorporate a variety of cases to elucidate multiple areas of a problem space. When students have access to a library of cases that are (1) carefully selected and designed to model disciplinary problem-solving and (2) suggest parts of solutions, there is even further opportunity to provide exposure to important concepts. Cases and narratives are most effective in problem-solving when learners reflect on the variety of cases, make sense of what they are encountering, and derive explanations of the experience. When this happens, learners are also more likely to remember and later apply these experiences to solve new problems.

Storytelling through case libraries allows learners to engage in causal reasoning and decision-making in a way that is natural to them (Kolodner, 1991). The better a story provides justifications for decisions made and explanations of outcomes, the greater the chance that learners will be able to apply later the lessons from the story. Further, when stories include not only what happened but also the resources and reasoning used to understand a situation, make choices, or solve a problem, cases can serve as a more knowledgeable peer for both learners and teachers, both (1) helping learners interpret situations and solve problems and (2) providing a model of good scaffolding for the teacher. The facilitator's role in these situations is to help learners – both individual learners and the collective – reflect on failures, identify deficiencies in their knowledge or reasoning that led to the failure, move toward fixing those deficiencies, and identify ways of labeling the experience so that they can remember it later to avoid making the same mistake.

Challenges of a Nonlinear Approach A central principle related to the design of case library systems suggests that stories be presented to the learners as decision aides (Jonassen, 2011b). To best support decision-making, the presentation of case libraries can be both linear and nonlinear. In a linear format, a learner is provided the material and related narratives such that the learner progresses in a straightforward and clearly delineated manner through the system. Conversely, in a nonlinear format, there is no single direction to progress through the overall problem. The learner is presented with decisions about how to progress, and these decisions affect the progression of the story.

According to CBR theory, reasoning is impacted by (1) when a case is presented (*insertion time*) and (2) when a case is retrieved. In linear storytelling, this is fairly simple. For example, a task analysis can inform the strategic points where a case should be presented in an interface. However, in nonlinear storytelling, insertion time becomes more complex. If narrative becomes disjointed, this could impact a learner's conceptualization of causality due to cognitive load. Given that in a nonlinear format, learners are afforded control about how to progress, it is possible that they may progress down a path that misses an important story, which could result in them not exploring important aspects of a problem space. Other challenges associated with nonlinear formats include learners accessing irrelevant information, being unable to distinguish which information is important and which is not, and attempting to traverse all pieces of the story by going back and trying to access all decision points. From a CBR perspective, these issues could disrupt the insertion of the case and subsequent retrieval needed for decision-making.

Methodology

The purpose of this exploratory qualitative evaluation was to investigate participants' perceptions of a prototype, game-like, nonlinear case library. More specifically, our research was a formative evaluation of participants' perceptions of ease of use and the nature of the learner experience. The research questions (RQ) that guided this study centered around issues of ease of use and learners' experiences with the prototype learning environment, specifically:

- (RQ1) How do participants perceive the ease of use of the prototype learning environment?
- (RQ2) What is the nature of learners' experiences while using the prototype learning environment?

Narrative Text-Adventure Learning Environment

For this research, we developed a game-like, case-based learning environment in the genre of a narrative text adventure game. Text adventures are a type of adventure game in which the user experience is facilitated primarily through text, although these games are sometimes augmented with graphics (as is ours). Narrative games are “those having a clear story line in which characters' actions are directed toward a goal in the story” (Adams et al., 2012 p. 235). Dickey (2006) provides a design framework for interactive learning environments that considers the following heuristics: (1) presentation of a challenge, (2) providing obstacles, (3) establishing roles, (4) establishing the setting, (5) providing a backstory, and (6) providing a means to support the unfolding of the narrative storyline. Each of these heuristics is embodied in our game, as described below.

In our environment, learners are presented with the challenge of solving a hiring problem in a sales management scenario in a health equipment sales company setting. The learner takes on the role of the protagonist who is being coached through a problem by his/her mentor and boss, Sheila. Through a series of brief (100–200 word) excerpts from an overarching case that acts as a framing story, learners discover the backstory that the company has had significant turnover for a sales management position, and the company needs to find a candidate for the position who will be a long-term employee. Learners are presented with a series of options for how they might proceed, and their selections affect how the narrative storyline unfolds. Learners have control over which stories to reference and the order in which the stories are accessed while working toward a problem solution. These options are represented as hyperlinks, and the learner can choose to follow them in any order. For example, after reading an excerpt that explained a hiring problem, the learner might choose to learn more about prior employees or choose to start reviewing resumes. As learners progress through the story, obstacles are introduced. Learners, in turn, explore these obstacles by reading stories that are told by other

employees. For example, one story introduces the dilemma of hiring someone from within versus hiring someone from outside the company. In another example, a former employee tells of how she was overlooked for a promotion based on her gender.

Educational Design Research

Educational design research (EDR) (McKenney & Reeves, 2012) was the overarching methodological approach that we selected to guide our research and development. Also commonly referred to as design-based research (DBR), this approach seeks solutions to educational problems through multiple cycles of inquiry and is often used when designing technology-based learning interventions. Over multiple cycles of analysis and exploration, design and construction, and evaluation and reflection, solutions to educational problems are devised. As a project scales, researchers gain better understanding of the underlying educational problem and its unique context and are better able to design impactful interventions. This leads to broader implementation and spread of the designed solution, hence resulting in greater impact. Key outcomes of EDR include a constantly maturing intervention and deeper understanding of how theoretical principles apply to a given educational problem when applied within a specific context.

We selected EDR as our methodological approach not only because it is considered to be a highly appropriate method of inquiry for learning technologies in higher education (Reeves, Herrington, & Oliver, 2005) but also because researchers suggest it is “particularly effective” (Hofer & Owings Swan, 2006, p. 4) for digital storytelling. More specifically, we opted for EDR at this formative stage due to some of the design tensions that emerged from our prior research (Tawfik, 2017). For example, from research on the first two instantiations of the learning environment, we found that merely presenting cases did not necessarily result in learners accessing those cases. In addition, we learned that passive reading of cases was insufficient to support retention and retrieval of cases to support problem-solving. This served to shift our focus from pure considerations of CBR to a broader consideration of how we could design our environment differently to more effectively support the aims of CBR. Many of the design ideas we generated based on our research were related to digital game-based learning and nonlinear storytelling. While we found these to be promising areas to explore, we did not find substantial guidance for how we could go about designing a case library that incorporated these approaches. EDR is particularly useful in situations in which design guidance is limited or in which guidelines for instantiating theoretical principles in concrete interventions is lacking.

Participants and Protocols

To assess learner perceptions of the ease of use of the nonlinear case library, as well as their general perceptions regarding system usage, we conducted a formative evaluation with a focus on ease of use and playtesting ($N = 5$). Participants were junior-level marketing students enrolled in a course entitled Sales Management. Although they were familiar with the subject matter from class, no participants had seen the cases or problem to solve prior to the study. The study was approved by the first author's Institutional Review Board (IRB), and all participants voluntarily agreed to participate in the study.

Participants were selected using a purposive sampling method of five participants from the Sales Management course. A think-aloud protocol was employed in the data collection sessions, each of which was recorded using Google Hangouts on Air. Each session was conducted with the same facilitator, and each took approximately 1 h to complete. We targeted five participants based on Nielsen's (2006) heuristic that five participants are sufficient to identify 80% of potential issues during user testing. The protocol for the study was developed based on a semi-structured task analysis. More specifically, participants were asked to progress through the learning environment and comment on their actions. When possible, the facilitator prompted participants on (1) cases as decision-making supports, (2) understanding of the concepts embedded in the case, and (3) general perceptions of the learning environment.

Upon completion of the task analysis, a semi-structured interview was conducted with the students. The interview protocol was derived from Reeves et al. (2002), which focused on both usability and multimedia learning principles. In terms of the former, the testing discussed issues related to aesthetics, navigation, visibility of system status, and error recovery. The multimedia discussions focused on message design, media integration, and decision-making scaffolds within the learning environment. Upon completion, participant interviews were transcribed by a research assistant. The transcriptions were later reviewed by the interviewer as a way to verify their accuracy.

Analysis

After transcription, all five interviews were segmented into specific line items. For the purposes of this study, line items were defined as critical moments, salient quotes, and unique ideas that emerged during the course of the think-aloud and in the semi-structured interviews. The process was comprised of two phases. In the first phase, the research assistant segmented the line items from the transcripts and subsequently categorized them into positive statements, opportunities to improve, and further suggestions.

Table 1 Codes and operational definitions

Code	Code definition
Problem representation	Relates to the process in which learners must determine the nature of the problem, the information needed to solve the problem, the tasks required to solve the problem, and the scope of the problem
Perspective taking	Provides opportunity for learners to understand the contexts and emotions that influence others' states of mind and their motivations related to the context
Decision-making	Characterized by the ability to choose from different options presented, which in turn gives the learner autonomy over choosing his/her own path through the game environment. The decisions that a learner makes are the context within which they can then make sense of the outcomes of those decisions
Retention	Refers to those features of the learning environment that promote the process of retention, which includes interpreting and indexing new experiences and incorporating them into memory
Retrieval/reuse	Refers to those features of the learning environment that promote the process of retrieval, which includes assigning relevant indices to specific cases, assessing the similarities between cases, and differentiating between cases

The second phase was open coding of the line items. After all line items had been identified, two researchers (first and second authors of this chapter) independently open coded the line items. The first step was to separate comments related to usability from those that were related to learning processes. In general, comments that focused on navigation, aesthetics, and general likeability were identified as relevant to the first research question. Comments related to learning processes were identified as relevant to the second research question. To approach the second research question, the researchers developed a set of codes using an axial coding process. This process included reviewing all line items to gain a sense of the whole and applying temporary codes where appropriate. After this, the researchers examined the temporary codes and grouped them according to theme. The groups were then reviewed, and a descriptive term was applied. Finally, the line items associated with each term were reviewed by the researchers, and operational definitions were collaboratively negotiated. These codes and their definitions are provided in Table 1. After this set of codes and definitions was developed, the researchers identified representative quotes from the corpus of line items. Codes, definitions, and representative quotes are reported in the following section.

Results

The results section below is structured according to the research questions (RQ) that guided our study: (1) How do participants perceive the ease of use of the prototype learning environment? (2) What is the nature of learners' experiences while using

the prototype learning environment? Our analysis considered RQ1 and RQ2 separately and is therefore represented as such in the sections below.

RQ1: Ease of Use

The first research question focused on ease of use. We operationalized ease of use as those comments that primarily focused on the effectiveness and efficiency of the learning environment, as well as participant's perceived satisfaction with elements such as aesthetics and navigation. In terms of aesthetics, learners appreciated the consistent nature of the design. For instance, P3 commented that the "[The] page background stays the same, which gives foundation, and then each picture has the same color skin which makes everything." In this case, the consistency helped to ground the narrative and characters in a single context. When asked if the chunking of text was appropriate, given that presenting text in a nonlinear fashion required participants to click more, P3 commented that:

I think it's okay if it's on different pages. I think if somebody is reading through this and they go to the next one they will be like, 'Oh, that clarifies it for me.' It feels like there is someone there to answer their questions [when going to the next page]. I feel like if this is all in one page it will be too much wording.

The quotes above suggest that the interface was designed such that the segmentation of the messages and context did not impede the learning process.

While comments were positive about the aesthetics, navigation was an issue that was often mentioned in respect to the nonlinear environment. As noted previously, we presented a nonlinear approach as a way to encourage inquiry, exploration, and decision-making. However, as typified by P2, comments suggest that this process was a challenge: "When you get stuck at the first slide it looks like dead end and you kind of get confused like, 'Is this gonna work out?'" Similarly, P3 commented, "I think going back is [a] little confusing because I was kind of scared to click the back arrow if it did something to start over." When told that this was possible using the back button on their browser, one participant (P1) commented, "I probably would have hit the back button if I would have known that it was an option, but I thought it could have stopped the system, so I was just like, 'I'm not gonna hit it.'" The quotes above suggested that going back to a previous page was needed for their problem-solving process, but it was unclear how to do this on the interface. When asked how to resolve this, participants suggested an "arrow at the bottom that says 'Back to Previous Slide.'" Alternatively, multiple participants also suggested a table of contents that was always displayed throughout the game. However, even with the challenges participants noted with navigation, the participants were all able to progress through all of the cases. It is plausible that once participants gain more experience with the system, some of these navigation challenges would be obviated.

RQ2: The Nature of Learners' Experiences

A total of five overarching themes emerged that underscored differences between the nonlinear format and more traditional narrative formats: (1) decision-making, (2) perspective taking, (3) problem representation, (4) case retrieval, and (5) case retention. These themes are discussed in-depth in the following sections.

Problem Representation Problem representation is described as the process by which learners must determine the nature of the problem, the information needed to solve the problem, the tasks required to solve the problem, and the scope of the problem. Problem representation is important because learners must be able to first define the problem scope in order to engage in activities that facilitate resolution. For this context, learners were tasked with solving a sales management problem in which a company was losing market share. Various elements of the problem included variables related to risk, training costs, market demands, and time needed to hire someone.

Similar to previous research (e.g., Ge & Land, 2003; Oh & Jonassen, 2007), learners expressed difficulty with the problem representation related to the ill-structured nature of the task. P2 noted:

You don't know if the hiring is the problem as a whole. Or you don't know if the problem is should we do experienced hiring. Or...this guy that we hired wasn't conveying the message or the new hire doesn't have experience.

While problem representation is known to be challenging, learners suggested the information gathering and inquiry elements of problem-solving were exacerbated in large part due to the requisite information being embedded within a nonlinear format. P4 expressed frustration:

I seem to keep going like a circular path. So every time I picked one option it's like 'let's hear more information', 'let's hear more information about'. I really just want to see it [the candidates] and then based on what I saw there judge them from the information I receive. I wanna see the applicants first and then get the information from Sheila.

When asked how to support their assessment of the issue, some participants described how they wanted to see all the information up front rather than piecemeal through the learning environment. For example:

It's tough at times to get the idea of what Sheila wanted.... At the end of the day if my task is to hire a candidate I need to see the pool of applicants so at least somewhere to rank the applicant I have. I feel like no matter how long I was on the system I will never get to an applicant. (P4)

In this case, the participant feels that navigation should be about finding required information needed to solve the problem, as opposed to unfolding the task across multiple pages. Similarly, P2 suggested how this might lead to cognitive load and ways to offload working memory:

Yeah, I thought that, like kind of the initial beginning, it was kind of confusing. So like may be if you started it off, like a background side or like kind of an information side page.

Perspective Taking Another theme that emerged was that of perspective taking, which was defined as the opportunity for learners to understand the contexts and emotions that influence others' states of mind and their motivations related to the context. In general, participants were positive in that the nonlinear learning environment afforded perspective taking and allowed them to take ownership of the material. For instance, P4 stated: "it also starts out with the great goal like I get to hire a person, so that's fine, it gives me ownership." P4 further commented: "I kind of like that feels almost like a game but at the same time I can put myself in the shoes where I can see the real world perspective."

When asked what elements of the learning environment supported perspective taking, many of the participants indicated that the multimedia elements helped them visualize the context. For example: "I mean this when you consider what I am looking at, I meant this makes you visualize who Steve is, which is good" (P3). Participants especially noted how the images helped to convey the emotive elements of the learning environment. As described by P3: "She looks angry, [but] not distracting. I mean, it gives you kind of a background like what kind of emotion they are feeling because it's hard to get emotion from just like text. So it kind like brings the text to life a little bit." P3 later expressed: "I like the visual, I think they bring the, like, that the text is really telling you. You know like what emotion they are feeling: they are angry, are they confused, psychotic." As these quotes illustrate, visual aspects were conducive to helping learners understand emotions, which went beyond purely conceptual elements of the instructional activity and provided hooks which supported retention.

Decision-Making Decision-making is a theme that is characterized by learners' ability to choose from different options presented, which in turn gives the learner autonomy over choosing his/her own path through the game environment. The decisions that a learner makes are the context within which they can then make sense of the outcomes of those decisions. Participants showed generally positive perceptions regarding their ability to make decisions within the learning environment, as illustrated by Participant P3: "I like it a lot 'cause it gave us the decision, like the decision making process was actually in our hands in a way other than just looking." Another participant (P2) noted, "[I] like that you're in control of where the conversation goes [because you get to] kind of deciding your own path." Further, in contrast to a more linear method of storytelling, learners could engage in iterative decision-making and understand the consequences of their choices. P3 also noted that the decision-making was beneficial because it afforded exploration of alternative solution paths:

[I]t ends up somewhere where maybe you're like, maybe I took the wrong avenue. You can go back to the beginning and redo it and see where it would take you then. I like that aspect of it.

While there were positive aspects related to decision-making, participants also described challenges due to the way the learning environment was structured. Specifically, students were not always confident that they chose the best solution path and indicated that they wanted a more overt way to identify where they went

wrong. For instance, P4 surmised that there were multiple ways to solve the problem: “[T]here may be further ways to post the job to find more applicants. You could do Craigslist, you could reach people in the companies for referrals, just another mass mail.” However, P4 expressed that this was not always clear: “I just felt there were some times when, once I clicked one of the options, I really wanted to go back and pick a different option.” P2 also suggested that the combinations and permutations of multiple decisions resulted in additional complexity in the nonlinear format:

Like if it could have offered, you know, like the very final page could’ve been: This is the possible solution for path that you took, this is the possible solution for path two, this is the possible solution for three. Then I think I could have gained something out of it, rather than just clicking through it.

In this case, the student recognized how the solution was generated based on the decisions that he made. In the end, he wanted to reflect on his path and understand how his solution may have resulted in different outcomes.

Retention Retention refers to those features of the learning environment that promote interpreting and indexing of new experiences and incorporating them into memory. While this study did not endeavor to measure retention of cases, and indeed this would not be appropriate for the qualitative methods employed, participants did show some evidence of retaining critical elements of the case. For instance, when asked what he learned, P3 made a direct reference to a critical component of the case: “the right mix between technical and social skills, that was helpful.” P3 later connected indices to cases:

Yeah, I think they [the cases] were clear about what they were trying to convey, Like, for example, the story about the Holly lady was telling about, they hired somebody who had the relevant, like, sales experience, but in the end wasn’t the right [fit] due to personality or being used to a different type of selling.

Similarly, P4 described how he was able to extrapolate outcomes and lessons from the cases:

Yeah, we got some good information [from the cases]. Unfortunately we might have upset Holly a little in the process, but we found out, sure, that they have those skills that in the past did not translate.

As described previously, learners can be provided cases as vicarious memory (Jonassen, 2011a; Tawfik & Kolodner, 2016). However, in learning environments such as case libraries, learners might not access those cases. It follows that learners will not retain the case if the cases are not provided in a way that engenders access. In contrast to other case library designs, cases in the current learning environment unfolded based on learners’ decisions at strategic points in the nonlinear design. In this prototype environment, participants showed some evidence of assigning indices and understanding outcomes, which are both critical elements of case-based reasoning.

Retrieval/Reuse The retrieval/reuse theme describes those features of the learning environment that promote the process of retrieval and in some cases reuse of cases, which includes assigning relevant indices to specific cases, assessing the similarities between cases, and differentiating between cases. Retrieval and reuse is important because it requires an accurate problem representation and identification of the relevant cases needed to inform a solution.

When prompted, learners indicated that they were able to retrieve and understand why cases were helpful, as exemplified by the following comment by P3:

Well, the information [from the case] about the high turnover is interesting And then the background about Steve: you have his technical expertise, but didn't have the right personality and social skills. Oh yeah, he wasn't a great fit, so you didn't have that right mix. So that was what they're wanting, which means the right type of goal and social skills. So that was helpful.

In this example and others, learners not only retrieved and reused one case but engaged in similarity assessment. As exemplified in the following quote by P4, this allowed learners to generate abstractions and principles beyond the contexts of individual cases: "So far, it appears that the people in the past didn't really fit with the culture, so I think I wanna learn a little bit more about Sheila's opinion on that before I progress." P4 further elaborated on the retrieval and reuse process:

So, first, one [case] is 'Let's talk about hiring someone with somewhat related experience in the medical field.' I think that some of the resumes that they have gotten, I feel like that might be hard to find if they don't repost about the jobs, or they don't send out another posting to get a new batch of resumes in. And I feel like it's similar to 'Let's talk about hiring someone from within' because they're gonna have that related experience in the medical field because they are already working in the company.

In another example, P3 described how he was able to extract a strategy from comparing strategies:

I think, I mean, the first two [cases], they make sense. But they can also be similar at the same time. Because I think when I look at it, hiring someone from within? It's going to have a related experience that they are looking for. So 'Let's talk about fitting in with various work culture' [case], I feel like this is out of the blue.

Discussion and Implications

A significant challenge of case library design is how to construct and embed cases in a way that supports learners' problem-solving. This challenge may be exacerbated in nonlinear environments because learners may not progress in a way that intersects with all of the available cases. The results of our qualitative evaluation of a nonlinear storytelling environment and associated case library design highlighted emergent themes related to problem representation, perspective taking, decision-making, retention, and retrieval/reuse.

As discussed previously, the two primary outcomes of EDR are a consistently maturing intervention and improved understanding of the theoretical principles that

guide the design of the learning environment. The design and evaluation efforts reported in this formative evaluation have implications for how designers might approach issues related to integrating cases into the solving of problems and helping learners identify relevant indices. The current version of our learning environment represents a substantial departure from traditional case library design. A common design approach with traditional case libraries is to provide access to cases in a system with the assumption that learners will actually access them (Ferguson et al., 1992; Jonassen, 2011a; Schank, 1996); however, prior research suggests that learners do not necessarily access those cases when working toward a problem solution (Schmidt & Tawfik, *in press*).

Hence, we designed our current system to require learners to access cases in order to progress through the system in a nonlinear format. We refer to this case design approach as *requisite imperatives*, that is, learners are required to interact with cases in order to progress to the final stages of the learning environment. To access different cases and information within cases, learners were required to choose from lists of constrained decisions that allowed them to progress. Each of these decisions represented an index that, in theory, could be used by learners to categorize and later retrieve cases in memory. These decision points function both to (a) label a decision and (b) provide immediate feedback on that decision in the subsequent nonlinear narrative. The usability data gathered at this stage suggest that decision-making within this nonlinear game-like approach is iterative. That is, learners may want to navigate to revisit pages as they observe outcomes for their decisions and progress in the learning environment. Features such as a table of contents and breadcrumbs trail may help indicate to the learner their progress, while also affording user-friendly opportunities to revisit previous pages.

We assert that this iterative interplay of decision and feedback represents a causal chain that leads in a stepwise manner to learners developing a comprehensive representation of the underlying problem. However, more research is needed that focuses specifically on the dynamic between learner, case, and learning environment in nonlinear case-based learning environments. One way to accomplish this could be to prompt the learner when to employ a case in a nonlinear format. In doing so, the learner is alerted to when a case merits further investigation. Alternatively, learners could be provided various reflection prompts (e.g., Ge & Land 2003; Jonassen, 2011a, 2011b) as a way to engender retrieval of relevant cases.

It could also be that new design models are required in order to foster analogical reasoning using the CBR process. This last point is particularly poignant in light of the complexity of using nonlinear case libraries. In these cases, learners are afforded more control over their inquiry; therefore, designers must outline potential learning pathways and anticipate when to embed germane cases based on the preceding decisions of the learner. Moreover, related cases should progress in conjunction with the pathways that learners have selected. While the research reported here provides some initial insights, how to design effective nonlinear case libraries remains unclear, and principles that could inform the design of these environments remain elusive. Furthermore, it is also unclear the degree to which specific concepts are retrieved and retained because we used a think-aloud approach at this stage of

the evaluation as opposed to traditional forms of assessment, such as testing. The EDR approach we have adopted to guide our research and development has been instrumental in helping us to approach these challenges; however, the principles that have emerged from this formative evaluation are both nascent and tentative. As such, they need to be more rigorously investigated in future design and research iterations.

While the findings presented here are promising, they have a number of limitations. First, our methodological approach relied on self-reported perceived learning that could not be independently verified with other data sources. In addition, we relied on a very small number of participants. Further, the context of this study was limited to business education, so our findings might not extend to other domains. This research was also limited in that each participant only used the environment once. Multiple interactions over time might have yielded different responses, as user experiences might change with repeated use. Finally, our focus was purely observational, with the intent of evaluating the learner experience broadly. This approach allowed us to observe participants approaching the problem in a nonlinear, iterative manner; however, our approach could be bolstered in the future by looking at specific patterns of usage such as time spent on each page, paths through the learning environment, and eye gaze behavior.

Directions for Future Research

The experiences of experts allow students access to expertise in how problems are solved by practitioners and apply the lessons learned in order to solve extant problems. Because the learner assigns indices to cases, it is important that learners properly interpret cases for future transfer. More understanding regarding how learners identify relevant indices is needed, as well as regarding misappropriations in their adoption of vicarious memory and regarding ways in which these experiences are used to solve new problems. Future research that contributes to these issues will help provide additional understanding in how to effectively design future CBR systems and learning environments.

When stories include not only “what happened” but also the resources and reasoning used to understand a situation, make choices, or solve a problem, cases can serve as a more knowledgeable peer for both learners and teachers, helping learners interpret situations and solve problems and providing a model of good scaffolding for the teacher. Further research is thus needed to understand how narratives are presented to a learner. While previous forms of cases have often been in a linear format, research is still needed to understand how nonlinear formats support the development of case libraries and subsequent case retrieval. We maintain that when this nonlinear presentation of case libraries is sufficiently supported, learners will be better scaffolded in their decision-making processes.

Much of the extant literature focused on case libraries approaches research from a qualitative perspective. These studies report generally positive perceptions about

how cases presented in a linear format help contextualize knowledge and support solution generation from various perspectives (Bennett, 2010; Kim & Hannafin, 2009; Kim & Hannafin, 2011). Additional studies are needed to understand how learners actually interact with these cases and when it is appropriate to integrate the narratives of the cases in different designs, such as nonlinear, game-like environments. Furthermore, it is still unclear the degree to which experiences are retained, applied, and later reapplied over time. It is possible that indices are reassigned to experiences over time; however, further research is needed to understand how memories are modified and reapplied over time. Lastly, future studies could investigate how long-term transfer is facilitated on new problems.

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Using Trust Telling and Amicable Inquiry for Open Educational Resources to Strengthen a University Network in Thailand

Jaitip Nasongkhla and J. Ana Donaldson

Abstract This project explores using trust telling and amicable (nonconfrontational) inquiry to strengthen a university network in Thailand as a source of social transformation and the creation of culturally relevant open educational resources (OERs). Trust telling in this context included the sharing of oneself through widespread options of media via the Internet, two-way communication, and amicable kinds of questions along with storytelling. The study results describe how university network members from different regional cultural backgrounds in Thailand used narrative storytelling about their authentic local cuisines. Through this experience, regional academic members accessed and gained a cultural understanding from the community while expressing their personal points of views, and these views were captured into a digital archive. The archives are composed into an open learning object (LO) under a framework of the 4Rs (Wiley, 2009. *Impediments to learning object reuse and openness as a potential solution*. [Online]. Available from <http://scholarsarchive.byu.edu/cgi/viewcontent.cgi?article=2231&context=facpub> (accessed 22 Nov 2015)): reuse, revise, remix open content, and eventually redistribute via an “Open Learning University Network System—OLUN.” The learning system allows authors to pose amicable questions for a culturally relevant learning interaction with the public and fellow scholars.

Keywords Social transformation • OER • Trust telling • Storytelling • Culturally relevant

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Importance of Storytelling and Trust Telling

Story telling early in our cultures was in a form of oral narrative with gestures and expressions combined with pictures and materials to mediate meaning and help audiences to remember the story. Oral stories continue to be created today, improvised by impromptu storytellers, as well as committed to memory and culturally passed from generation to generation. In this project design, narrative storytelling used a dialog to explore, expand, and collaboratively evolve the story into a vivid picture with the use of amicable questions. This resulted in a trust between the narrators and audiences through a process of a two-way communication in the open learning system. This process refers to the work of Theodori (2005) who illustrated a picture of community in two categories: a free social grouping or territory-free and a territory-based community. The territory-free social groupings are people networking based on their common interests or goals, such as an academic network. The territory-based community is constituted by a shared territory, common life, and mutual identity. In this study, storytelling is meant to be a channel of common conversation among territory-based community members, stimulated by amicable questions between tellers and audiences to reconcile an unknown or mislead perception about ones' culture, alleviate prejudices, and build a culture of trust in a community (Çetin, 2016). An amicable question, an interrogative statement that expresses a polite and friendly desire, avoids disagreements and arguments while embracing a positive and antibias approach within a community. Furthermore, the atmosphere of trust telling throughout the storytelling conversation is archived in a video learning format and is published for anyone to learn from this positive cultural discourse. It turns into a cultural competence when ones' understanding of others' cultures is based on an open learning communication through a method of instructional storytelling. The trust is built during the storytelling process as mentioned by Hustedde and King as cited in Pstross (2014) that storytelling is a way a community discovers its soul based on emotion and faith. Hardin (2002) conceptualized a *trust* to be an attribute of relationships within a social group, occurring in a dynamic of inter- and intra-group interaction.

Storytelling in this narrative instructional design model conveys personal thought and memory based on personal experiences incorporating local wisdom. With dialog in words, sound, and/or images, even with improvisation or embellishment, narrative stories are shared as a means of community activity, engagement, exploring, cultural preservation, and a vehicle for instilling moral values. The story of a cuisine, by reflecting a local value, maintains its identity through food and the way of the local culture.

Audiences participate in the story with listening skills and enhanced personal connections through shared understanding. Furthermore, audiences become engaged with active amicable questions and imagine the story from different perspectives. Storytelling, therefore, is a tool and foundation for learning and teaching. Collaboratively, a storyteller and audience seek best listening practice skills and reflection through the amicable questions, as well as giving and gaining trust. Storytelling, therefore, is also a tool for strengthening a community.

During this project, this holistic approach of learning during the media development shows its effects to at least three participating groups: content experts, instructional technologists, and learners. Local instructional technologists or apprentice teachers or instructional technologist students learn from local wisdom regarding the cuisine. Meanwhile, local content experts learn to reflect and collectively add the local community values with instructional technologists during the phase of development. Learners are encouraged to appreciate other cultural values as well as reflect on their own and share their observations.

Human knowledge is based on stories, and the human brain consists of the cognitive machinery necessary to understand, remember, and tell stories. Storytelling requires auditory and visual senses from learners who learn to organize their mental representation of a story, experience their story, and realize its value. Tellers reflect their thoughts through a story and then become aware of their experiences and values. A communication of community values in a story reflecting the local cuisine assists learning through storytelling and guides members to become aware of their own cultural identity in an area-based community. As an intersocial group of the university network community, it finds success in discovering its soul and faith through storytelling that unites a power of learning and sharing in an academic world.

Introduction to the Thai Higher Education Setting

Thailand is located in the heart of Asia, literally on a crossroad between South and East Asia, with a diverse population of over 60 million people. Around a decade ago, public universities in Thailand changed their status to self-administration and now receive only partial government-supported funding. With this independent status, universities have the authority to decide internal and external university policies based on their financial structures and individual strategies. In becoming an autonomous university under government supervision, universities must meet countrywide quality assurance standards aligned to key performance indicators as verified by the Commissioner of Higher Education (Chan-o-cha, 2015; Office of Higher Education Commission, 2015). Universities are awarded a university ranking based on critical competition among universities in terms of demonstrated improvements in curriculum, student outcomes, faculty, support staff, as well as the physical infrastructures.

The Collaborative University Network Model (Singh, 2005) represents an alternate to a university ranking. There are 324 universities in Thailand (92 public universities under government supervision, 69 private, and 19 community colleges). These universities are supported by the government within an area-based network, which results in nine nodes/hubs of regional research universities: (1) Chiang Mai, (2) Chulalongkorn, (3) Kasetsart, (4) Khon Kaen, (5) King Mongkut, (6) Mahidol, (7) Prince of Songkla, (8) Suranaree, and (9) Thammasat. Project funding from the government can be granted for a proposal of regional academic activities, such as innovative, initiative research solutions on a yearly basis. Countrywide reports have revealed an unequal funding distribution among hubs. This results in issues regarding

quality and sustainability of the network for areas without funding. This university network model represents a large-scale autonomous university collaboration. The geographically distributed and heterogeneous university members exist supported by a state-of-the-art telecommunication infrastructure.

The success of collaborative networks is described in many research studies (Balland, 2012; Freel, 2003; Huggins & Johnston, 2010; Singh, 2005) with an agreed focus that includes the size/numbers and the proximity of partners in related geographical distances and scope of disciplines. A large and diverse network is well suited to explore new collaborative opportunities and derive new knowledge. When complex and tacit knowledge and values are transferred within the network, a connection for an effective relationship between individual members must be strengthened through mutual trust and confidence. Trust is established among members when there is a confidence in the organization supporting the network and there is extensive communication within the network. Communication can support a strong fundamental understanding and help close the interaction gap between diversified Thai regions (Ess & Sudweeks, 2001).

Cultural Considerations

The Thai sense of identity is allied with democracy, Buddhism, and openness to different religions and practices. Although the country is proud of its rich heritage and tradition, it has also adapted and embraced the rapid changes brought about by globalization. Thailand is an open, vibrant, and diverse society, endowed with a rich cultural heritage. Thailand continues to face major changes in living and lifestyles. Bangkokian embraces an urban lifestyle influenced by globalization and is centered on the metropolis of Bangkok. The Southern regions have primarily adopted the Muslim religion, with a strong alliance with its southern neighbor, Malaysia. The North and the Eastern regions are home to isolated indigenous tribal groups with traditional folklore traditions.

The Association of Southeast Asian Nations, (ASEAN) was established in 1967 in Bangkok, Thailand, with the signing of the ASEAN Declaration (Bangkok Declaration) by the founding members of ASEAN: Indonesia, Malaysia, Philippines, Singapore, and Thailand. There are now ten member countries. The legal framework of ASEAN is to strengthen the region in three pillars of economic growth, social progress and cultural development, and political security in the region. In this abrupt changing world of the ASEAN community and as the country moves toward “Stability, Prosperity, and Sustainability” (Thai Nation Vision of 2015–2020), cultural competence is a requirement of Thai citizens. Cultural competence is having the knowledge and skills needed to interact with people of different cultures (Chen & Starosta, 1996, 2005; Ess & Sudweeks, 2001; Goode, 2004; Jandt, 2013; Molefi & Gudykunst, 1989; Ng’ambi & Luo, 2013). Cultural competence as defined by the Thai nation vision is having the knowledge and skills needed to interact with people of different cultures. Each Thai University is to act as a change agent in leading Thailand to a social transformation through this diversity. The importance of this

study as a beginning step in targeting this national mandate is key to understanding the value of this effort. Each Thai University is mandated to act as a change agent in leading Thailand to a social transformation through this diversity.

Close group interactions and personal networks exist in the Thai culture. Stories are shared for learning *within* the group and *remain there* within the group. Some Thai individuals would say: “I would rather die with the truth/knowledge than giving it away to ones I don’t know.” Some of the faculty participants in this study shared that they believed that those who deserve knowledge must prove themselves; knowledge should not be open for all. This belief may be difficult for individuals outside of the Thai culture to understand and challenges the government mandated positive social transformation edict and need for cross-cultural understanding outside an individual’s identified group.

One major factor in forming an effective networking and community is trust. A trust can be built through a variety of forms of communication. Telling about oneself is a sign of trust for the Eastern Thai culture. This can be shared through widespread options of media via the Internet, carrying a message with two-way communication, and being facilitated by amicable kinds of questions along with the story telling or what might be labeled *trust telling* in this context.

OER Cultural Implications

For this study, OER is defined as “Educational materials which use a Creative Commons license or which exist in the public domain and are free of copyright restrictions” (Wiley, 2009 p.9). “Creative Commons is a global nonprofit organization that enables sharing and reuse of creativity and knowledge through the provision of free legal tools.” (Creative Commons Corporation, 2016). The rapid growth of open educational resources (OER) has made free materials available across the globe; however, from the international perspective, the obstacle of language limits this access.

Taking a human rights perspective, that access to education is a basic right of all humans, OERs do indeed demonstrate great promise, in their dismantling of several key barriers to access, like cost. However, to date, they have failed to meet one of the fundamental criteria of access, by being limited to a few dominant languages and largely unavailable in indigenous languages in the developing world. (Oates, 2009, p. 3)

One term that might not be familiar to Westerners is the label *colonized content*. This is the concept that conquering nations have subjugated the valued knowledge of the colonized country. Often the national languages and traditions are replaced by the foreign influences. The Thai people express a great deal of pride in the fact that they never have been colonized yet their educational resources often are limited to English or American perspectives.

There is currently a limited number of OERs in the Thai language or tribal dialects. The innovative incorporation of culturally relevant OERs is critical to the accessibility of this project at a national level. All of the materials are licensed under

Creative Commons (CC), giving rights to the public to reuse, revise, remix, and redistribute. Later, in the contribution stage, in the Open Learning University Network System—OLUN system—authors compile the materials into a learning session and post friendly questions to the system. All video and audio materials are in Thai or the regional language with Thai subtitles.

The OLUN system was primarily designed to be an open content repository with four user categories: system administrator, contributors and reviewers, instructors, and learners. Contributors upload their original contents as a .pdf, multimedia, video, and html or reuse media with an existing Creative Commons (CC) license. The authors will determine the CC license appropriate to their intentions of publishing their works publicly. The very first contribution from the university network is expected to be this project: a cultural difference issue through local cuisine storytelling. The storytelling content in the OLUN can be managed as a courseware with activities that help learners to enhance their cultural competence. The trust is strengthening through telling and amicable questions as the learning system enhances a trust telling atmosphere to share other knowledge that is open to the public.

The OLUN Research Project

Under the framework of open educational resources (OER) that includes content development, software development, and a delivery system, the university network took a leading role in accommodating a cultural assimilation through a learning mechanism with open content, media, and shared communications. Members from Thai universities learned to value local cultural content and wisdom from the storytelling of a local cuisine, and members eventually became storytellers of their own local regions.

The project Open Learning University Network (OLUN) was targeted to initiate a collaborative network relationship using activities supported by a computer network as a means of communication and a tool to build trust within a network. The network is known under a framework of the “Infinite University Network of OER.” The university network agreed to initiate an “Open Learning University Network System – OLUN system” to be an open content repository as well as a learning space where members could learn from the OER reusable content of other members. The framework of the university network is in four stages:

1. Leadership nomination node
2. Innovative network development
3. Innovative network contribution
4. Neo-network cycle (refer to Fig. 1)

In the first stage, leadership nomination node, appreciative inquiry (AI) activities initiate the network plan, and a potential leader is nominated from the hub. During the second stage, network members develop open learning materials based on a narrative storytelling design process. The local instructional technologist and content experts work together, producing digital artifacts such as

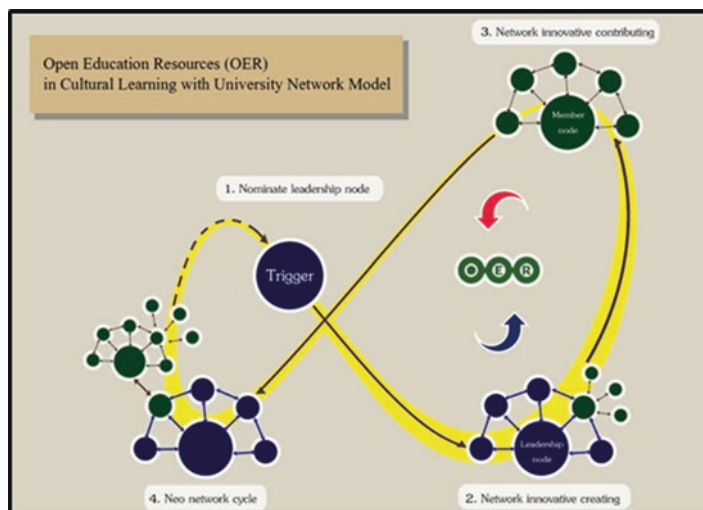


Fig. 1 OLUN model

pictures, video clips, and narrative text materials. The local cuisine and folklore is told from personal experiences by subject matter experts in a local community who are committed to contributing their knowledge to the public with a belief that their story is preserved and beneficial to others. A peer group (instructional technologists) in the community provides amicable questions and records the conversation with the local storyteller, which is later used in the narrative learning process. Finally, the open media is tested and delivered to other communities as a learning resource (learning object or LO).

The story is now repeated and retold with questions for strengthening a trust between participants. In addition to the open learning material, an online role-play activity is designed using an asynchronous mode of learning communication tools. Eventually they tell their own stories in the neo-network cycle at the final stage. Figure 2 shows the positive members' opinions in a scholarly exchange of online communications.

Within the culture it seems that using storytelling to cross educate others is hindered by a long-term attitude of hesitance in trusting to tell a truth, especially sharing personal stories among Thai academics. Technology is a benefit when people can communicate with no need to be face-to-face or in a real-time situation. Using video archives could help contributors to, at their own pace, build trust with others, with a perception that knowledge will contribute to a better life for all. However, talking about events related to personal experiences meant to be public knowledge still is hard for individuals in the Thai culture. The question is: What issues should be the starting position of an open communication?

University networking forms a community of trust by bridging from one group to another. This project illustrates a study of the South and the Northern hub storytelling and open content/media archiving from the storytelling of Thai regional cuisines. In summary, trust is strengthened in the network with personal experi-

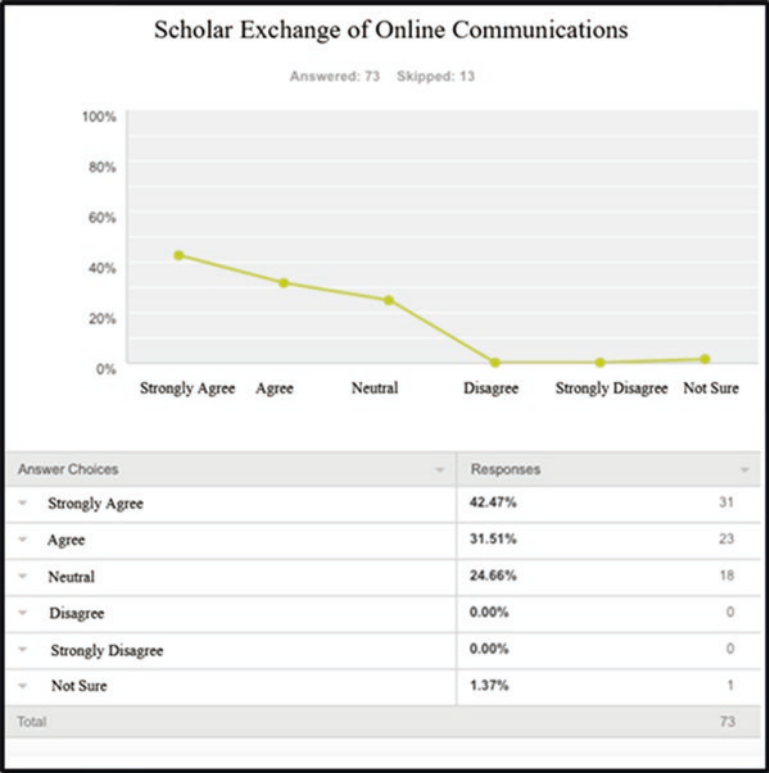


Fig. 2 Positive scholar exchange

ences of storytellers in a form of multimedia that used reusable media, published and available under a Creative Common (CC) license. The media is open for use as a learning resource in the OLUN system, which accommodates amicable inquiries during the storytelling, along with using an asynchronous communication delivery methodology within the system.

Early in the project, a call to participate in an open demonstration of the OLUN system and storytelling of local cuisine content (olun.cu-inet.org) was made to other university network members who might be interested in the project. Around 150 university members attended the initial demonstration. A questionnaire survey was distributed to the participants to assess whether they felt comfortable with open online communication with other scholars. The data showed the respondents mostly strongly agreed and agreed with a question on being comfortable in online communications and academic idea exchanges online (Fig. 2). This enforced the researchers’ beliefs of other members’ readiness to take part in the OLUN system. By focusing on the nonthreatening subject of storytelling about their local cuisine, it was felt that this approach would open up academic minds and cultivate their trust when learning about other cultures.

Cultural Competence

A cultural competence test was administered before and after as an online learning activity within the OLUN system. Appendix A (Cultural Competence Statistics Before and After OLUN Study) documents the demographics of the learners from four regions of Thailand and the scores obtained before and after the measured activity. The Northeastern and the Southern learners had a significant higher score of cultural competence.

Cultural competence defined in this research is a learner's perception toward cultural knowledge, attitudes, and skills. The instrument was developed based on the four components of cultural competence: cultural knowledge, cultural awareness, cultural skills, and cultural encounters. A total of 113 items were created. The Item of Objective Congruence (IOC) was applied, using three experts in research and psychological measurements to validate the items with the acceptance criteria of congruence at >0.60 . The items were selected with the congruence between 0.7 and 1. Then the instrument was tried out with a sampling group of 116 students, with a corrected item-total correlation, r_i , which should be accepted between 0.20 and 1 to be 59 items with a range between 0.204 and 0.686. Furthermore, the Cronbach's coefficient of its reliability is 0.948; 0.845 for cultural knowledge.

Project Process

For this project, the learning is taking place through a method of narrative storytelling (Norrick, 2000) with the support of the instructional design methodology for open media development. The following describes the process used:

- S*-Searching: Search for existing knowledge about Thai local dishes or cuisine with a history or folklore that reflects a value of the local community and maintains the local identity and wisdom.
- T*-Telling: Local folk stories are elicited by an instructional technologist who resides in the local area. The storytelling is recorded in audio or video format. Eventually it is collaboratively explored and expanded using amicable questions by an instructional technologist and is eventually shared with others. The storytelling is narrated based around a theme of the local cuisine.
- O*-Open dialog: Open dialog communication is used. Along with the telling, interviews with amicable questions are posted to the storytellers that intend to create an open dialog. The open dialog in the storytelling process is meant to be an activity for instructional technologist to collectively and collaboratively elicit a personal perspective and cultural value to add a flavor to the story with local wisdom and perspectives when producing the archived task. This is actually accomplished through an interview by an instructional technologist who resides in that area with local folks. The answers and the dialog are expected to be collaboratively shared with others; eventually, the talks are selected and inserted

into the narrative media. The story is added with a focus on local wisdom and perspectives when narrated. Questions are also suggested to share the learners' community identity and culture. There is an emphasis on what has changed in the community and what should be expected in the future.

R-Recite: The narrations are in the local dialect, and captions are inserted into the media to allow for a better understanding and to help students to learn from hearing the story while checking the meaning from a script. The questions that are selected (recited) from the open dialog are intended to be shared as both individually and culturally shared perspectives.

Y-Why: Amicable questions are suggested to teach about the learners' community identity and culture, including what has changed and what should be in the future. Questions will be inserted into the learning system and are intended to provide an interactive learning experience, such as role-playing in a discussion forum.

Teller: Learner/audience becomes a storyteller. The story is told in the media form, and the audience is asked to compare it to their own experiences and culture. Audiences and learners are encouraged to become tellers and collaboratively work as a partner with their local instructional technologist. In this narrative form, online role-playing is also performed by learners who imagine themselves as someone within the environment and culture as learned from the storyteller.

Based on the instructional design of storytelling in OER development, listeners practiced their skills and reflections in order to pose an amicable question back to the storyteller. Spontaneous listening and reflection between the storyteller and the media producer were developed and patterned into courseware that allowed learners to achieve cultural competence scores. This reflected the power of the media and ritual of the story; learners were encouraged to contrast and compare the food and culture between different local cuisines.

The production team was surprised by the stories behind some dishes they had never heard of but that other cultures ate every day. They stated they would never forget how those dishes were meaningfully crafted for a whole family. The traditional way of eating together from a big tray is no longer accepted due to hygiene concerns; however, it would be considered an insult not to see a village craft a dish and share communally as a family for their bonding and a cherished time. Those who are invited to the family dinner are considered special guests, and one must be prepared to join into a proper cultural encounter. Another example expressed by the production team was regarding milk. The Thai alternate to cow milk is coconut milk since dairy does not suit the Thai digestion system. This is also supported by recent research on the benefits of coconut acid and its prevention of cancer.

Conclusions

This preliminary research project was intended to enhance the university network through an open content development activity in the OLUN system, a narrative storytelling of a local cuisine as a cornerstone to building trust among the university

networks and to unite university networks to achieve understanding with other local cultural content to increase knowledge and collaboration.

Storytelling is a longtime existing strategy to communicate and pass on knowledge between generations in a closed cultural group. Culture can be viewed as a holistic approach to the fundamental elements of living in a community. It is our belief that tacit knowledge is revealed through the inclusion of open content as part of multimedia development. During this project, leaders in the university network were taking responsibility for inviting local experts, working with the storytellers, expressing and reflecting their thoughts along with providing amicable questions. During the media development process that resulted in the creation of the storytelling, open media trust was built among the community. Eventually, other communities learned from the design of amicable pre-questions throughout the storytelling and repeated the same process in the spirit of giving and sharing in an open learning environment system.

Appendix A. Cultural Competence Statistics Before and After OLUN Study

	(I) Demographic	(J) Demographic	Mean difference (I-J)	Std. Error	p-value
Before activity (Bonferroni)	Northeastern	East	−1.070486	0.432543	0.091
		South	−1.006413	0.314986	0.011
		North	−1.048466	0.31091	0.007
	East	Northeastern	1.070486	0.432543	0.091
		South	0.064073	0.314986	1.000
		North	0.02202	0.31091	1.000
	South	Northeastern	1.006413	0.314986	0.011
		East	−0.064073	0.314986	1.000
		North	−0.042053	0.093743	1.000
	North	Northeastern	1.048466	0.31091	0.007
		East	−0.02202	0.31091	1.000
		South	0.042053	0.093743	1.000
After activity Dunnett T3	Northeastern	East	0.19069	0.07592	0.375
		South	.49635	0.07905	0.045
		North	.62662	0.08492	0.014
	East	Northeastern	−0.19069	0.07592	0.375
		South	.30565	0.06481	0.026
		North	.43592	0.07185	0.002
	South	Northeastern	−.49635	0.07905	0.045
		East	−.30565	0.06481	0.026
		North	0.13027	0.07515	0.413
	North	Northeastern	−.62662	0.08492	0.014
		East	−.43592	0.07185	0.002
		South	−0.13027	0.07515	0.413

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Narrative Qualities of Design Argumentation

Colin M. Gray

Abstract The narrative qualities of a design presentation and subsequent critique comprise a *design argument*, distilling designers' rationale for their design, rooted in their process. In this paper, I analyze two consecutive design presentations from an introductory undergraduate human-centered design studio, documenting the argumentation structures students rely upon when "selling" their design. Dominant argumentation structures of these presentation events are described and related to narrative in a human-centered design context.

Keywords Design argumentation • Design education • Human-centered design • User experience (UX) design • Narrative • Design process • Design presentation

Introduction

The goal of a design presentation—the center of critique in a studio pedagogy—is to convince peers, instructors, and other stakeholders that a solution is appropriate and compelling in solving a given design problem (Dannels, Gaffney, & Martin, 2008; Morton & O'Brien, 2006). The underlying *design rationale* of this argument must be bound up by logic, knowledge of strategies for implementation, and precedent that the solution extends or replaces. Critique as a formative and summative assessment event (Klebesadel & Kornetsky, 2009) often foregrounds considerations of process and design rationale, creating a discursive space in which rationale can be probed and extended (Dannels, 2005; Dannels et al., 2008; Oak, 1998). However, a critique or presentation event focused solely on design rationale may relegate the ultimate or projected user of the solution to the periphery, focusing on design cognition-oriented issues of process, rather than storytelling of real-world use.

In the past decade, direct methods of funding have driven entrepreneurs to "sell" their designs in digitally mediated ways, through sites such as *Kickstarter* or *Indiegogo*. These sites generally require a statement about the design and a brief

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3- to 4-min video that explains the design concept. This format has encouraged the rapid presentation of a design approach or end product based on the compelling nature of its underlying narrative. Often, these videos rely on an embedded scenario, showing how an existing product or solution is inconvenient or irrelevant, using a specific set of narrative steps to walk the potential buyer or backer through their design, explaining why it is superior to existing solutions and solves a design problem. This pattern has been used not only to sell incremental solutions but also to introduce new paradigms of technology interaction.

In a human-centered design context, narrative is a natural outcome of increased cognitive (and actual) engagement with the end user. While critique practices in design education have historically been artifact-centric, with a peripheral interest on process or strategy (e.g., studio art), re-centering the design process around human needs and use has resulted in the increased use of narrative structure that revolves around human actors and human needs.

Narrative is a primal form of communication that is inherently human-centered; the language of story speaks to us on a level that engages our emotional faculties, enabling deep involvement and emotional investment (Erickson, 1996; Quesenbery & Brooks, 2010). Increasingly, human-centered design approaches include the use of design methods that allow a designer to situate the user within the design process. Personas and scenarios are often used to humanize the user, ensuring that the design team can adequately empathize and position-take with the user as a mediating force in making design decisions (Cooper, 2004). In addition, other methods such as storyboards, user journey maps, and experience maps portray a user's interaction with a product or system across time, visualizing multiple points of interaction in a user-centric rather than technology-centric way (Martin & Hanington, 2012). These analytic and communication-oriented design methods privilege narrative and the user's place within that narrative, highlighting an increased interest in talking about the user in narrative terms. While these stories can sometimes be overly simplistic (e.g., the "desire path" where everything goes right), they can also include "rounder" user characters that come across barriers in their use of a product or system, demonstrating not only the ideal use but also how the product or system addresses recovery from common errors.

Purpose of the Research

In this study, I explore the ways in which narrative is intertwined in design argumentation, seeking a better understanding of how students build and communicate their understandings of process and outcome through presentations. By *design argumentation* or *design argument*, I refer to the underlying rationale or design judgments that the student employs and/or relies upon to substantiate the rigor and utility of a solution (e.g., Dalsgaard, Dindler, & Fritsch, 2013; Duschl & Osborne, 2002; Fischer, Lemke, McCall, & Morch, 1991).

All of these types of narrative—variously focusing on chronological retelling, human-centered stories, or logical inferential chains—are important in professional practice. It is as of yet unclear how instructors and learning experiences may effectively scaffold students' ability to construct narratives of these types for diverse audiences. This prompts several research questions:

1. What patterns of argumentation do students use in their design presentations?
2. How do patterns of argumentation change between project presentations?
3. How do patterns of argumentation relate to the narrative quality of project presentations and human-centered design commitments?

Method

In this study, I present an analysis of student presentations from an introductory undergraduate course in user experience (UX) design, taught with a human-centered focus in a studio learning environment. These presentations were situated in a single semester, representing the first two projects out of four projects in total. Presentations included 18 students, comprising 9 team presentations for each project. Only one student had previously taken a UX-focused course, and no students had significant work experience in related areas of human-centered design.

Data Sources

Primary data sources included the video and audio recordings of student presentations, final submitted presentation files and digital documentation, and audio recordings and photographs from classes leading up to each presentation. The author served as instructor for this course and, to increase the internal validity of the representation of the classroom experience, wrote reflection memos at multiple points in the semester to document instructional decisions and perceptions of student experience.

Each project was video recorded from two angles and included different sets of two students working as a team. The first project was approximately 2 weeks in length, and the second project was approximately 3 weeks in length.

Project 1: *Your goal is to create or modify an existing activity tracker application to empower users to be healthier. You will do this by understanding and systematically altering the user's mental model about what activities are beneficial, rewarding these behaviors rather than common "cheats" to the system.*

Project 2: *Your goal is to create a replacement for the five-star rating system that Uber uses to track and reward drivers in their systems. You must consider the ways various rating systems constraint the input of users, the ease of use, and the ways in which this information could be used maliciously against drivers.*

Students were provided minimal guidance regarding what to present beyond the requirements in the project brief, with the expectation that they would need to be able to “pitch” or “sell” their idea to stakeholders with little background in UX or design concepts. This approach places the onus of effective, jargon-free communication on the design team rather than the instructor or projected stakeholder, as would be commonly the case in industry (Gray, 2014). For project one, students collaboratively determined through a discussion with the entire class that the following elements may be beneficial to discuss.

- Problem you solved
- Your approach
- Research and relevance
- Audience/user
- Evolution of idea
- Testing
- Solution

Project one was graded using a mastery approach, with a full score indicating the ability of an early professional in the field. This approach intentionally resulted in a failing average for the class, which possibly led to students’ reconsideration of project and presentation approach for the second project. In project two, students were arranged in new teams, and the instructor required the students to produce a short “pitch video” drawing on the Common Craft (<http://www.commoncraft.com>) style to explain the “core functionality and user flow” of their design. Common Craft videos are generally minimal in style, using stop-motion or live-motion video of paper prototypes with human hands interacting in order to tell a story, intentionally contextualizing user interactions into a narrative that is easily parsed with minimal jargon. Scenarios were introduced as part of the persona creation process during project two, and this contextual focus was intended to influence the way students conceived of the design process and their role within it.

Presentations were limited to 7 min in length, and students were generally cut off if they exceeded this length, excepting technical issues. The average length for project one was 7:04.25 (SD = 0:30.27; min = 6:27.8; max = 8:21.5), and the average length for project two was 6:59.84 (SD = 0:47.37; min = 5:22.3; max = 8:28.9).

Analysis

The analysis process began with a detailed transcription of each team's presentation to facilitate further analysis. Speech acts were transcribed and then split based on duration and change of topic, with timecode assigned to the beginning of each act. An initial thematic analysis was performed to identify the content and structure of the presentation to emerge, clarifying the progression of students' skill in crafting compelling narratives. Thematic analysis was carried out in three stages: (1) identification of candidate themes, each indicating a specific topic being discussed, based on all project one presentations and a selection of project two presentations, (2) consolidation of candidate themes based on prior work (i.e., Blevis & Siegel, 2005; Gray, 2013; McCarthy & Wright, 2004; Parrish, 2014), and (3) reapplication of consolidated themes to all speech acts. Topics and descriptions that resulted from this thematic analysis are provided in the next section.

These themes were then used to create color-coded sequence diagrams (Fig. 1), producing a visual record of the presentation structure, and descriptive statistics (Table 3) on the occurrence of the specific topics. Speech acts, theme application, and timecode were processed in a custom PHP script to generate diagrams and statistical output.

Findings

Patterns of Argumentation

From the 18 presentations, I identified 12 distinct topics that describe the presentation structure and related content. While all topics are consistent with human-centered design in some sense, the specific orientation and occurrence of these topics across two sequential presentations provides some insight into the students' development of argumentation ability. Labels and descriptions of each topic are provided in Table 1.

Topics were generally linked to recognizable parts of a human-centered design approach, including problem framing (i.e., focus), user research (i.e., audience, primary research, secondary research), concept generation (i.e., discarded concept), testing (i.e., usability testing), and iteration. But beyond these topics, the students also utilized multiple approaches to share their design outcomes in the form of a narrative, using feature walkthroughs, prototype walkthroughs, and scenarios to contextualize their solutions. These three approaches to sharing design outcomes build on previous work relating to critique in an HCI context (Gray, 2013); in this case they explicitly focus on how a concept is communicated, rather than pointing to a retelling of a design activity. Each approach is exemplified through excerpts from student presentations in Table 2.

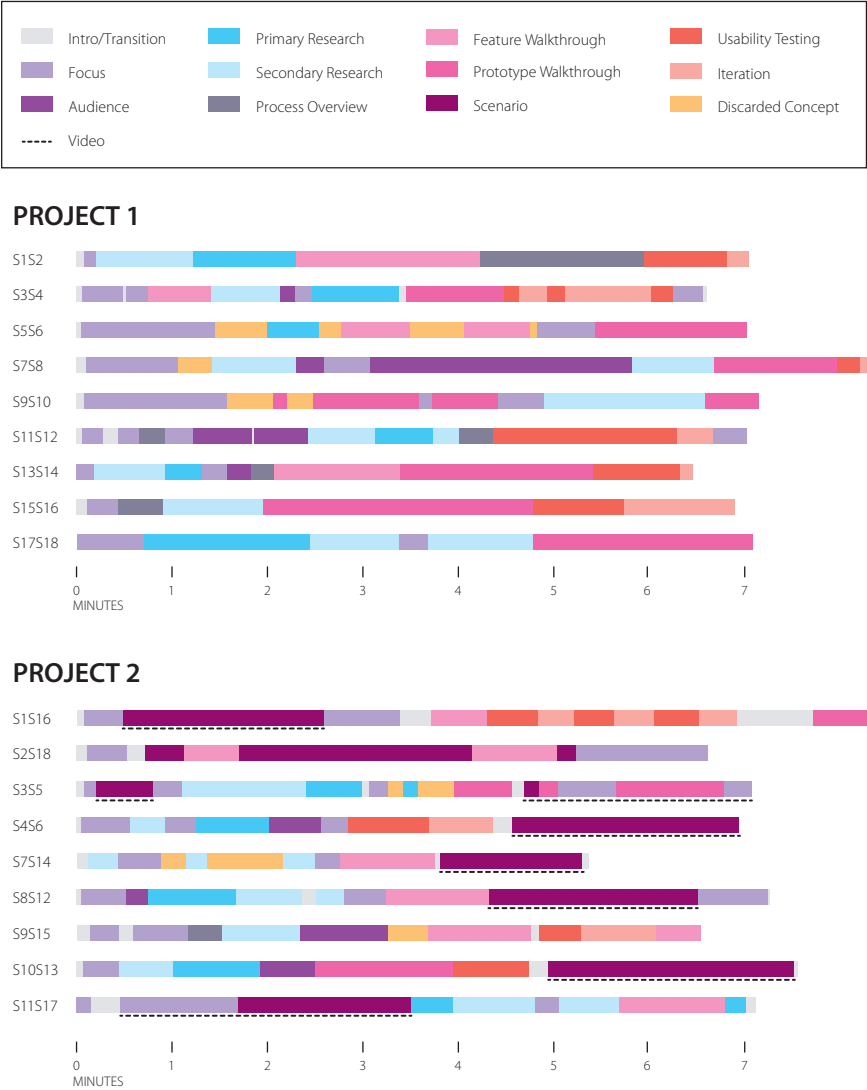


Fig. 1 Sequence analysis of project presentations

Changes in Argumentation by Project

Students spent more time on certain topics in their presentations, which reveals their assumptions about what elements of the presentation were important and reflects a type of design argumentation that felt most appropriate based on their project experience and baseline understanding of human-centered design (Table 3). For the first project, the prototype walkthrough (21%) and research activity (24%) dominated

Table 1 Topic descriptions

Topic	Description
<i>Intro/transition</i>	Team introductions or transition statements that introduce a new segment of the presentation
<i>Focus</i>	Project focus or working problem frame
<i>Audience</i>	Target user group, often expressed via a set of personas
<i>Primary research</i>	Interviews or other forms of direct data collection with users, including insights for the project focus
<i>Secondary research</i>	Academic or industry sources that provided conceptual or theoretical insight
<i>Process overview</i>	High-level description of the team’s approach to the problem, frequently including the listing of process stages
<i>Feature walkthrough</i>	Description of designed functionality without use context
<i>Prototype walkthrough</i>	Description of designed functionality with generic use context, generally using wireframes to support description
<i>Scenario</i>	Description of designed functionality through a user story, presenting functionality from the perspective of a specific user
<i>Usability testing</i>	Testing of prototype materials and resulting errors or validation
<i>Iteration</i>	Design changes that were made in response to research or testing
<i>Discarded concept</i>	Description of a concept which was later discarded by the team

Table 2 Examples of solution descriptions

Project one (P13P14)	Project two (P10P13)
Feature walkthrough	Prototype walkthrough
S14: And this also has clips and videos. Because I don’t know about you guys, but I’m very very very active on Pinterest, and I find that I’m very inspired by people who show their workouts, show if they’re improving. So we have a little function that shows a list of, like an Instagram-like layout where people who are fit, people who are giving their workout, inspirational videos. S14: Then we also have the competition, so people who aren’t just trying to show off to their friends. We have a function that’s able to find people around them who want to do what they do or are doing what they’re doing, and to find users like that, we created forums that we designed kind of like Slack channels where people can talk about whatever they want like marathons, basketball—if they wanna play basketball with someone they can just go on the forum and be like “hey I’m playing at the co-rec, let’s go.”	S10: Let me elaborate a little bit more on the prototypes. We used the slider function because we thought it would be easy and intuitive to use. And that was backed up by our interviews, and people said it was intuitive to either slide them or tap on them, and it would just stab to wherever you pointed. We also added a comment function, because through our interview, people said that they would really like to add a comment function so they could justify their rating. That was just—that was a little bit.
Prototype walkthrough	Scenario

(continued)

Table 2 (continued)

Project one (P13P14)	Project two (P10P13)
S13: So afterward we decided to make our prototype. So the homepage looks exactly the same, we only added the motivation tab at the bottom here. We replaced that with the challenges, and we moved challenges inside the motivation. S14: From the Fitbit <<inaudible> > if you just click on that. As you can see we get that Instagram-like layout where you have all the pictures and ideas at your disposal. And then if you go back to the motivation and click on “easy meal prep” there’s a list of easy meal prep like the BuzzFeed videos that flood your Facebook wall. You just click on one and we figured if there’s easy, healthy meal prep, people will be more inclined to actually go and eat healthy. S13: Next is the friends tab. So this is your friends page. You’ve got your friends on the bottom here and you can also add your friends, either through like a QR code scanner or like a username, and then if you click on “around me”, again this was inspired by kind of like slack, so you know if you wanna talk about a certain topic, you can go into the channel and talk with people around you in that area, and then you can also add people as friends within the channel as well.	(Video with computer voice) Meet James. James just arrived at the train station and needs to get to the city. James orders an Uber service. The Uber arrives and the driver greets him with a smile. When he gets into the car, he notices that it’s a bit messy. As they are driving down the road, a chicken crosses the street, causing the driver to swerve, alarming James. James feels uneasy for the rest of the ride. When they arrive, James is prompt to rate the driver. He chooses to rate the driver four out of five, but has no means of justifying his rating. He feels that his rating is inaccurate of the driver and is displeased with the rating system. (video with new computer voice) James is on the train station and needs to get to the city. James orders an Uber service. It arrives, and the driver happily greets him. When James gets into the car, he notices that it’s dirtier than expected, but he puts up with it. As they are driving down the road, the chicken crosses the street which causes the driver to swerve, alarming James. James feels uneasy. As the trip nears towards the end, James receives a notification on his phone. The notification from Uber reminds James to get his driver a rating, and provides him with an ETA. Since James isn’t doing much right now, he decides that he will rate now. James goes through the process of rating the driver on his attitude, cleanliness, time, atmosphere, safety, and comments about the incident. James is delightfully surprised to see a thank you screen appear with a chance to win a prize. James flicks the wheel. Congratulations James, you’ve won a new hat. When James arrives at the city, the driver hands him the hat. James exits, happy that he has provided sufficient feedback to help the driver improve, and as a bonus, he got a swag-tastic new hat.

the presentation. Students relied heavily upon interviews they had conducted during primary user research and concepts on motivation, health, or competition from secondary academic sources to demonstrate their mastery of the design space. However, these research accounts were almost completely disconnected from the solutions the teams had designed, leaving the prototype walkthrough with minimal context or connection to insights from their research. This is particularly indicated by a complete lack of scenario use in the first project presentation. Instead, teams focused their presentation directly on the wireframes they had produced (i.e., prototype walkthrough), with only a thin and generic overlay of use context. While most teams introduced personas as a representation of their user group or projected audience, these descriptions never reemerged in the team’s description of the solution, leaving a gap between the user, use context, and prototype.

Table 3 Topic application by presentation

Topic	Project 1		Project 2		P1→P2 Δ by %	Subtotal
	Total duration (seconds)	% of total	Total duration (seconds)	% of total		
Intro	40.8	1%	41.4	1%	0%	82.2
Focus	583.6	15%	656.4	17%	2%	1240
Audience	279	7%	136.8	4%	−4%	415.8
Primary research	316.4	8%	241.1	6%	−2%	557.5
Secondary research	597.7	16%	382.2	10%	−6%	979.9
Process overview	182.9	5%	20.9	1%	−4%	203.8
Feature walkthrough	319.7	8%	406.4	11%	2%	726.1
Prototype walkthrough	815.6	21%	246.7	7%	−15%	1062.3
Scenario	0	0%	981.4	26%	26%	981.4
Usability testing	327.5	9%	209.1	6%	−3%	536.6
Iteration	194.4	5%	159.6	4%	−1%	354
Discarded concept	151	4%	120.6	3%	−1%	271.6
Transition	9.7	0%	176	5%	4%	185.7
Total	3818.3	100%	3778.6	100%		7596.90

In the second presentation, there were several key differences in the presentation structure and approach. Most notably, teams took advantage of scenarios to explore and contextualize their design process and solution. Rather than a mere listing of features (i.e., feature walkthrough) or disconnected discussion of a set of wireframes with a thin narrative, teams used a narrative-driven scenario to tell the story of a particular user and use context, letting the user narrative lead the discussion of the solution. This user narrative often came at the expense of describing the prototype itself; scenarios occupied a full quarter of the presentation time, with feature and prototype walkthroughs declining to 18% (from a combined 29%). This change in presentation strategy, coupled with a decrease in discussion of distinct research activities (from 24% in project one to 16% in project two) and audience (from 7% to 4%), indicates a very different form of argumentation.

These trends become clearer when comparing the structure of presentations in Fig. 1. First, it is notable that the addition of the video component in the second project appeared to support the use of scenarios in a significant way; 80% of all acts coded as “scenario” appeared within the videos that the students had produced (noted with a dashed line in Fig. 1). One student team (P2_S9S15) did not have enough time to show their video, but the video file included a similar narrative structure to what was observed in the other team presentations.

Argumentation and Narrative Qualities

The sequences and descriptive statistics indicate an increase in emphasis on the solution itself, moving from 29% in project one to 44% in project two. While the general sequence of argumentation remained the same, with teams introducing their focus and relevant research prior to introducing their prototype, the scenario served to connect all of these elements together, allowing the user/audience to emerge in the context of the solution rather than as a discrete and disconnected persona.

Several rhetorical structures evolve in the first and second project, demonstrating early awareness of the narrative qualities of communication as they relate to “selling” UX concepts. While the number of teams is small, the following rhetorical structures may indicate promising areas for future study. First, two teams used a cycle of usability testing and iteration to highlight their sensitivity toward testing results and the activation of these results in further iterations on the prototype. While the multiple iterations of test results and changes were most pronounced in P2_S1S16, this behavior was also present in P1_S3S4 as well. Second, the use of primary and secondary research to structure the design focus for each team demonstrates a beginning information and research literacy, where an assertion, inference, or insight from research can be used to construct a specific problem space that grounds the team’s design activity. Teams tended to use more insights from primary research than secondary in the second project, even as the total time spent on research topics decreased. The rhetorical structures surrounding project focus and research changed as well, with research positioned prior to project focus in the first project (e.g., P1_S1S2; P1_S13S14) and research sandwiched between focus statements in the second project (e.g., P2_S3S5; P2_S8S12). Interestingly, three teams in project one (P1_S7S8; P1_S9S10; P1_S15S16) and four teams in project two (P2_S1S16; P2_S2S18; P2_S7S14; P2_S9S15) never discussed primary research, even though it was a key component of the project requirements. Perhaps this is due to the increasing complexity of requirements and communication expectations, since all teams did include documentation of these primary research activities in their documentation. Third, in the shift from the first to second project, the time spent on each topic became more distributed, with more variation occurring within sections of the overall narrative. This may indicate an early effort to move beyond a strict topical progression (focus to research to prototype to testing) and toward an overall narrative that may include many of these elements at multiple points in the presentation.

Discussion

The approaches used by early UX students to construct their design arguments provide insight into their early conception of human-centered design values and the appropriate means of communicating these values to an audience. While these two consecutive presentations provide only a snapshot into the development of students’

ability to work and communicate in human-centered ways, the progression from project one to project two is indicative of how rapidly argumentation structures can change once tacit values are adopted or otherwise considered by students. The video requirement in project two that was used to communicate scenarios provided an apparent scaffold for students to express their solutions *in context* in a way that may have been impossible or improbable in the presentation itself.

From Process to Solution-Focused Narratives

The students were faced with a balancing act of adequately representing their process and “selling” the solution that resulted from their process. Representing process can effectively be used to sell a solution, but in project one, the students appeared to talk about process steps as being linked to rigor in a more traditional sense—a means of demonstrating that they had completed the various activities required by the project brief. In the second project, students were significantly more successful in relating disparate activities within their process in an integrated scenario, demonstrating their ability to link research insights with knowledge of the target user population and the behaviors supported by the final solution. Thus, the students appeared to successfully move past a process-dominated narrative that was largely chronological and linear in orientation to a narrative that was solution-focused, pivoting around argumentation that linked process activities to specific aspects of the solution.

Developing Human-Centered Values Embodied by Narrative

There appears to exist a strong tension between students’ ability to adopt key elements of design argumentation (e.g., process, research, future strategies) while also focusing on user stories to humanize the final solution in narrative form. Process-oriented and scenario-oriented approaches lay bare different aspects of narrative which are important to consider, each of which foregrounds specific design values.

A process-oriented approach details the designer’s cognition, prioritizing the ways in which a solution evolved over time based on research insights, prototyping, and testing; this approach is often chronological, with an expectation that a rigorously executed and presented process will validate the final solution. This approach is most consistent with assessment and evaluation in a traditional classroom, where students attempt to communicate that they have addressed all “checkboxes” through their presentation. However, this approach tends to privilege process as a primary means of validation, which may be simply stated as: “If the process was followed, then the results must be valid or appropriate.” Other scholars have addressed the limitations of this reliance on process as a form of guarantee (e.g., Boling & Gray, 2015; Nelson & Stolterman, 2012; Smith & Boling, 2009), although it is yet unclear

how to meaningfully scaffold student design learning *without* reliance on a simplified representation of a design process.

In contrast, a scenario-oriented presentation focuses on the humanizing appeal of the final solution, with the presenters often leveraging easily digestible research insights to motivate and explain how a solution will solve a problem through a true-to-life scenario, activating the solution in context in a compelling and relatable way. This approach foregrounds narrative qualities, allowing human needs, insights, and solutions to emerge in context through a scenario or story. While there is definite value to using narrative as a means of explaining design concepts—prioritizing a user’s embodied experience rather than feature lists (i.e., Dewey, 1938/2005; McCarthy & Wright, 2004)—this approach requires storytelling ability which is often not highly developed. As noted by instructional design scholars (Boling, Siegel, Smith, & Parrish, 2013; Parrish, 2014), narrative structures often take one of two forms: (1) “stranger comes to town” and (2) “someone goes on a journey.” Each of these forms is also frequently found in a design context but, if not skillfully executed, can fall into the trap of novelty for its own sake (e.g., something so defamiliarized that it appears innovative but lacks explicit relevance to common situations) or a journey that is overly positive or Pollyannaish (e.g., a new technological experience that goes perfectly the first time). In this classroom experience, students tended toward polarization: depicting an unusually negative situation where everything went wrong while overrepresenting the positive behaviors of interaction when a user in a scenario was interacting with the solution.

Implications and Future Work

Narratives appear to have substantial value in communicating a solution in a human-centered way (Erickson, 1996; Quesenberry & Brooks, 2010). In progressing from a process- to solution-oriented style of communication, students appeared to simultaneously demonstrate a higher relatedness toward the projected user group and provide a more compelling account of their solution with greater contextual awareness and complexity. While this study is limited in scope and the thematic results should not be construed as directly generalizable to other design education or practice contexts, the study strongly suggests that understanding and effectively embodying narrative qualities of design communication represent an important competency for early design students. Design education has traditionally focused primarily on issues of representation, prioritizing visualization of a design solution over the ability of the designer to articulate the relevance or purpose of a design (Morton & O’Brien, 2006). The results from this study demonstrate the pedagogical value of encouraging design argumentation in early learning experiences and the use of presentations as one way for students to practice talking and arguing in human-centered ways—using their powers of persuasion and storytelling to legitimate their design process and solution. The progression from feature-focused to scenario-focused argumentation also suggests the value of well-placed instructional scaffolds; while

students may initially be uncomfortable playacting a narrative “live” in a presentation, the production of a video appears to effectively scaffold the ability of students to tell an involved user story via a scenario.

Additional research is needed to understand how argumentation ability is formed and develops over time and to what degree this ability is linked to other elements of students’ developing design expertise. There does appear to be some link between students’ ability to conceive of and execute on a design solution and their ability to communicate that solution to others, but the presentations alone do not provide adequate explanatory power to probe conceptions of design in any depth. Exploration of the distinctions and interconnections between design ability and communication of design outcomes represents an exciting area for future work.

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Scenario-Based Workplace Training as Storytelling

Hedy Lim

Abstract Storytelling evokes a sense of adventure, inviting the learner to imagine a time and place other than the present. Workplace training is explicitly practical, focusing on how to do our jobs appropriately or serving organizational goals (Jia et al., *Exp Syst Appl* 38: 3372–3382, 2010, p. 3371). Scenarios provide an intersection between story and traditional workplace training, encouraging learners to imagine possible actions and outcomes and to reflect on relevant past experiences, thus considering how content might apply to those situations. The purpose of this chapter will be to draw a connection between the centrality of story in the human experience and the reality of scenario-based workplace instruction.

The process of developing workplace training in our story is simple and straightforward; subject matter experts provide information; and employees are required to demonstrate retention by passing cognitive tests. What then would be the goal of introducing imaginary stories to serious professionals with seemingly more important well-defined tasks? Clark and Mayer (*e-Learning and the science of instruction*, Pfeiffer, San Francisco, 2011) understood workplace training development as intentionally working to help people change, requiring an understanding of how learners process and adopt new information while acknowledging of the role and nature of a positive learning environment (p. 33). The workplace learning experience must be built for adults with complex learning modalities and depends on an understanding that learning is change. The learning context draws its symbolic meaning from the experience of work itself (Michalski, *Manag Learn* 45(2), 2014, p. 146). Workplace instruction must draw direct links to work to retain its contextual nature. Story infuses the training with this meaning. Constructivist concepts can be applied in very practical ways in the design and development of workplace training, particularly through analysis of learning needs and authenticity of training contexts.

Keywords Workplace learning • Workplace instructional design • Scenario-based instruction stories • Compliance training • CBL • Scenarios

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Once upon a time, a workplace required all of its employees to complete tediously repetitive annual training in order to appear compliant with industry regulations and organizational initiatives. All those standards were met, because quiz questions for professional adults were standardized for fifth grade reading comprehension and answers could be easily guessed. Since employees only had to score 80% on their tests, they would skim and robotically click through computer modules, or superficially listen to lecturers, merely to pass the training. Many of them ignored the content altogether, never having considered how or why the content might be important in their job roles. But then 1 day, an instructional designer joined the organization and asked, “What if this story could be used as a scenario for training? It would help us all understand how training could be meaningful! It would not even require any high cost or high tech development to just use the story!”

Storytelling evokes a sense of adventure, inviting the learner to imagine people and places other than those present. Workplace compliance training, on the other hand, is explicitly practical, focusing on how to do our jobs appropriately or serve organizational goals (Jia et al., 2010). These topics might range from infection prevention and hand hygiene to Institutional Review Board processes and procedures, sexual harassment prevention, workstation ergonomics, or hazard communication standards. Scenarios provide an intersection between story and workplace compliance training, encouraging learners to imagine possible actions and outcomes and to reflect on relevant past experiences, thus considering how content might apply to real situations in the future. The purpose of this chapter will be to draw a connection between the centrality of story in the human experience and the reality of scenario-based workplace training. Beginning with an exploration of how stories can fit into the reality of contemporary workplace training, it will consider the conceptual constructivist foundation of story-based training; its theoretical foundation in task-based, problem-based, and simulation training; and reflect on the practical aspects of low-fidelity scenario-based training. The story of our lone innovative instructional designer will guide us through this journey.

How Stories Fit with Workplace Training

The process of developing workplace training in our story is simple and straightforward: subject matter experts provide information that they find important, the training team publishes it, and employees are required to demonstrate retention by passing cognitive tests. Our rogue instructional designer has an uphill battle: What would be the goal of introducing imaginary stories to busy, serious professionals with important and well-defined tasks? If professional practice in any field, or more specifically at the organization in our story, is seen as more than following steps of models or processes, but as involving skill and critical decision-making, the instructional designer’s initiative is vitally important. Workplace learning should be less the processing and remembering of content and more the practicing of developed skills and critical decision-making. Developing

instruction, in turn, should be more than collecting and composing components of training but interpreting content for meaning toward developing learning experiences that allow learners to explore new aspects of process and practice improvement. Clark and Gottfredson (2008) spoke of *learning agility* in organizations, learning that defies the permanence of competency, recognizing that self-development is a skill in itself that must be continuously and collaboratively nurtured both for individuals as well as for organizations (ibid). This idea of learning as both an ongoing and a social process demands a comprehensive and profound understanding of the way people learn. No longer is learning an isolated task that is accomplished prior to beginning work, but it is a component of work that must become tightly integrated with work processes and organizational cultures. Schein (2010) described an organizational learning culture as one that, among other characteristics, encourages proactivity, problem solving, and positive assumptions about individual contributors (ibid). While these concepts are rather ideological, the reality of a leader that promotes an organizational commitment to learning is one that seeks to empower its members. A learning culture is about investing in the members of an organization, with the recognition that individual development leads to positive organizational growth. The recognition and value of learning agility and a learning culture both assume workplace learning is more than seeking competency but learning in order to grow personally, corporately, and societally. Organizations and individuals must commit to working toward the reality of improving the workplace and the community through willingness to learn and change. These types of qualities have become essential for contemporary organizations to navigate the instability of global markets. So the question for our instructional designer in her new job is whether the company is ready to take such a leap; and, if not, what smaller steps might guide it in this direction?

Scenario-based instruction is a natural fit for bringing stories and meaning into workplace training. Clark and Mayer (2011) understood workplace training development as intentionally working to *help people change*, requiring an understanding of how learners process and adopt new information (see above p. 33). By its nature, learning is indeed change, as knowledge development and understanding are a pathway to recognizing better ways to work. The introduction of new ideas is a first step, but learning and change both require a shift in a person's existing understanding of the world, toward the integration of new content that essentially adjusts an existing framework. Perhaps the core change is really here, in how the workplace understands training and learning; if training is not intended to promote change or indeed to direct employees to do anything new, there is no cause for engaging them any differently than the story has already described. The learning context draws its *symbolic meaning* from the experience of work itself (Michalski, 2014), so workplace instruction must draw direct links to work itself to retain the value of meaning. Story is a deep-seated tool that infuses information with meaning; workplace training is essentially meaningless without it. Merrill (2013) defined instruction as *goal-directed* learning through intentional intervention (ibid). Engaging learners with intentionality is central to the

introduction of a meaningful story. Scenarios are essentially interactive stories, in that they allow learners to direct the outcome of the story that is being told, by *choosing their own adventure*. Beyond reading about an actor, scenario-based workplace instruction is rooted in activity within a relevant story. In completing a scenario, the learner is granted ownership of the story as a personal and participatory experience. Constructivist concepts can be applied in very practical ways in the design and development of workplace training, particularly through analysis of learning needs and authenticity of training contexts.

Stories as Conceptually Rooted in Constructivist Learning Theory

Constructivist learning theory underpins the foundational concepts that drive scenario-based training for the workplace. Authenticity is a term used to describe how realistic a learning experience is and how well it is able to create a connection for the learner of an existing memory or understanding, as Merrill (2013) called *activating existing knowledge* (ibid). This can be a first step in establishing relevance and attention for a learner. For Dewey (1938), learning was not about imparting knowledge but about the learning *experience* and how it affected not only a subject's competence but the composition of a person as a collection of their unique past experiences. Constructivist learning theory was built on this idea, as Hannafin, Hill, Land, and Lee (2014) explained, to "support the individual's efforts to construct personal meaning," by particularly focusing on the learner, promoting realistic tasks and resources, including diversity in viewpoints and resources, and recognizing prior knowledge and experience (p. 643). Learning becomes more than taking in new information but the personal construction of knowledge and meaning through the integration of content. Both scenarios and individual roles must match with the learner's concept of reality in their work context in order to maintain instructional credibility through authenticity. Our instructional designer considered the idea of being a credible storyteller; to create an authentic experience, she knew she would need help not only from organizational leaders but also from subject matter experts and some of the learners themselves. The learner must, as Clark (2013) described, "become an actor in the scenario" (p. 11), recognizing themselves as the protagonist in the instructional story. Deep learning is promoted in online training when the learner identifies as a cocreator of experiences and knowledge (Fong, 2010). Learning and change are connected through this experience of personal knowledge creation. Instructional stories are the foundation of learning and memory, making them the cornerstone of change for both the individual and for the group. If our designer can weave a story that captures the imagination of the organization, the stage will be set to make meaningful changes in any area.

Theoretical Foundations of Stories in Learning

While variations in the terminology used to describe scenario-based instruction make it more difficult to fully grasp its grounding in the literature, it draws foundational concepts from task-centered and problem-based learning (PBL); simulation will also be discussed later in this section. Clark (2013) created a comprehensive manual on designing *scenario-based e-Learning* and defining it as “preplanned guided inductive learning, [a situation] in which the learner assumes the role of actor responding to work-realistic assignment or challenge” (p. 5). This is the essential topic of our story, yet in the wider academic literature, the topic is not well-defined in this way; it is discussed in relationship with tasks, problems, and simulations. Merrill’s (2007) task-centered learning described authentic tasks as realistic, *real-world*, or *worked examples* (p. 8). Authentic learning contexts are engaging and motivating because they are credible; they tell a realistic and relatable story. Within an authentic scenario, the learner can then work through these realistic problems and practice realistic decision-making. Relevance in constructivist workplace learning is provided to learners with content that is *authentic*, demonstrating the realistic ways content can serve a specific situational context, such as best practices or novel work situations. Problem-based learning (PBL) is widely discussed in the literature as an instructional method that centers on learning problems or scenarios. Jonassen (2012) focused on the importance of *the problem to solve*. Rather than presenting instructional content as statements or explanations, PBL invites learners to learn in the midst of *solving a meaningful problem* (p. 101). Content is presented only following learner exposure to the motivational factors of learning, or in response to specific questions and concerns. Problems are intended to motivate learners to engage with the instructional content. Learners presented with well-told scenarios will not need to expend additional effort in considering whether or how the content might relate to their work, as these considerations are designed to be central to every aspect of the learning experience.

There is a great deal of discussion regarding simulation, especially in contemporary healthcare competency training. Arafeh (2011) explained that simulation-based training allows the simultaneous inclusion of “cognitive, technical, and behavioral learning objectives” within a single patient care scenario (p. 172). Generally, discussion of simulation is focused on a wider set of ideas than simply the story or the scenario itself, including interpersonal interaction and team communication, which is referred to as *behavioral* learning objectives. Hansen and Arafeh (2012) explained the importance of practice within the simulation environment, as it provides an opportunity for learning both interpersonal behavioral roles as well as cognitive algorithmic medical care content rather than simply assessing *insufficiencies* (ibid). Simulation provides learners with an opportunity to interact with and explore realistic scenarios and consider potential results of their decisions and actions rather than simply receive feedback on the correctness of an answer.

Englert and McDermott (2016) similarly described the use of simulation toward teaching both *clinical decision-making* skills as well as *psychomotor* activities (ibid). The use of simulation training in healthcare can increase competence and reduce risk to patients by allowing practitioners to practice their skills without putting patients at risk (Battles, 2006). High-risk, low-incidence situations in healthcare are recognized as a high priority for training in general and a particularly good fit for simulation training. Simulations provide learners with an opportunity to participate in a learning story within a safe environment, exploring different options and particularly being allowed to make mistakes. Simulation can refer to both high- and low-fidelity training environments, meaning that learners can be immersed in a setting that engages all of the senses or they may be invited to imagine the situation with fewer such inputs, such as a purely verbal discussion that focuses on a contrived scenario. Ideally, these new ideas and strategies will promote learning in a safe context for the learners in our story. How might scenario-based training promote learning while minimizing risk for our instructional designer's compliance training?

Stories as Creating a Sense of Presence

The inherent value of scenario-based instruction for workplace training comes from the development of personal meaning that is inferred through the act of storytelling. While budget is always a consideration in business, the core concept of scenarios does not necessarily indicate *any* additional cost. Our instructional designer might find a way to implement fresh new ideas and strategies without necessarily requiring a significant financial investment. Kearns (2009) explored aspects of high- and low-fidelity simulation training for aviation industry crews, finding that low-fidelity simulation can be as effective for training as long as “it simulates cognitive processes” or the training promoted a realistic sense of teamwork and decision-making (pp. 1570–1571). The concept here is that the authenticity is within *the learner's mind*. The capacity of a story to capture a learner's imagination allows the learning experience to exist within a state of suspended reality; indeed, it is the story itself that provides a pathway for the learning to create personal meaning.

Chen, Grierson, and Norman (2015) also explored high- and low-fidelity instruction, for nursing students. They found that the level of fidelity did not affect learner performance but posited that high-fidelity environments might actually distract learners and hinder learning by providing extraneous information that needed to be processed. While high-fidelity simulation has promoted the use of scenarios in a way that is attractive in its use of new technologies and promoting realistic learning, it cannot be allowed to detract from the core concept of the psychological experience of considering a story within the human experience.

Our instructional designer does not need to promote the establishment of an expensive and high-maintenance simulation lab, per se, but can start with the use of scenarios by including stories in simple, even text-based training. The true value of

scenario-based instruction comes from this capacity of the story to develop a sense of presence.

Conclusions

Consider scenario basis as a tool to imbue training with personalized meaning, one that provides instructional designers with a pathway for learners to entertain the significance of any learning content. Scenarios do not provide a formula, but rather a mindset regarding the way training content is considered. While it may not require high-fidelity development in the end, it does require an investment of content discovery, such as considerations of how the content is relevant to specific learners and why the content is prescribed in any particular way or at all.

The instructional designer in our story worked through the idea and found that stories *could* be told about the instructional compliance content. For example, in considering fire hazards in the workplace, employees would not just memorize the type of fire extinguisher that should be used, but they would practice finding the correct references and tools to use in order to minimize danger during fire emergencies in their own workplace environment. The employees learned that they could help improve processes and gain protections against litigation, not because they memorized the phone number of the corporate compliance officer, but because they engaged with a story of a realistic reportable situation, and they practiced finding the right resources to provide feedback to organizational leadership about their own experiences. They considered the importance of washing their hands in specific work situations when they feel rushed or inconvenienced by the requirements against stories of real adverse situations. Employees were given the opportunity to think realistically about situations where they or their colleagues might feel harassed or uncomfortable in their work environment. These employees learned more than the content of the training, but they began to feel more comfortable suggesting ways that they could improve their work environments and their organizational culture. They began to feel that they owned the experiences and, eventually, the organization itself. This story is provided as a first step toward reflecting on all of the training that is developed and how scenarios can be reimagined in this way toward increased efficacy and facilitating meaningful personal, organization, and societal change.

While the call to tell stories in training is intentionally made to sound simple, it should be understood that it *does* require specific intentionality and creativity. It is a call to reclaim the instructional role of storyteller; scenario-based instruction allows teachers and learners to recapture the human experience of sharing stories. For example, simply converting a training quiz question from a statement of facts into one that invites learners to consider a real-life situation that makes use of such knowledge might not take much more time nor energy at all; it does specifically requires intentionality and a respect for the experience of the learner. While a fundamental systematic change in the way we teach and learn in workplace compliance is not an easy one, the first step might be simpler than imagined.

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It Is a Two-Way Street: Using Storytelling and Narration as a Formalized Method to Promote Partnership Between the Instructors and ID Team in Higher Education Context



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Abstract The purpose of this chapter is to discuss the implementation of storytelling and narration as a formalized method to promote partnership between the instructors and instructional design (ID) teams in a higher education context. The authors utilized a single case study method to investigate the process, outcomes, and challenges of this approach at a large midwestern land-grant university. From the instructor's and ID team's perspectives, storytelling and narration were effective strategies throughout the ID process and facilitated the establishment of a partnership. The authors aspire to call for a shift in the mindset from the technocentric point of view of ID to a partnership perspective with emphasis on trust, collaboration, mutual understanding, openness, and empathy.

Keywords Storytelling and narration • Instructional design and development • Professional development • Online and blended learning • Higher education

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Why We Wrote

Rapid innovations in technology urge educational systems to meet students' diverse learning needs. However, technology alone will not make a difference; if students are motivated and engaged in activities that are meaningful and relevant to their lives, substantial learning will occur (Fullan, 2007). Unfortunately, instructors find it challenging to accommodate students' learning needs as they lack proper preparation, knowledge, and expertise in designing these kinds of learning activities (Desimone, 2009; Morrison, Ross, Kemp, & Kalman, 2010). More than ever, instructors need guidance from instructional designers (IDers) to ensure that "what is produced serves a necessary purpose, meets the needs of students, is attractive and well-organized, is delivered in an appropriate mode, and is continually evaluated and improved" (Morrison et al., 2010, p. 5). This professional demand implies the cruciality of IDers' work (Gustafson & Branch, 2002).

IDers need to excel in problem-solving, flexibility, creativity, and artistry while having sufficient knowledge of learning and learning theories (Cheung, 2011; Hirumi, Appelman, Rieber, & Van Eck, 2010). Further, an IDer should be a resourceful and creative thinker, keenly aware of the shifting boundaries of the context and roles, and continuously seeking appropriate opportunities for creativity. IDers are introspective lifelong learners, active listeners, and effective communicators who demonstrate a demeanor supportive of collaborative creativity (e.g., flexibility, empathy, diplomacy). They are passionate advocates for the development of efficient, innovative, and enriching learning experiences, seeking to continuously integrate innovative approaches to personal practices while exploring possibilities. While demonstrating sensitivity to the balance between creativity and costs of development, the exemplary IDer "should always pose the question, what if..." (Clark, 2015, pp. 182–183). The work of an IDer should also expand to a social level to empower others to make informed decisions (Yusop & Correia, 2012). In sum, IDers need to develop relationships based on trust, collaboration in teamwork, mutual understanding of perspectives, openness to accept differences, and empathy.

A closer look at the instructional design and development process would shed light on IDers' work and relationship with instructors. Using the systematic ID process, IDers help instructors identify educational problems, determine learning objectives, and design instructions that utilize learning theories, educational research, and best practices (Morrison et al., 2010). During this process, IDers and instructors ideally build a collaborative relationship, which not only supports the development of the project but also sets up a system of support through ongoing multi-directional communications (Brigance, 2011; Mudd, Summey, & Upson, 2015). Furthermore, IDers should go beyond consultancy on technology or pedagogy. Instead, they should establish mentorship and a long-term partnership with the instructors.

To develop this partnership, using storytelling and narration could be a useful approach for sharing knowledge and skills with the instructors in a straightforward

way, without being unnecessarily imperative or condescending. Planned but casual use of storytelling can encourage others to change past practices and adopt new and innovative strategies (Vance, 1991). An additional benefit of stories within an organization is “the rich, additional, and incidental information about an organization contained in the story” that orient the audience into the context (Vance, 1991, p. 53). Through sharing others’ stories about the work experiences, one could bring change and develop trust and confidence (Barker & Gower, 2010; Sole & Wilson, 2002). Used strategically, stories and narration have the potential to strengthen communication and establish the partnership between the instructors and ID team. Thus, we will examine the use of storytelling and narration as a formalized method to cultivate a long-term partnership between the IDers and instructor who are also the authors of this chapter.

Standing on the Giants’ Shoulders

The working process between the ID team and instructors is a nonlinear but fluid process, consisting of ever-changing power dynamics of learning and mentoring, questioning and answering, collaborative brainstorming and problem-solving, and reflective and invigorating empathizing. To extricate this process, the authors combined two conceptual frameworks to provide an overarching foundation for envisioning this relationship-building process.

The CANE Model of Motivation provides a structure of the components needed for an ID team to motivate the instructors. Combining the definitions of commitment and effort to further define motivation, the CANE Model identifies the importance of personal agency, emotion, values, self-efficacy, and goal commitment in conceptualizing motivation (Bandura, 1997; Clark, 1999). Before the instructors become self-sufficient in teaching online and blended courses, they must engage in learning about particular pedagogies, best practices, and emerging technologies during the consultations. This relationship could be considered as a mentor-mentee relationship. In the later phases, the nature of collaboration mostly depends on the instructors’ motivation in gaining and adopting professional skills, ultimately culminating in the motivation to foster a partnership with the ID team to collectively innovate professional practices in a larger context. This relationship transcends the mentorship into a partnership. Therefore, because of the changing nature of the relationship, we argue that the ID team should consider the CANE Model to conceptualize the necessity of cultivating a partnership to maximize the outcomes of the collaborations with the instructors.

Bearing in mind the cruciality of the constructs in the CANE Model, the IDers could use storytelling and narration as a formalized method to engage both the IDers and instructors in learning, sharing, and collaborating. Both the ID team and the instructor should share professional and personal stories on learning in general and on learning about teaching and developing online and blended courses. In the beginning, IDers should tell more stories about the context, barriers, and their

understanding of a particular project (commitment), goals setting and thinking process concerning content, pedagogy, and how they follow through with a project (mental effort). Moreover, they should share their professional beliefs, enjoyments, emotions, and achievements through the stories in a relatable manner (commitment). Telling professional yet personal stories might help the IDers build a deep connection with the instructor. The empathy developed along the way might also assist the instructor to internalize not only the knowledge mentioned but also the commitment and mental effort needed for a design project, which will be mirrored in the stories told by the instructors shortly after.

The Adaptive Mentorship© model assists the mentor and mentee to reflect on their roles during the process of adaptation and innovation. It also highlights the importance for the mentor to synchronize an adaptive response to match the task-specific developmental level of the protégé (Ralph & Walker, 2010). We reiterate that the working relationship between the ID team (mentors) and the instructors (mentees) is nonlinear but fluid. We call for a shift from viewing the working process as a one-way street that only consists of technological support and troubleshooting to regarding it as a two-way street with dynamic and multifaceted activities that help build a partnership. Thus, the synchronization of the ID team's adaptive response to the instructors' developmental level is key to ensuring a successful partnership (Ralph & Walker, 2013).

Using storytelling and narration as a formalized method, the ID team encourages the instructors to tell stories and provide narration early on in the process so that the team can determine the instructors' development through analyzing and data mining during and after meetings. The team also tells stories focused on specific constructs to synchronize with the instructors' developmental levels. At the beginning stages, more emphasis is given to the constructs illustrated in the CANE Model to motivate instructors to collaborate on the design project. As the instructors become more and more confident and motivated, the team adds details on pedagogy and technology into the stories as an indirect way of teaching. When the instructors develop more competencies, the team will use more narrations to facilitate the project. However, stories will remain an essential element for developing empathy. During the delivery, stories are at the center and continue to be an effective way for brainstorming and problem-solving, since context becomes more important and detailed. In a word, utilizing and differentiating the affordances of storytelling and narration during different stages enable the ID team to synchronize support and adaptive response to the instructors' developmental level, which results in more efficient collaboration cognitively and emotionally. Figure 1 illustrates suggestions of using this method during different stages of a project.

How We Wrote

We used a single-case embedded design (Yin, 1994). Situating in the larger context of one case, we examined various units and subunits to have a better understanding of the case. The primary units of the analysis were the instructor and ID team. The

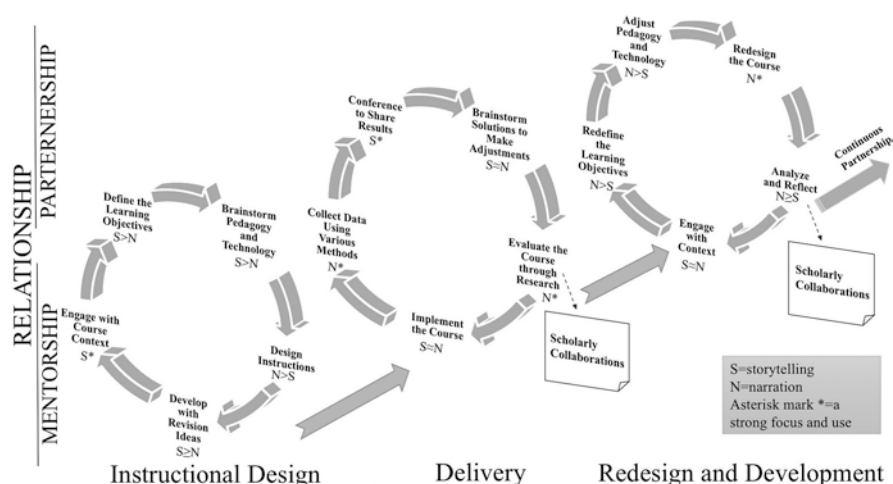


Fig. 1 Using storytelling and narration during the instructional design and develop process

embedded subunits of analysis were (1) perceptions of the method, (2) outcomes from implementation, and (3) challenges of adoption.

Backstage Story

Our chapter is grounded in the redesign and development process of an orientation course offered at a large Midwestern land-grant university. This course aims to provide the open option and preprofessional first-year students adequate preparation for academic success in college. Academic advisors are in charge of teaching orientation courses similar to this one due to their expertise in academic life and career orientation. Before the redesign, the course had an enrollment of about 540 students. It had 2 large lectures and 15 recitation sessions (with 30-50 students in each) every week. One lead instructor, who was also an academic advisor, was in charge of teaching the lectures and developing other course-related materials. During the lectures, representatives from different academic departments, colleges, and student service offices presented topics that may be helpful for students to succeed during their freshman year. All other academic advisors in the college had to teach one or more recitation sessions. During the recitations, these academic advisors had the flexibility to implement their curriculums, use the course handbook, or bring guest speakers every week. In general, the majority of the academic advisors at this university had teaching responsibilities. They had relatively high subject matter expertise but relatively little training on teaching. Even so, with some unintentional institutional barriers, they were not incentivized to participate in any training on teaching. The difference in teaching readiness and teaching approaches resulted in an inconsistency in the quality of this course. Moreover, with several senior advisors planning for their retirement and a rocketing enrollment number, the lead instructor

faced multiple challenges, such as lack of staff, insufficient resources, difficulties in scheduling classrooms, and so forth. Furthermore, academic advisors observed relatively low student engagement during the lectures and recitations. Therefore, to find solutions, the instructor began to work with the ID team to redesign the course. The ID team came on board to provide consultation on the redesign in the summer of 2015 using methods such as backward design, storytelling, and narration. During the weekly consultation sessions, Autumn, the lead instructor, and the ID team, which consisted of the other three authors, analyzed the context and content of the course to design the activities and create assignments. In fall 2015, the team guided Autumn throughout the course delivery, and in the spring 2016, the design team met with Autumn biweekly to problem-solve, brainstorm, and further develop the course.

Who We Are

The authors are the lead instructor, Autumn, and a team of IDers, Yi, Wei, and Nadia. Autumn has had experiences in teaching both face-to-face and online courses on psychology and orientation topics since 2008. Autumn strives to address the challenges in a large-enrollment course by implementing team-based learning and flipped classroom pedagogies to provide students with a more active and engaging learning environment. The ID team included two senior designers, each with more than 4 years of experiences in designing online and blended courses and a junior designer with 2 years of experiences. All members of the design team were also Ph.D. students in a Curriculum and Instructional Technology program and had academic training and research experiences.

Collaborative Knowledge Building

We analyzed meeting agendas and notes, email correspondences, and follow-up interviews. One major data source was the two consecutive semi-structured interviews with the instructor conducted at the end of the first course delivery. Another major data source was the meeting agendas and notes from meetings with the instructor and debriefing sessions of the team. Work and research agendas were used by the team for planning and documenting the meetings and designing and implementing the research plan. Lastly, email correspondences included a variety of topics that contributed to the understanding of the relationship.

The analytical approach involved qualitative thematic analysis of the data sources. Utilizing a top-down approach, we engaged in critical reading of these data sources to identify broader ideas discussed. The summative content analysis involved comparisons of content, followed by the interpretation of the underlying context. We mainly focused on finding recurring patterns or keywords in the data.

Instructor's Perspectives

More and more, professional staff at institutions of higher education are finding their roles expanding to include not only positions of support in divisions of academic or student affairs but also the position of the classroom instructor. Although the potential for innovation in this new role is exciting, transitions can often be accompanied by challenges. As there are challenges for the instructor in the design, development, and delivery phases of a new online or blended course, there may be challenges in the development of a new partnership with an ID team. Three particular challenges became apparent as potential barriers to collaborative partnership: justification for time invested, uncertainty regarding the roles of the ID team, and fear of instructional critique.

The expansion of a staff member's role to include the instructor does not necessarily signal the decrease in other responsibilities. Therefore, it becomes imperative that the investment of time in teaching-related activities be clearly supported by a personal sense of motivation, perception of impact, and institutionally valued outcomes (e.g., scholarly contributions). Through narration in quickly answered electronic communication and motivating anecdotes of other instructors' efforts to balance professional responsibilities, the ID team demonstrated increasing commitment and consistent mental effort toward the course throughout the process (Clark, 1999). As the ID team continued to educate the instructor, she experienced more confidence in her ability to convey the importance of the course redesign to colleagues. As a result of her increased confidence in utilizing online grading tools, Autumn convened a series of grade calibration meetings with colleagues and the ID team. This resulted in a more efficient experience for the staff and a more meaningful, feedback-intensive experience for students.

Many instructors, whether new to the role or seasoned veterans, may not have had the opportunity to collaborate previously with an ID team. Instructors may have been told by colleagues that the ID team's role is merely technological or instructors may have no framework for understanding the working relationship with the ID team. This limited or inaccurate information may lead to uncertainty in the course design and development process. By utilizing storytelling and narration, the instructor can receive clarifying information from the ID team. The team's examples of collaborations with other instructors can lead the instructor to have more confidence in moving beyond technological inquiry, and this trust may lead to motivation to deepen and extend the partnership with the team beyond the existing course. Storytelling and narration also equip the instructor with a richer body of knowledge from which to promote collaboration, mentorship, and partnership with ID teams when sharing with colleagues both within the course's institution and in national and international communities of learning.

Before the establishment of mutual trust, respect, and clarity of roles in the instructor and ID team relationship, the instructor may experience a fear of critique from the team. Although instructors may have confidence in their skill set as related to their discipline or even traditional classroom instructional strategies, instructors

may have less experience, and therefore less confidence, in the domains of technology or pedagogical innovation. As unexpected challenges occur during course delivery, the ID team can use storytelling to responsively increase an instructor's sense of confidence and competence by reminding the instructor of earlier successes in the course, by sharing examples of other similarly designed courses, and by providing solutions in other courses. Doing so creates an environment through which an instructor is encouraged to bring forth complex challenges and readily expects to be met with support and an ongoing sense of agency, rather than the anticipated fear of critique. Table 1 provides an example of using the method to address instructor's questions and concerns.

The commitment exhibited by the instructor and the ID team in addressing challenges and persisting in building a mutually supportive relationship has led a number of outcomes for the instructor, including a future partnership for scholarly collaboration. The time required for this collaboration was justified by the opportunity to create three professional development workshops for the instructor's academic unit. In addition, the instructor was invited and presented at two workshops for faculty and staff, two institution-wide events, one regional conference, and several scholarly publications. By doing so, the instructor had the opportunity to further utilize storytelling in discussing the pedagogies employed and the opportunity to clarify the roles of a partnership between the instructors and ID teams. Lastly, the instructor was also accepted into a graduate program for instructional technology, evidence of lasting confidence and commitment that extend beyond the scope of collaboration on a particular course. Overall, there is significant evidence for the growth that can happen on the part of the instructor as a result of the intentional, committed, and ongoing use of storytelling and narration on the part of an ID team.

ID Team's Perspectives

During the course development process, the relationship between the ID team and the instructors is fragile and surrounded by several challenges. The following themes emerged as common challenges: demand of work, limited time, quantity and quality of feedback, and keeping the motivation high.

By implementing the backward design model, the designers guided Autumn on how to align various course components and maintain a coherent alignment. The designers set up an explicit goal of using storytelling and narration to mentor Autumn to create meaningful content and activities for students to accomplish their learning outcomes. We had a rigorous and consistent scheduling of working meetings held during the development and delivery stages. During these meetings, we discussed insightful pedagogical solutions, as well as troubleshooting technical difficulties. The amount of time needed for these meetings was a major challenge due to the difficulties of coordinating four professionals' schedules.

Another challenge regards time limitation. Although the redesign of the course started early, time was always a constraint. Nevertheless, the design team, as well as

Table 1 Sample story from the instructor

Autumn is an academic advisor and the lead instructor of the course. Yi, Wei, and Nadia are instructional designers. Yi consulted Autumn on the course design. Yi, Wei, and Nadia formed an ID team to collaborate with Autumn on the course development and research.

Autumn: I feel like I should have Blackboard figured out better by now but I seem to be having some problems still.

Yi: That's okay! We have been doing this for a long time, and we still come across new situations and challenges ALL the time.

Autumn: Okay, well, I'm trying to grade students' essays. I told them that there were no extensions. I turned on the tracking feature as you suggested, and I can see that for some students it was recorded that they submitted something, but I can't seem to find their files.

Yi: Let's all look at the grade book together and determine if we can troubleshoot while we're here together.

Wei: For how many students have this issue? Is it only happening in one section?

Autumn: It seems to be happening in both sections, but to a relatively small number of students. I feel really frustrated that this is happening so late in the semester.

Nadia: No worries, we're here to help! We want you and the students to have a great learning experience in this course. Hmmm, how did you have students name their files when they submitted them?

Autumn: Um, I'm not sure that I gave them any specific instructions regarding the file name.

Yi: In other classes, we have seen situations where a file name longer than ten characters can cause a problem. Sometimes the system rejects the file without letting the instructor or the student know that it wasn't submitted correctly.

Autumn: Oh goodness – I would have not even thought to consider that as the problem. I really thought that the students hadn't figured out the system by now. I'll be sure to include the file name restrictions in the instructions for this class and when I copy the section for next fall. Rather than taking up class time, I'll be sure to include this information in my weekly videos as well. I know that I have a meeting with some other advisers and faculty who might not know this could be a problem, so I'll share that too. Where else would you suggest we should share this tip?

Wei: We can share it at our monthly user group meeting, and you might also want to share it at your monthly team-based learning faculty group.

Autumn: Good suggestions! Let's try to help others avoid this hiccup. I'm glad to have your support in figuring out these unexpected challenges.

Autumn, approached the project with a high level of commitment and flexibility. Being open to discuss time conflicts and rescheduling regular meetings allowed everyone to understand the constraints each other faced in the daily work. During the work meetings, the IDers adopted a listen-to-better-serve approach to delve into the context and better understand the needs of instruction. In addition, through storytelling and narration, the team was able to construct examples and show Autumn similar cases that served as the references for the project.

How to provide constructive yet practical and context-sensitive feedback was another major challenge. From the team's perspective, the context, quantity, and quality of the feedback are of utmost importance in building the partnership. Excessive feedback could be overpowering and intimidating, suggesting a tendency for micromanaging. On the contrary, little feedback is counterproductive to the

design project. The ID team decided to use storytelling and narration to handle challenging situations. To provide feedback efficiently, the team conducted weekly meetings, always scheduled before the weekly meetings with Autumn, to go through items on the meeting agenda. The team utilized strategies such as brainstorming, critical thinking, and crowdsourcing, to prioritize issues, determine when to use storytelling or narration, and select possible stories to tell and phrase narration. By rehearsing during the team meetings, the team was able to produce constructive feedback, which was sensitive to the context.

Finally, the biggest challenge faced by both the ID team and instructor was keeping themselves motivated throughout the project, which is both long and daunting at times. Similarly, storytelling and narration were utilized to promote motivation. The ID team discussed within the team the appropriateness of using storytelling and narration to create a sense of accomplishment. When the team decided what stories to tell, they intentionally combined diverse expertise from their own and other stakeholders' and weaved components that demonstrated commitment and self-efficacy into the stories (Clark, 1999). For example, the design team relied on their ID experiences with a large-enrollment engineering course to set the scene for using stories and later narration. The dialogue in Table 2 exemplifies how the team incorporated storytelling and narration at one of the meetings.

Composing stories became an invigorating empathizing process during the team meetings, which provided a safe space for sharing ideas and coming up with strategies and solutions. Moreover, it was also an invigorating empathizing activity for the instructor. The instructor was encouraged to share stories during meetings, and the IDers helped analyze the stories and focus on the comments on the related solutions. Having a growth mindset, instead of fixed mindset, everyone was given space to grow, instead of solely focusing on the success or failure of the design project (Dweck, 2006).

All in all, the ID team, along with the instructor, developed a genuine collaborative partnership through utilizing storytelling and narration. This method not only enhanced the design project but also strengthened trust and communication between the ID team and instructor. Our relationship has transcended the consultancy on ID and technology; rather, it has progressed from a mentorship into a long-term partnership.

Suggestions to Other Instructional Designers

The partnership fostered during the project is fruitful and rewarding. However, we want to caution the readers to consider the context when adopting this method. To be more specific, all the participants in this project are in the same age group, have the same gender identity, and share similar professional experiences. Despite having different personalities, the participants were able to work together and build upon each other's experiences. This context was by chance and will be hard to

Table 2 Sample story from the instructional design team

Autumn is an academic advisor and the lead instructor of the course. Yi, Wei, and Nadia are instructional designers. Yi consulted Autumn on the course design. Yi, Wei, and Nadia formed an ID team to collaborate with Autumn on the course development and research component.

Yi: Autumn, I noticed that students constantly asked each other about the deadlines and details of the assignments during our classroom observations. Some of them did not even know they need to write an essay. I heard one student exclaimed, “What is peer evaluation? Was it graded? Did I get a score on Blackboard?” How is everything going on in the course?

Autumn: I have been receiving emails from students asking to clarify deadlines and details on the assignments. I don’t think there is anything wrong with the way the Blackboard page has been built. I have to keep emailing them where to find the schedule, and I also sent them an announcement this morning. I don’t want them to be relying on me telling them all the answers. I expect them to be self-sufficient on using the course resources. That’s what they will be doing in their future classes!

Yi: Ok, well. I worked with an engineering instructor last year; I remember he had a large enrollment class, like about 900 students. It was huge!

Autumn: I bet it was, 900 is a lot!

Yi: Yes, I helped the instructor develop his schedule so it could be clear enough to students about their assignments and due dates. Students kept emailing him with questions about the group assignments, due dates, and details about the project. The instructor wanted to have something that answered all of their questions so he could save some time to work on his research.

Autumn: Like how many students did he reply? If the schedule had all the information for students, why wouldn’t they understand?

Wei: The thing is that, with online courses, an instructor may need to spell out things more clearly and detailed since it is not easy to see the students. All the course is asynchronous. Moreover, you don’t want 900 students asking you questions or the same question.

Yi: Yes, students in the engineering course felt really frustrated and did not know how to check the assignments details in Blackboard, or how to check for the submission of assignments, and things like that. It was really overwhelming for students and the instructor. The instructor copied and pasted the email responses when the answers were very similar. However, can you image how much work it was for him to reply to all students?

Autumn: Yeah! He could’ve sent an announcement to the whole class, and then all students could’ve benefited from the clarification, no?

Yi: He did actually, but the communication in asynchronous environment made it more challenging to give details.

Nadia: It seems then that it is better to add more details to the schedule or provide students with weekly announcements. In a way, it seems that would reinforce the instructions, right Yi?

Yi: Yes, that is a good option. However, you would have so much written text! Moreover, it can also cause some troubles because you don’t know if the students wanted to read long texts of instructions!

Autumn: What solution did you come up with then?

Yi: We discussed with the instructor the possible solutions, and we decided to create weekly video instructions! It was actually very fascinating to do. I helped the instructor focus on the relevant points he wanted to highlight in the video, and, most importantly, the expectations he had for the weekly work. It worked really well actually!

Autumn: Yeah, that sounds like an excellent approach.

(continued)

Table 2 (continued)

Wei: Yes, it is. You have to be careful since the videos should not be too long. The video instructions or video reminders should be short and with major points and precise information, for example, the expectations of the work for students. Also, you can provide any feedback on the previous week's work.
Nadia: So, what would you suggest, Wei, as the length of the video?
Wei: About 10 min will be ok.
Yi: I prefer 1–3 min. Otherwise, students will feel overwhelmed.
Autumn: I see, so you suggest I can record a video where I tell students what they will be doing in the week, and perhaps adding some feedback on their team assignments. Yeah.
Yi: Yeah.
Wei: I agree that it is best to keep the videos short. Within 3 min seems to be a reasonable length.

replicate in other working environments. When other professionals plan to adopt this method, it is crucial to outline the context peculiar to the ID projects.

Providing adaptive mentorship to the instructors is the top priority of the ID team. The authors would like to argue that the instructors should also provide adaptive feedback at different stages of the process. Communication between the instructors and IDers should be a two-way street with knowledge sharing, question and answers, feedback, and collaboration built on the prerequisite of having a growth mindset. In this chapter, the authors focus more on how to provide adaptive mentorship to instructors from the ID team's perspective. More work should be done in the reverse direction to further this discussion.

Working in an ID team helps the individual designers to bounce ideas and rehearse the stories and narration before the meetings with the instructor. Moreover, collective knowledge sharing and building also elevate the whole team professionally.

Continuing to nurture the partnership and collaboratively promoting changes and innovations outside the scope of a single project are the goal for the ID team. From the project experiences aforementioned, formalizing storytelling and narration as a method for collaboration during the design and development process is both efficient and beneficial for all stakeholders. One fruitful outcome from the partnership is the continuation of collaboration outside the scope of a single project to promote a shift in the understanding of the dynamics and responsibilities of instructors and ID team inside the institution. The authors work toward achieving this goal by sharing the whole story with others at the same institution by providing workshops and seminars and having conversations. The authors will continue to share with other IDers and instructors about how to unfold the process of partnership and whether to focus on storytelling or narration at different stages of the project. Lastly, another important result is that the authors have come to realize that the benefits of this partnership are worth promoting at the institutional or even national and international levels. Therefore, the authors plan to continue collaborating and promoting change in the field of instructional design and development.

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Personal Tales of Instructional Design from the Facilitator's Perspective

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Abstract Graduate students in adult education and training share the reflective process of instructors/trainers asked to remove their facilitator hats and don an instructional designer hat. Many do not know what this hat looks like. The goal is to develop their own reflective process of ID that fits their field. The students create their own visual of the instructional design process to tell their story. These stories come from a broad range of professional fields.

Keywords Adult education • Instructional design • Reflective process • Graduate students

Background

Designing instruction is a unique and individual process. Many individuals become designers because they are asked to by their organization, yet they have little or no formal training in instructional design. Others go through significant training, earning a graduate degree, in the process of instructional design. Some organizations use a formal model for the design process but most often not. Often those not trained in instructional design develop learning as they were taught.

I added the introduction to instructional design class to our adult education and training master of education curriculum in 2002. Over the years I refined the course and added the assignment for students to create their own visual and tell their personal story of instructional design. I found that this creative process is an important aspect for facilitators to solidify their understanding of the design process. My coauthors are graduate students in adult education and training, enrolled in this introductory instructional design class. Some of the authors participated in a face-to-face offering of the course, and others were in an online offering. They were not all in

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class together. The average age of participants in the graduate degree is 45, and most are working in the field as corporate trainers, emergency service educators, nonprofit educators, and adult basic education instructors and in other related training settings. These coauthors have some experience in designing and developing learning events because it is “part of their job.” They have completed graduate studies in learning theories, processes, and methods of facilitating learning and research methods. The instructional design course requires each student to synthesize their prior learning and experience in the field to build a new learning event from start to finish. Six students, facilitator-designers, share the process and their reflective experience through visuals and story as they are asked to remove their facilitator hats and don instructional designer hats. Many do not know what this hat looks like. The typical response is to jump in and create an outline of learning events. In the class, I ask them to slow down and describe each decision they make based on data and theory. At first, many are frustrated, wondering why I don’t trust them to “just build it.” They wonder why they have to share all the details. “Well,” I say, “I cannot read your mind.” Then I follow up with, “If you are designing this for someone else to teach, you need to spell it out for them.” About a third of the way through, as they are developing assessments for the objectives they created earlier, I often see the light bulbs getting brighter and hear, “Oh, I get it” as they circle back because they need another piece of information about their learner or the environment. About two-thirds of the way through the class, a common comment is “There is no way I can design this to do a good job of covering everything I want to using the methods that are best in the time my organization has allotted for this workshop. What do I do?” The students start to realize why they have experienced so many poorly developed trainings and workshops. They run into challenges with their organizations and hear things such as “You don’t need that information. Just build it.” This chapter shares the stories of instructional design from the facilitator-designer’s perspective.

The Process That Leads to the Story

In the course I start with a conversation about what instructional design is, which is supported by their readings in the first chapters of the Smith and Regan (2005) and a review of the *Survey of Instructional Development Models* (Gustafson & Branch, 2002). My goal is not to teach them a specific model, rather I want them to develop their own reflective process of ID that fits them and their specific field. The students apply their research skills while gaining information to justify the need for a new learning event and the perspectives of various stake holders. Immediately, many find that there are conflicting goals depending on who in the organization they talk to.

They continue the design process through gaining information about their potential learning audience. For those students who are developing a learning event for their work, this is where I often see the first challenges of removing the facilitator hat and donning the ID hat. They often feel that they already know a lot

about the employees who will participate in the training and the expectations of the organization. When pushed to dig more deeply, they often find that they did not know as much as they thought. In the end they make new connections and strengthen relationships within their organization while they realize that “doing it the way it is always done” is not necessarily the best path.

The Assignment

Toward the end of the semester, students create their own visual of the instructional design process to tell their story of ID. The assignment indicates:

For this activity, you should be creative. We have investigated a number of instructional design models, and in this class followed the basic Dick & Carey Model. We have discussed the risks and potential consequences of skipping any step in the model. Through your experience, create your own visual of how you perceive the instructional design process or how you might implement it in your place of work. This can be a digital image, something you make 3D and photograph and post. Try to illustrate your emotions and passion within your model.

I ask the students to create the visual in a format they can print out and post on their wall as a reminder of the process.

Gaining the Stories

Based on their work on the ID project and their visual model, I invited students to narrate their visual to tell their story of the instructional design process. Six students share their unique stories expressed through their visual. They worked individually to create their narratives, and then after I compiled them all, they reviewed each, which prompted some of them to expand on their work.

Paula Johnson: Paramedic and EMT Training

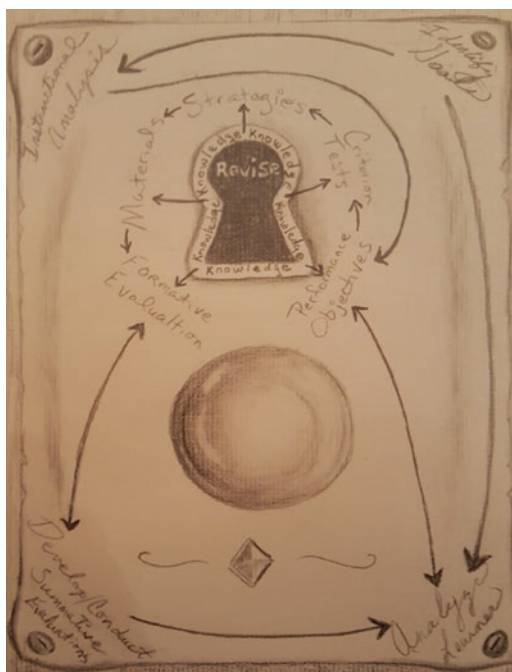
Living in Beckley, West Virginia, I currently run the paramedic and EMT programs at New River Community and Technical College (four programs in total at four separate campuses separated by an hour's drive to each). I also teach the didactic components for two out of the four programs (translation – I stay super busy!) Nevertheless, I think it is important to maintain my EMS skills and experience, so I work part time for the Boy Scouts at the Summit Bechtel Reserve, in Mount Hope, during the summer.

When it comes to instructional design, Emergency Medical Services (EMS) operates in an environment that really provides no rules or guidelines. Accreditation

dictates what is taught. Therefore, we develop instruction in a format that we find most beneficial for the student. The biggest concern for instruction is to provide an environment that is as authentic as it can be. A lot relies on passion and interest in the field and in education. I can go out and work as a practitioner and help a certain number of patients, but if I can teach paramedics, I am reaching more than I could on my own. I have a great respect for my field and passing it down to other people.

Learners typically have some prior experience, so instructional design is about scaffolding and problem-solving because the environment is always changing. If the educator has a passion for doing it, they will find a way to help the students understand. The patients we attend to have not read the text book, so they don't present that way the book describes it. New EMS staff need to build confidence and build on prior knowledge to be able to problem solve. The feedback loop I use makes the biggest impact. If I can get them kinesthetically involved using simulation, the lesson goes further. My practice is influenced by Richard Mayer (2003) who emphasized rehearsal and comprehension. The devil is in the details. If you don't keep an open eye for what the student needs and wants, then you will miss your mark, and the door will never open. "Adapt and Overcome," is common verbiage for EMS personnel, and as designers we need to do the same. A willingness to remain fluid and adapt our strategies and overcome the challenges was identified from a continual analysis of the students and the environment. I need to be willing to change and take action, even if it means scrapping what I have already developed. As an instructional designer, I look at the job as an art form influenced by many shifting parts: culture, stakeholders, students, goals, objectives, and the environment (Fig. 1).

Fig. 1 EMT trainer's vision of instructional design



The Visual Design

One of the hardest lessons I learned from the instructional design course (and still struggle with), is articulating my decisions and actions onto paper. The best advice I received from Dr. Kaminski is to approach instructional design with the mind-set that you are making something that another instructor (without any prior experience) can recreate. I think my difficulty comes from the many steps that I personally revisit and parts that I revise with research and experience. It is hard to describe all those directions that my mind takes to come to a final product. The picture I drew allows me to provide an abstract visual of all those steps. The student is the “key,” the center of my purpose. As the “doorknob,” it is my responsibility to make sure all the working parts are in place so that the individual can open the door to knowledge. Begin by identifying the goals of the training event, analyze the learner and the method for instruction and verify the performance objectives. Start on outer edges and spiral toward the middle, and then through evaluation back out and spiral back in again until you get through the door. Goals are set – look at the learner and environment to make it work. Facilitators need to address all the pieces and parts of the classroom component, so the facilitator ensures the student has what they need to open the door.

Shelly Otis: Training Services Coordinator at Stanford Health Care

I am a training services coordinator at the Center for Education and Professional Development at Stanford Health Care. The Center works with nurses, physicians, and hospital staff. We coordinate continuing education courses, conferences, American Heart Association basic life support courses, and advanced cardiac life support courses. Our mission at the Center for Education and Professional Development (CEPD) is to create an environment that promotes excellence in patient care by providing state-of-the-art professional development programs for the health-care community.

My current role supports the structure of the basic life support curriculum. I focus on how the content is delivered to our participants in order to increase the retention rate. We are currently reviewing the curriculum and enhancing our evaluation to assess the student's confidence level before attending the course as well as after the completion of the course.

Currently in my environment we do not specifically use a model to enhance our training or revise the curriculum. Although there was no specific model utilized by our organization, we have begun discussing the importance of the instructional design model and how it can enhance our course curriculums. My model has been very useful as a road map on how to design an educational training or program. I have found out the hard way when you skip steps that it can cause unforeseen issues

throughout the root system. When steps are skipped, it causes me to go back to the beginning of the instructional design model, which creates delays in the rollout of a new training or program. The instructional design model can feel restrictive at times but only if you let it. It is important to be creative and think out of the box because it will allow for the potential participants to provide feedback on how to improve the original design. The instructional design model is a process. The original idea that you had at the beginning may or may not be totally different at the end because of the feedback provided by potential learners and colleagues. Incorporate as many people within your organization as possible because it will bring in new ideas, perspectives, and areas of concern for where they see training needs.

The Story Behind Your Visual of ID

The visual of instructional design I titled *The Life Cycle of Instructional Design* because it encompasses the beginning stage of an idea through the implementation of the instructional event. At the very bottom you will see in the soil instructional design, which represents the foundation from which everything grows. As you will see, the larger root system is made up of the key themes within instructional design. As the roots get closer to the trunk of the tree, you will see all of the components involved in designing an instructional program or course. Moving up through the base of the tree, we involve the stakeholders to provide feedback on the design and overall instructional strategies for the event. Then we will implement the event, and after the conclusion of the event, we will revise the instruction based on the feedback from the formative and summative evaluation. Finally, it is important to let the instructional event blossom throughout its life-span (Fig. 2).

Instructional design is important in the development of retention for our learners. We will be utilizing this model in order to strategically develop a new follow-up training within 6 months of a basic life support course or advanced cardiac life support course. The goal is to enhance patient care and intervention in a cardiac emergency.

Dwayne Perry: Strength and Conditional Coach

Clawing up the ladder, I worked my way up from a volunteer student assistant strength coach for Colorado State's football team to a head strength coach position for multiple teams at Fort Lewis College (DII) in just a few short years. Fort Lewis, also my alma mater, struggles to compete for national contention due to an overwhelming lack of resources compared to most other colleges. Strength and conditioning was a major key that FLC went without prior to my arrival. I now oversee more than 150 student-athletes on the football, volleyball, women's lacrosse, and women's basketball teams every other day. In addition to that, I'm teaching four

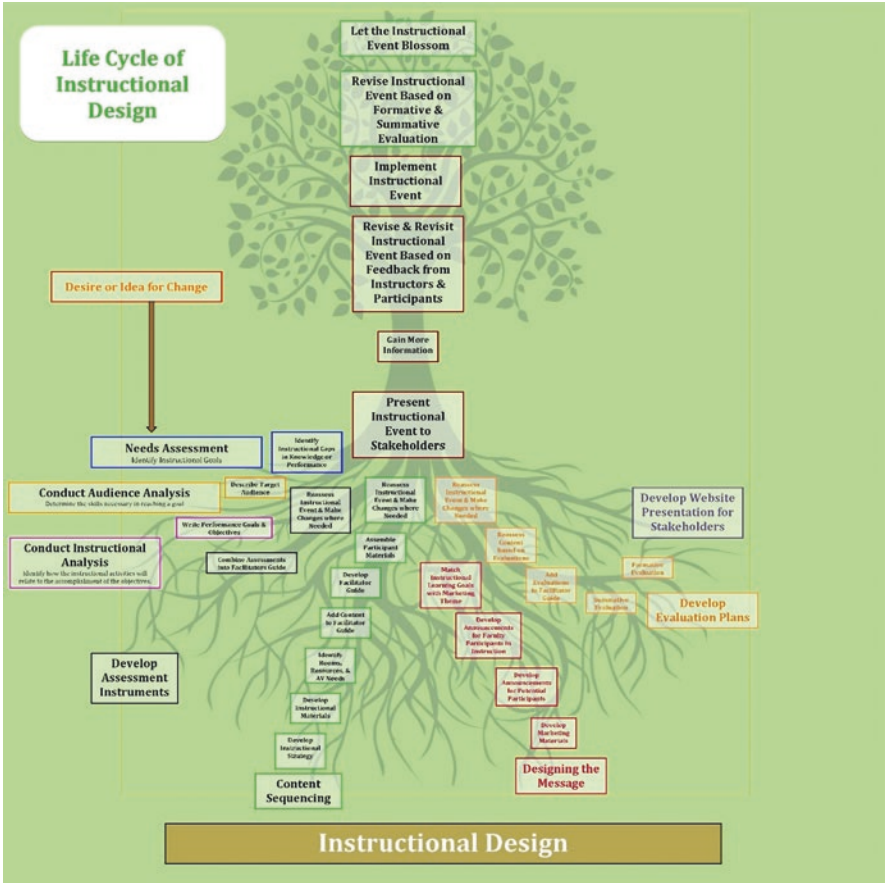


Fig. 2 The life cycle of instructional design

classes and doing laundry for every sport in the program. The to-do list of this type of schedule can drive any sane person to the brink (I question my own sanity every day). To keep from being overwhelmed, some type of vision and focus must be created to keep the strength program and myself on track.

Most athletes are a combination of visual and kinesthetic learners. These are also my top learning methods. It was important for me to explain the core principles of the program in a way that can easily transfer to the student-athlete’s comprehension. I ended up taking our school mascot and tying the core pieces of the program to different parts of the body that easily connected to principle of what I want to explain. It has made for a model to overview and guide the program.

The correlation between coaching and teaching makes it easy to use the most effective teaching methods on the field and in the weight room. The management of so many different budding personalities makes for a lot of trial, error, and revision along the way. Though the method of delivery may change like the weather, the core

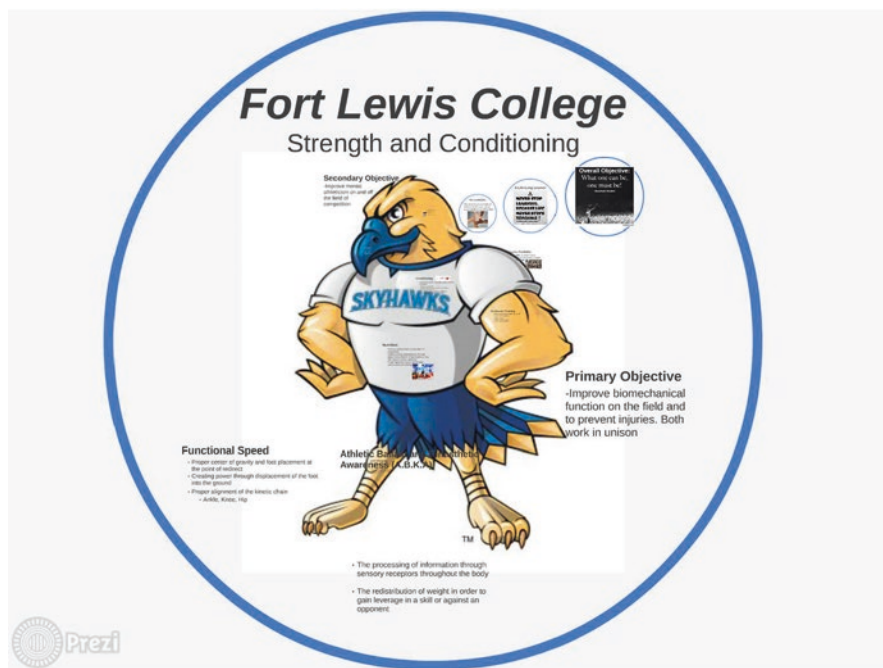


Fig. 3 Tying school spirit to instructional design in athletics

principles set in the design process can guide it all. My ID model is like a lantern on a night trail, illuminating each step toward my destination...

For the full Prezi, visit <http://dkperryj.wix.com/dkperryj#!program-goals---objectives/jggve> (Fig. 3).

Tracy Schmidt: Sergeant Correctional Officer in a Colorado State Prison

I am a retired police officer but currently working as a sergeant correctional officer in a Colorado State Prison. My original goal was to get my Adult Basic Education Authorization and work as a teacher in the prison; however, since taking the initial classes in adult education and training, I decided I wanted to get my master's degree and change the prison educational system. It is deplorable. I would like to have prisoner's learn skills to enable them to get jobs when they get out of prison as opposed to forcing them to take GED classes.

My visual depicts the frustrations I experienced during the course and the instructional design process. It shows that after developing the first steps of the design, we had to continue on with developing the second but at the same time revisiting the

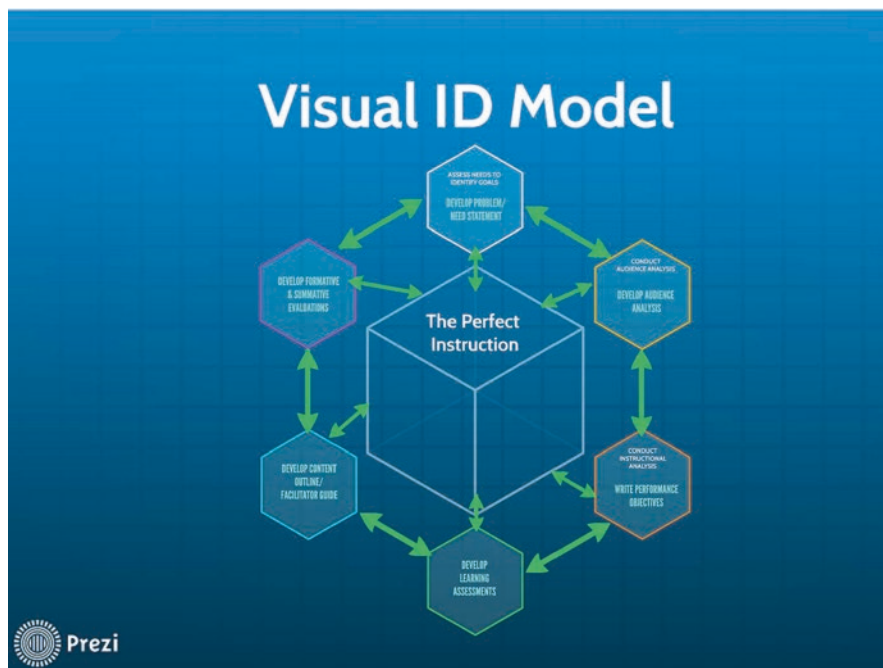


Fig. 4 A prison trainer's expression of instructional design

first. This continued on throughout the entire process with having to continue on but also having to revisit, revise, and redevelop previous steps. In this model, the center figure is conceptually a crystal where during any of the steps one can travel through the crystal and revisit any other step in the process while continuing around the cube and continuing on with the instructional design process (Fig. 4).

Mindy Whetsel: Heath Ambassador Intern at Second Harvest Food Bank

I graduated from Colorado State University with my master's in education, and I also accepted a position as a Health Ambassador Intern at Second Harvest Food Bank. My job entails educating the community about general health and nutrition. One of my most valued experiences of the adult education and training program was the instructional design class. I am very checklist oriented, and going into the ID class, I assumed that it would be the same way. Man, was I wrong! There were times where nothing made sense to me, and I thought for sure that I would fail, but then something amazing happened...a light bulb turned on. Here is my ID story.

Before the ID class, I had no experience with instructional design. My professional background has always had me dealing with nonprofits. If you are familiar

with nonprofit organizations, you know that they depend on grants from mostly the federal and state government. This is a great thing for these organizations, but it can be negative in that it puts limitations on materials that they are funding. That has been my experience in the health education field anyway. I never really had to plan out the instruction because it was already written out for me and I was expected to stick to it, so I did.

Fortunately, with my new position as a Health Ambassador, I have more freedom to plan health education events out. I am looking forward to applying my new ID skills to this job.

My Visual

The first thing I wanted add to my visual of ID is a way to represent my passion for health and helping others, so I added the background with the heart in hands. The second thing I wanted to convey is how cyclical the ID process really is.

The Dick and Carey model, which is the model used for the course, really resonated with me, and I went with it. I laid out each step that had to be accomplished and designated them with the thick maroon boxes with the dotted teal line. I placed them around the ID process cloud and drew thick arrows to show that these steps are definite and need to be accomplished for a successful ID process.

Next, I revisited my project and thought through every single step that I took. During the project, I made sure to take notes on anything that I had to return to based on changes that had occurred during the process. That is what you see designated with the gray dotted arrows.

No, my visual is not a perfect, complete circle, but it shows the nature of the ID process. Most importantly, it represents how a young, inexperienced educator learned how to overcome and appreciate instructional design.

As I mentioned before, I never had to plan out instruction until this class. Due to the nature of my workplace, things were already planned out, and I was expected to just follow. I would venture to say that whoever developed those lessons, presentations, etc., had some kind of plan or model that they went off of. However, since it was already planned out for me, it never really crossed my mind that there could have been some kind of model or process.

Now that I do have experience with ID, I see how helpful it is in all areas of education, including health. With my new position, I'm given a lot more freedom to educate how I see fit, which I can use a model or not. But knowing what I do now, I will use an ID model. This new opportunity is the perfect place to use my new skills! (Fig. 5).

As far as letting others know about ID, I have let co-workers, friends, and family know, especially those who are involved in a field where they teach others. I've let them in on how education is more than just talking about a subject. There really is a plan, and it's more than just checking something off of a list, and it's just done. You are never really done, but that's not a negative thing.

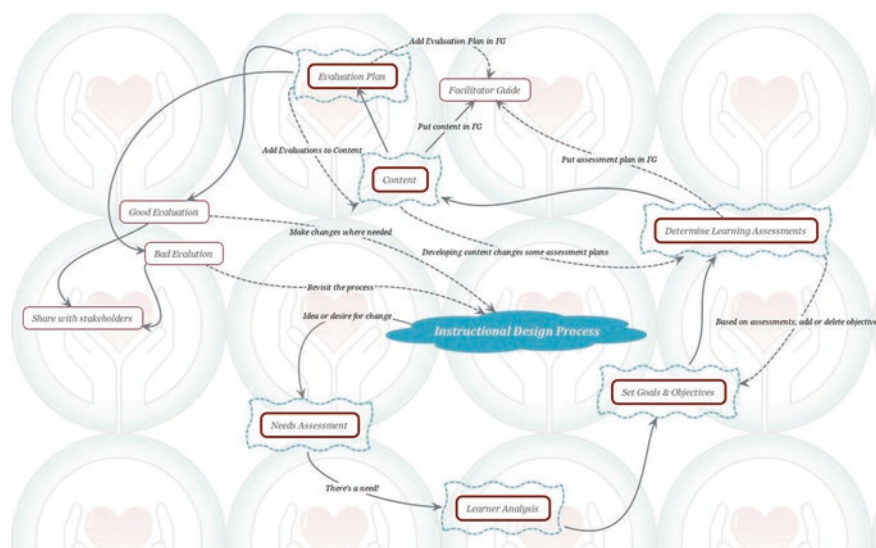


Fig. 5 Helping hand at the food bank reflect caring in the design of instruction

When it comes to skipping steps, I think there are negative results and consequences. Everyone does things in a different way, but I do believe that ID is one of those things where each step needs to be “completed” and revisited. When initially working through the ID process, you may think that you can come up with goals and objectives later or not even at all, but then how do you tell if the event was successful? Or maybe you believe that something is such a problem and needs to be addressed immediately, and there is no reason to do a needs assessment, so you skip to the learner analysis, but through that process you learn there really isn’t a need. In both of these situations, time and resources are being wasted. It’s no good for the organization that you are working for, and it’s no good for your reputation as an educator.

This leads me to frustrations with ID. Of course, this is from my own perspective, but being a checklist-oriented person made this process hard for me. I have always been the type of person who checks something off my list, and I’m done with it. I quickly felt frustrated with this process when I learned that this would not be the case. I didn’t want to revisit things. I wanted to keep pushing through and complete the project, and I will admit that I did a few times. But every time, I had to go back because it would have thrown the whole project off. When I think about it now, I do see how much time I wasted. I would have been better off doing it right the first time.

The funny thing is this also brings me to what is awesome about ID. There would be times during the process where I just wanted to give up and felt like a failure. I just could not wrap my head around why needed to go back to a step, change something, or just completely get rid of it, but then one day it all clicked.

I remember the moment so clearly. I was working on assessment plans, and I just looked at my husband and said, “I get it!!!” He looked at me like I was crazy and said, “Okay, good for you.” In his defense, I just yelled it out, so he had no clue what I was “getting”, but even though he didn’t share in my excitement, I didn’t let it get me down. I finally realized why things had to be revisited, changed, or scrapped altogether. And, yes, all of these things happened at some point in my project. However, I didn’t see it as a negative thing anymore. I saw it as making myself a better educator, doing what is best for my students, and reaching a goal(s).

Hayley Williams: Volunteer Coordinator and Corrections Educator for Adult Basic Literacy Education

Currently I wear many hats for my local ABLE (Adult Basic Literacy Education) program. I coordinate our volunteer tutor program, instruct GED corrections classes, and write curriculum for the program. I never really thought of myself as an instructional designer. However, through further exploration of the process, I now have another official hat to wear. I pick up the instructional design hat when creating learning events for tutors and teachers. Going through the ID process, I felt much like a fly buzzing here and there, constantly reevaluating prior steps in the model. While frustrating at times, it became obvious to me that this was the beauty of instructional design; the checking and rechecking were what amounted to a strong design (web) at the end. The process guided me to a product that was based on research and designed for a specific audience. Now, when asked to organize a learning event, I look at my web model, reflect on my original experience, take a breath, and begin the process. When collaborating with peers to develop a learning event, I bring my experience from my instructional design class to the table. I shed light on detrimental steps to development of a quality learning event and encourage others to use a model in the design process (Fig. 6).

My organization does not follow an instructional design model to my knowledge. With that said, I believe it is a worthwhile process to use when designing instructional events for a target audience. Time and financial resources are often a concern for many nonprofits, and therefore the beauty of a model is that once you are familiar with it, you can focus more time on the steps that are key to your purpose or audience. While I do not recommend skipping steps, each designer will have steps that he or she can move through more quickly. I found myself circling back to reevaluate parts of the design process time and time again for thoroughness. While the feeling of *déjà vu* became frustrating at times, the outcome of a quality product made it worthwhile. Presenting a relevant and well-researched design for an instructional event promotes buy in from top to bottom.

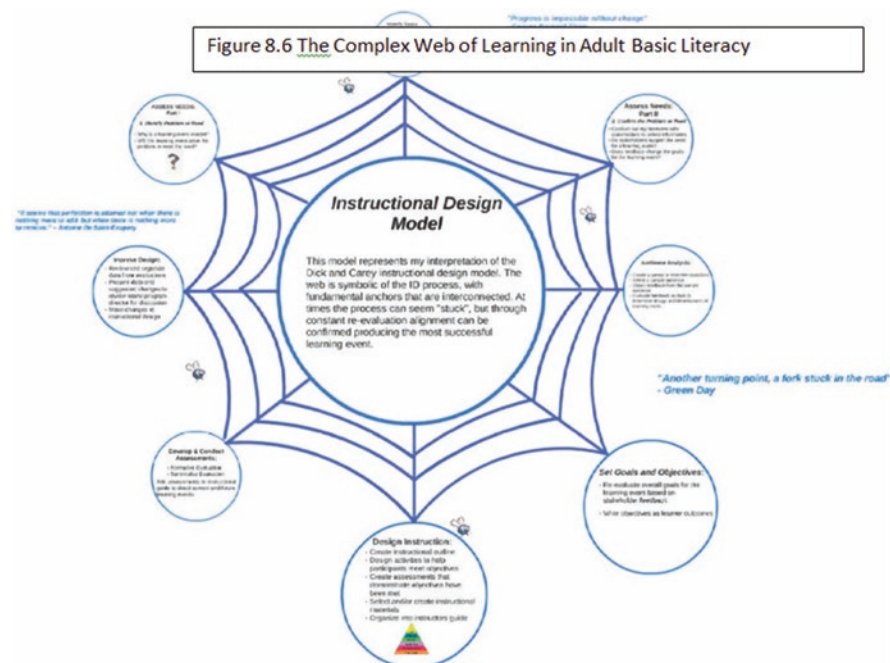


Fig. 6 The complex web of learning in Adult Basic Literacy

Putting on the Instructional Design Hat

Mindy Whetsel indicated, "It is easier to have an ID hat on for the creative purposes. It allows you to explore the other side of teaching. Teaching is more than just educating others about information. Teaching really is a process and I feel ID is a huge, creative part of that." Hayley Williams indicated, "It is so ingrained in me to think like the teacher or facilitator that I had to take a step back and think about what needs to happen before I can even get to that point. I found that I kept sliding back into the facilitator role, so I constantly had to keep myself in check and think much broader." Paula Johnson states, "For me, it is extremely easy to create all kinds of fantastic facilitation tools for use in the classroom; but setting aside that hat for ID ensures that the tools I use are not excessive or irrelevant to the course objectives. There are too many things that have to be covered in a paramedic course for me to fill time with "nice-to-know" projects or topics that may or may not be of value to

the learner. Wearing the ID hat affords me an opportunity to streamline the material and tools to what is the best use of student and instructional time.”

Reflection in the Stories

For the facilitator-designers, the visual design process is valuable in multiple ways. First, it provides them with a model that fits their perspective of the design process. The process of creating the visual allows them to highlight the aspects that they consider most important or most likely to be left out. It also develops another path for recall of the design model. Mindy Whetsel felt that the visual design process is valuable because it helps remind her that each step must be revisited, with even small changes. She actually based her model on the model we used in class and has not had the chance to really make it her own yet but is sure that will happen in the future. When she looks at her own visual, even now, she can remember why she had to go back and update her previous thoughts. From another perspective, Haley Williams reflected, “The visual is a great overview of the process, helping me to see the big picture but also to stop and reflect throughout the process. Creating the visual after having going through the ID process was a great culminating activity and still serves me well today. I can picture it in my head when thinking through the process, but just in case, I also have it posted at my desk. I am getting ready to start a new ID project and when brainstorming the model was in my head reminding me of steps to take.”

Paula Johnson added, “The visual design process was extraordinarily valuable to me. I am a visual person, and an opportunity to create an artistic rendering of the process and what it means to me as an instructor helped me articulate my thoughts more clearly not only to others, but to myself as well.”

Summary

Flies, doors, spirals, passion, and so much more. Learning facilitators, now with a sense of instructional design, have varied experiences. As you review the unique models above, you might notice that the graphical design reflects the field of work of the creator. This was incidental to the outcome of the assignment, yet it illustrates the importance of the process of creating one’s own visual model.

While Shelly Otis, who works in health care, used a tree to depict her model, Tracy Schmidt, a corrections officer, used a modular, structured design, and Dwayne Perry, a strength and conditioning coach, used his school mascot as the backdrop for his design, a very strong jayhawk. When discussing this with the designer authors, Paula Johnson noted, “In what other field is a person so wholly trusted that they are allowed complete uninhibited access to another person’s home, belongings, and family members? ‘When in doubt, do something.’ That is a motto EMS providers

live by. The pinnacle of our job is to make access to the patient, provide treatment and transport to an appropriate facility, and always remaining an advocate for individuals within our community. We open the door to address patient needs. These needs might be in the form of physical, mental, or emotional support. As an educator I attempt to mirror the classroom to the expectations of patient care in the field and that includes supporting the learner in all aspects.” Mindy Whetsel put a nice cap on this discussion: “For me personally, I feel it’s important for people to understand where my passion lies. That’s why I made my visual represent it. From looking at the other models, I feel that is what they were thinking as well. Not only that, but we understand our respective field and that makes the ID process more comfortable, for a lack of better terms. I know a lot of us struggled with the process, so remembering why we do what we do helped us get through.”

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Storytelling as Transdisciplinarity: An Experiment in First-Year Composition and Communication

Michael T. Smith and Jeffrey J. Evans

Abstract In *The Myth of the Frontier*, Joseph Campbell writes “the rise and fall of civilizations can be seen to have been largely a function of the integrity and cogency of their supporting canons of myth...when the mythology of a culture no longer works, there follows a sense of both disassociation and a quest for new meanings.” In other words, our societies are built upon storytelling. This article examines a transdisciplinary class taught with a cross-departmental team of five faculty members that was centered on the theme of storytelling. This class was organized within the newly proposed transdisciplinary studies program in the Purdue Polytechnic Institute in fall 2014. Titled “Culture, Communication, and Digital Narratives: Storytelling as a Way of Thinking,” the class was a 7-hour class for freshmen that met the university’s core requirements of First-Year Composition and Introductory Oral Communication but also sought to reach beyond the confines of these classes by incorporating visual and audio design (and the technologies associated therewith). This article will first argue the theoretical underpinning of this class that storytelling is a fundamental mode of learning. It will then argue that it is one that works particularly well in the context of transdisciplinary studies (albeit with its share of pratfalls).

Keywords Transdisciplinarity • Storytelling • Design • Communication • Narratology

Introduction

In *The Power of Myth*, Joseph Campbell (1988) notes “the rise and fall of civilizations can be seen to have been largely a function of the integrity and cogency of their supporting canons of myth...when the mythology of a culture no longer works, there follows a sense of both disassociation and a quest for new meanings.” (unpaginated)

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In other words, our societies are built upon storytelling. The stories we tell ourselves are key to how we conceive of ourselves and of the very society in which we live. In the deepest sense, the storytelling we do is what gives us meaning.

Education is one grain of society very much built upon various myths and storytelling. Everything from how we conceive of class containers to how we present material is based upon some tradition that harkens to some story, if not something akin to the mythic.

This article reflects upon a transdisciplinary class taught with a cross-departmental team of five faculty members with instruction that was centered around the theme of storytelling. We understand transdisciplinarity as a very particular concept involving the *blending* of different disciplines. Petrie (1992) describes it as follows: "The notion of transdisciplinarity exemplifies one of the historically important driving forces in the area of interdisciplinarity, namely, the idea of the desirability of the integration of knowledge into some meaningful whole" (p. 304). As it overcomes disciplinary boundaries, we operated with the mantra that transdisciplinarity is the best route to address new demands and needs in the world.

In this article, we will first argue the theoretical underpinning of this class: that storytelling is a fundamental mode of learning. We will then argue that it is one that works particularly well in the context of transdisciplinary studies (albeit with its share of pratfalls).

The class in question was organized within the newly proposed transdisciplinary studies program in the Purdue Polytechnic Institute (formerly the College of Technology). Following months of planning, our program accepted a pilot class of 35 students in the fall 2014 semester. All of these students were admitted into the Polytechnic Institute and volunteered for the program. All students in this sample were beginning freshmen. Two thirds were admitted into a technology-based major, while the remainder were admitted into the university's exploratory studies program.

We offered this pilot group of the said seminar class, which was titled "Culture, Communication, and Digital Narratives: Storytelling as a Way of Thinking." The class was a 7-credit hour class that met the university's core requirements of First-Year Composition and Introductory Oral Communication but also sought to reach beyond the confines of these classes by incorporating visual and audio design (and the technologies associated therewith). It also included information literacy.

The course was team-taught by a group of five faculty. These faculty came from the departments of CGT (Computer Graphics Technology), Communications, ECET (Electrical and Computer Engineering Technology), English, and Library Sciences. During its best moments, these faculty crafted impromptu dialogues with one another during the class sessions in the interest of transdisciplinarity. However, on many occasions one would take point and lead the discussion.

The goal of the class was multifold. The most basic aim of the class was to meet the university's core requirements for First-Year Composition and Introductory Oral Communication. However, the more elevated goal was to use the theme of storytelling to not only meet these requirements but to exceed them in three major ways. First, we hoped to combine the curriculum of these two core classes to identify

similar concepts in both unifying the curriculum and avoiding redundancies. Second, we aimed to incorporate technological components, particularly via the audio and visual requirements throughout the class (this was particularly appealing for a cohort of technology majors). Third, we hoped that through the former two goals, we could form moments of true transdisciplinarity which would break out of the traditional siloes found within education to provide a more holistic and informed view of a given concept.

The Power of Storytelling

Much of the theory behind the class was that narratives give us a “new mind” when encountered. A narrative is not a superfluous entity outside of critical thinking; rather, it is a type of thinking in its own right.

Evolutionary biologist E. O. Wilson (2014) claims in *The Meaning of Human Existence* that we evolved via gossip:

The roles of both individual and group selection are clear in the details of the human social behavior: People are intensely interested in the minutiae of behavior of those around them. Gossip is a prevailing subject of conversation, everywhere from hunter-gatherer campsites to royal courts. The mind is a kaleidoscopically shifting map of others inside the group and a few outside, each of whom is evaluated emotionally in shades of trust, love, hatred, suspicion, admiration, envy, and sociability. (p. 24)

In other words, our minds were sharpened by and consequently particularly take to the stories we tell one another (whether these be in the areas of social manipulation, relationships, or reputation management). In addition, he clarifies that what he means by gossip is colored by a critical lens insofar, as the storytelling we engage in is not simply a reporting of moral and social concerns but an analysis of them.

Storytelling, therefore, is not simply an activity to pass the time but constitutes a fundamental trait of human nature. Paley’s (1990) work with young children confirms that the need and the ability to tell stories are both innate: “Amazingly, children are born knowing how to put every thought and feeling into story form. If they worry about being lost, they become the parents who search...Even happiness has its plot and characters” (p. 4). Similarly, tech journalist Jeremy Hsu (2008) asserts that we are wired for storytelling. He claims that a story broken down to its simplest form is simply a connection of cause and effect, which is how we think. We think about narratives all day long whether it is about our work or running errands. We make up stories in our heads for every action. In fact, Hsu (2008) found that “personal stories and gossip make up 65% of our conversations” (unpaginated). More so, when we hear a story, we want to relate it to ourselves thereby creating an interpersonal dimension to our way of thinking in this manner.

One can see the elevation of storytelling as a mode of thinking in many ancient societies as well. For example, the ancient Greeks (and Romans after them) conceived of storytelling as an intricate component of philosophizing and general thought. This perception, in part, is why many writers of ancient times (such as

Plato, Cicero, etc.) would communicate their philosophy via a dialogue. The story of a learning was considered the learning itself. In other words, storytelling was not a superfluous fluff wrapped around the actual content of the so-called lesson. Instead, it was integral to it.

Much contemporary research lends credence to these perceptions. From a communications perspective, the twentieth-century philosopher Walter Fisher (1987) coined what he called the “narrative paradigm.” This theory claims that all meaningful communication is a form of storytelling or giving some report of events. He subsumes *all* communication under the header of narration, the “symbolic actions—words and/or deeds—that have sequence and meaning for those who live, create, or interpret them” (p. 58). As a result, human beings experience life as a series of ongoing narratives and hence think in a very fundamental way through a narrative frame of various narrative variables such as conflict, character, and plot trajectory. He calls this frame the “narratistic attitude,” in which we fundamentally view the entire world as one large narrative (or a series of smaller narratives put together).

Furthermore, at a conference called the *Presentation Summit*, Jon Thomas (2011) presented a panel titled “The Art of Storytelling.” The basic summary of this panel is that we interact with storytelling in several beneficial ways. For example, he claims that information presentation should be centered around a story. Regardless of the topic, organizing its information around a beginning, middle, and end will engage an audience to the topic. Moreover, storytelling can often make us care about a topic—even if it is typically outside of our ken. In fact, it’s a direct route to give meaning itself to the topic at hand. With care and meaning established, it finally provides a stronger motivation than a nonnarrative mode of communication, all of which are beneficial for pedagogical success.

The sheer magnitude to which stories give meaning bears more emphasis. In an experiment conducted by Uri Hasson at Princeton, a woman was placed in an MRI scanner and told to tell a story to a group of listeners also placed in MRI scanners:

When the woman spoke English, the volunteers understood her story, and their brains synchronized. When she had activity in her insula, an emotional brain region, the listeners did too. When her frontal cortex lit up, so did theirs. By simply telling a story, the woman could plant ideas, thoughts, and emotions in the listeners’ brains. (Gallo, 2014, p. 50–51)

Hasson concludes that a story is the only way to activate parts in the brain so that listeners turn the story into their own idea and experience. The brains of the person telling a story and listening to it can synchronize, helping shape the very manner in which we both think and communicate to one another.

Implementing Storytelling in the Classroom

From the pedagogical lens, it does not take much of a jump to see how storytelling can be beneficial in the classroom, and research has affirmed as much. For one thing, “stories help us organize and remember information, and tie content together”

(Caine & Caine, 1994, p. 121–122). Additionally, “learners embedded in contextual, authentic, real world problems [i.e. within stories] are more engaged, draw on more resources, and transfer learning more effectively” (Andrews & Hull, 2009, p. 17). In other words, learning is most effective when it takes place in a social environment that provides authentic social cues about where knowledge resides and how it is applied. The US Department of Education even went so far as to claim that “even students with low motivation and weak academic skills are more likely to listen, read, write, and work hard in the context of storytelling” (Geisler, 1997, p. 23). Hence, storytelling seems to be beneficial for students at all levels.

In our classroom, we explored communication with a mind-set toward the benefits of storytelling as described above by setting up a dichotomy between what we termed “mediated communication” and “performative communication.” The mediated communication side is what brought technology into the discussion. This side focused upon the various mediums through which we communicate. In other words (as this was a class out of the Polytechnic Department), it focused on the technology *that enabled* the very act of communication—whether that technology was writing itself or an array of audio software and instruments. Reflection upon how technology enabled other disciplines as a kind of base upon which they grow was a large part of the transdisciplinary efforts. The performative lens, then, viewed communication as a form of storytelling with the theory given above in mind. When combined, these two modes constituted the class’ two poles: at once technology-based and humanities-based. Ideally, they were blended together in the instruction and assignments.

For this 7-credit hour course, we assigned the students five major projects with floating due dates (and a final portfolio that collected revised versions of all of the projects). These projects touched upon the five mediums of oral, written, visual, audio, and multimodal communication. Most students completed this last assignment by making a film—an assignment that combined the first four mediums into one. The decision to make the due dates floating came about *in part* because we did not want to seemingly privilege one form of communication over another or give the impression that one form naturally led to another form in a type of linear progression. Conceptually, this reasoning seems sound even upon reflection, but practically the lack of solid due dates caused a great deal of trouble for many students who let projects slip out of their hands. What we saw was a particular rush of submissions in the last 2 weeks of the semester (a number of which were evidently completed in haste due to procrastination).

Even this transdisciplinary structure was seen as a component of storytelling. Davar Ardalan (2016), the Director of Storytelling and Engagement at SecondMuse states:

Systems thinking is another form of storytelling. To tell the story well, we aspire to see all sides of the situation. Great stories are not a simple antagonist and protagonist but have a complex web of three-dimensional characters with their own perspectives and idiosyncrasies. In the work that we do, systems thinking is one way of exposing this story. (unpaginated)

Hence, the web of a story's narrative being similar to the transdisciplinarity inherent to the class (in the form of mediated and performative communication) was an analogy underpinning the class.

The first question we asked the students in the class was also the toughest: "What's your story?" This was the core of every assignment they were to do throughout the semester, which is why we asked them this question on day one. Ultimately, they were to use the various mediums we worked in to compose a story of who they were, broadly speaking.

This base question proved to be one of the greatest challenges to the students. We found there to be a number of reasons for this in faculty reflection. First, many of the students quite simply thought that they didn't have a story to tell: They were too young, or too shy, or simply not interesting enough. Second, the type of self-reflection inherent in asking "What's your story?" was foreign to many of them, albeit a window into much of the humanities work and critical thinking we hoped to achieve (which again culminated in a revised portfolio of the work done up to that point). Third, the task of presenting themselves through a variety of mediums challenged their conception of what a story is. It forced them to engage in storytelling not as a highly bounded activity but as an activity that could take multiple forms with multiple purposes.

For instance, one assignment had them create a soundscape that told a type of narrative. They were not allowed to speak a narrative within the audio track. Rather, they were instructed that the sound itself should tell a story. Students were prepared for this assignment with two major in-class exercises in addition to a typical sampling of relevant readings. First, they examined their physiological changes to the presence of music by having a partner measure their heart rate, first resting with no music, then with music playing. As Anthony Storr (1992) suggests, which we confirmed, heart rate tends to rise, signaling arousal: a generally enhanced state of being. Second, the group was exposed to a musical piece and then asked to dissect the story being told by the music, with no visual cues provided by us. None of the students had ever heard the piece, the opening credits to the HBO miniseries *John Adams*, before. By the second listen, the group had described aspects of musical genre, historical placement, ethnicity, and scenario (aspects of freedom and war) with amazing precision without any information on the musical piece provided from the instructors. When we told them the context of the musical piece after this exercise, the accuracy of their suppositions/interpretations revealed to them the power music has in stimulating clear mental imagery that tells a story.

The first week, the (ostensible) assignment was to create a sculpture that told or at least reflected their story. We did not give many details besides this basic instruction so as to not constrain them but also to allow us to see what ideas on preconceived ideas of storytelling they already had. To build their sculpture, the students were given an array of materials from Legos to clay to PVC pipe. Once they had finished, they were to get into small groups and tasked to interpret what their peers' stories were from their sculptures. In addition, they were to write a reflection piece comparing their own story to their peers' guesses and interpretations as to what their

sculpture meant. To encourage an unrestrained expression, neither component of the assignment was graded.

Obviously, this assignment had them coming out of the gate with a task involving quite a bit of abstraction. That was the point. What we wanted to illustrate was how easily communication breakdowns happen—whether it be from filtering, selective perception, information overload, emotions, language, silence, communication apprehension, gender differences, political delineations, or any of the other categories typically studied in the field of communications. In addition, our technological component allowed us to introduce more contemporary theories of communication such as those of Sherry Turkle (2015), who writes that the increase of technologically driven communication in the past several decades has led individuals to be faced with condensed communication in such forms as email, texting, and social media; this, in turn, has led to a notable change in the way younger generations communicate insofar as individuals are constantly multitasking both physically and mentally as phone (or other device) presents another world ready in their pocket at all times.

There were two pedagogical advantages to this exercise. First, it fits along the lines of “showing, not telling.” Instead of lecturing to the class what various categories of communication breakdown they might experience, we let them come face-to-face with it themselves. The sculpture exercise was an experiential learning experience revolved around their story and their perceptions of other stories as opposed to a flat lecture. Technology, in all its forms, helped illustrate this lesson.

In addition, the experiential component allowed us to introduce the *concepts* of communication theories like Turkle’s without forcing dense academic articles upon them. This was a freshmen class, after all. Instead, we would pose questions to the students such as: What details did you notice? How long did you study the sculpture? Were you distracted by anything?

Here is where experiential tasks such as this connect to storytelling. When the students formed a dialogue with one another regarding their sculptures, they effectively began to form stories: “Conversational learning represents a meeting point of multiple individual voices woven into an interconnected whole. Mutual interdependence resides at the heart of valuing the local truth of each of these voices for social learning through conversation” (Baker, Jensen, & Kolb, 2002, p. 43). Hence, the dialogue brought together the elements of experiential learning, transdisciplinarity, and storytelling.

Storytelling as a Form of Transdisciplinarity

Herman (2013) considers storytelling both as a target for interpretation and as a resource for making sense of experience itself. To do so, he takes a transdisciplinary approach, putting ideas from narrative scholarship into dialogue with such fields as psycholinguistics, philosophy of mind, and psychology (to name a few): “[. . .] in

such an approach, multiple disciplines all converge on the mind-narrative nexus, with each discipline bringing its own field-specific concepts and methods to bear on the questions at hand in a way that fosters genuine dialogue and exchange” (p. 311). The end goal of Herman’s work is to have a prismatic view of how the process of narrative world-making supports efforts to understand and engage with various aspects of lived experience.

Much of Herman’s conclusion heeds to a warning given by cognitive psychologist Richard Gerrig (1993) on the perils of one-way importation of ideas (who is biased himself in only looking at the one-way transition from mind sciences to literary studies). Gerrig warns that these often eclectic and haphazard transitions across disciplines remain unaware of larger debates in the field from which the concepts are borrowed. To a degree, this could be said of any literature review within even a single field, as it will always be limited in what it can encompass and therefore fall prey to an accusation of being eclectic and partial. All the same, one should not dismiss Gerrig’s concerns. Herman (2013) arrives at the logical conclusion of multidirectional sharing between fields as a basis of true transdisciplinarity:

Rather than seeking to subsume all traditions of narrative study under the sciences of mind, and thus potentially undercutting the autonomy of scholarship on narrative, my goal has been to highlight the need for a variety of investigative tools [...] Because unidirectional borrowing, though commonly conflated with interdisciplinarity, in fact undermines efforts to foster genuine dialogue and exchange across fields of study, it is crucial to foster a diversity of analytic perspectives on the mind-narrative nexus. (p. 312–313)

To reiterate, this “dialogue” is what we hoped to accomplish in our transdisciplinary class with the overarching theme of storytelling. Storytelling was to be seen as a transdisciplinary lens, which in turn was viewed through several transdisciplinary lenses.

Conclusions

Ultimately, we found that much of the theorizing behind the advantages of storytelling proved itself in the classroom. We obtained several artifacts from the students that support as much, including a number that revolved around a technological and multimodal component.

However, the failings of the class came about when we failed to understand (or anticipate) the set of challenges that come with thinking in a narrative mind-set. These complications ranged from the psychological (“I don’t have a story to tell”) to matters of comprehension (“How can a photograph tell a story?”). One idea that we had to assuage the former difficulty would be to spend more time introducing storytelling itself as a topic that surrounds us everywhere. Anecdotally, there seems to be a persistent myth that storytelling refers to something almost ethereal—that it is out of reach in some ways and constitutes something of a rarity as opposed to something that constantly surrounds us in the everyday as the literature above

describes. Similarly, while the students took to the technological demands of making a soundscape and an image fairly well, there were occasional struggles to see these as narratives. Again, additional scaffolding could be provided to describe narrative as a richer concept than students' preconceived notions might.

Incidentally, the greatest successes and greatest failures came at the exact same moment: when our forms and methods of communication across disciplines combined to form moments of true transdisciplinarity. The reason for this seemed to arise from a simple enough trade-off: a greater understanding of the material at hand could be attained through transdisciplinarity for the simple reason that this offered multiple lenses from which to view the same topic. We used storytelling to connect these lenses to form a more complex and intricate view of the topic than a traditional curriculum would have demanded. However, the difficulty arose from the fact that this was ultimately a more complicated picture, and, therefore, demanded more effort to comprehend. Transdisciplinarity offered a deeper understanding, but it (rather naturally) demanded more effort for one to attain it.

Ultimately, we argue that this benefit exceeded the demands. By the end of the semester, the students seemed to not only have a deeper understanding of our relevant topics individually, but—most importantly—could see their overlaps and relations to one another.

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Advancing Social Narrative Intervention Tools for Students with Autism: The Role of Educational Technology

V. Paige Hale and Matthew Schmidt

Abstract Formal contributions from the instructional design and technology field have the potential to yield more effective, next-generation social narrative interventions for individuals with autism spectrum disorder. Social narrative interventions are a category of behavioral interventions characterized by their use of short, story-like vignettes. This chapter explores an array of advanced technology tools that might be leveraged to facilitate the design, delivery, and monitoring of social narrative interventions. Research literature on learning analytics and human-computer interaction (e.g., eye tracking, galvanic skin response, etc.) as well as authoring tools that allow individuals to create their own social narratives are explored. This examination ends with a description of a conceptual next-generation social narrative intervention and discussion of implications.

Keywords Social narrative interventions • Autism spectrum disorders • Instructional design • Analytics • Eye tracking • Game-based learning

Introduction and Purpose

Although the broader field of education has paid considerable attention to the challenges associated with educating individuals with autism spectrum disorders (ASD), this has not, to date, been a significant focus of instructional design and technology (IDT) research. For example, a search for the term “autism” in the field’s flagship scholarly journal, *Educational Technology Research & Development* (ETR&D) yielded only eight articles between 2006 and 2015. Of those eight, none included the term “autism” in their title, and only one included the term in its abstract.

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This chapter attempts to increase awareness in the IDT community by addressing the question of how trends in IDT might be applied to the development and delivery of social narrative interventions (SNI) for individuals with ASD and other developmental disabilities. To this end, we examine current practices, research findings, and future directions for SNI with these populations. We continue by considering the ramifications of advanced technologies such as analytics and physiological feedback mechanisms to the development of SNI. We review literature on analytics and advanced feedback mechanisms, as well as on state-of-the-art tools that might impact the next generation of SNI. Finally, we consider factors that might impact adoption of advanced SNI among practitioners.

Why Reexamine Social Narrative Interventions?

According to Collet-Klingenberg and Franzone (2008) via the National Professional Development Center on autism spectrum disorders, SNI are a category of interventions that focus on teaching social skills, manipulating or scripting social behaviors, and helping learners adjust to changes in routine through the use of short, story-like vignettes. Although basic technologies have been employed to create SNI, a review of research suggests their development might be impacted by current trends in IDT. As such, we assert that the next generation of SNI tools could be more effective if rooted in the knowledge base of the IDT field. Not only could formal contributions from the IDT field yield more effective, next generation SNI, these contributions could also be leveraged to facilitate the design, delivery, and monitoring of SNI.

Understanding the Autism Spectrum

To understand the instructional needs and potential design challenges for learners with ASD, one must be familiar with key characteristics of the disorder. Research on the effectiveness of interventions is increasing concomitantly with public awareness of ASD and early intervention research. According to the nonprofit advocacy organization *Autism Speaks* (2013), ASD is a general term for a group of complex disorders related to brain development. The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (2013) is the preeminent reference work providing standardized nomenclature and diagnostic criteria for all recognized mental disorders. The DSM-5 notes ASD is characterized, in varying degrees, by difficulties in social interaction, verbal and nonverbal communication, and repetitive behaviors (American Psychological Association, 2013). Collectively, these three areas have been characterized as a “triad of impairments” (Wing, 1997, p. 20). Although a variety of disorders exhibit some similar diagnostic criteria (e.g., social [pragmatic] communication disorder, Rett disorder), we focus specifically on ASD in this

chapter. According to the Centers for Disease Control and Prevention's Autism and Developmental Disabilities Monitoring Network (2014), autism now affects 1 in 68 children. Given this high prevalence, effective interventions are imperative to address the difficulties in social interaction and communication that individuals with ASD experience.

Social Narrative Interventions

As noted in the DSM-5, individuals with ASD often have difficulty with communication. The DSM-5 (2013) describes their issues related to social, or pragmatic, communication as, "difficulties following rules for conversation and storytelling, such as taking turns in conversation, rephrasing when misunderstood, and knowing how to use verbal and nonverbal signals to regulate interaction" (p. 47). SNI can target issues with pragmatic communication. SNI are sometimes referred to as "social stories" or "social scripts," with some nuanced differences; hence, our use of the term SNI is intended to be an umbrella term for this intervention category. Indeed, the term SNI tends to be more apropos, given that these narratives are often not stories but instead "may be descriptive of a situation, or may outline the steps in a sequence or process" (Vickers, 1998, para. 3).

SNI operate on the principle of making social cues especially salient and providing models of appropriate responses. They can be constructed using a variety of media that span the continuum from low tech to high tech. On the low-tech end of the continuum, a teacher or parent might write or print a narrative and read it out loud to a student. These types of narratives are often accompanied by visual supports such as pictures. On the high-tech end of the continuum, a teacher or parent might construct a digital narrative using presentation software like PowerPoint. These digital SNI can be enhanced with a variety of multimedia elements including audio narration, video, and animations. While the design of SNI can vary, they are typically positive in tone, individually tailored to specific learners' needs, and are quite short (Gray & Garand, 1993). An example would be a short, two to five sentence description of a social scenario that focuses on relevant social cues and appropriate responses. The story would be descriptive in nature and could include information about the settings, participants, others' feelings and reactions, consequences, and analogies relating the story to other similar situations (Hagiwara & Myles, 1999). In a meta-analysis of SNI, Kokina and Kern (2010) suggested the following design principles for maximizing intervention effectiveness:

- (a) Targeting reductions in inappropriate behaviors, (b) implementation in the general education setting, (c) the use of target children as their own intervention agents, (d) social stories read immediately prior to the targeted situation, (e) social stories describing simple singular behaviors rather than complex "chains" of behaviors, (f) brief duration of intervention, (g) the use of functional assessment to inform the intervention, (h) the use of

comprehension checks, and (i) involving elementary-aged participants with higher levels of communication and social skills and low or moderate levels of challenging behaviors (p. 825).

Basic pen and paper or typed SNI can be relatively quick and easy for practitioners to compose when provided with guidelines and proper training (Dev, 2014). However, the creation of digital SNI may be more complicated, since many in-service teachers struggle to successfully integrate technology into their teaching practices (Dev, 2014). Additionally, practitioners often lack easy access to research (Hall, 2015), so they may not have access to evidence-based practices for implementing digital SNI in an effective, systematic manner. Further, Hagiwara and Myles (1999) found that inconsistent implementation across contexts was a limitation to their implementation of a digital SNI. Despite these limitations, their potential to improve the social and behavioral functioning for individuals with autism lends support to continued efforts to apply multimedia tools to SNI. Additional studies, particularly ones comparing treatments, are needed to determine which SNI are the most efficient and effective for this population as well as those which promote generalization of skills in individuals' natural environments and social settings (Malmberg, Charlop, & Gershfeld, 2015).

Literature Review

Research from the field of IDT focusing specifically on applications for autism and other developmental disabilities is limited. However, an established, generalized educational research base examining technology applications for this unique population of learners exists, which focuses on the application of multimedia tools and instructional technologies to improve the lives of individuals with ASD. Much of this research concentrates on remediating the two primary deficits of ASD: communication and reciprocal social interaction. For example, multimedia social skills instructional programs and SNI have proven successful for many individuals with autism (Beaumont & Sofronoff, 2008; Cihak, Smith, Cornett, & Coleman, 2012; Crozier & Tincani, 2005; Hagiwara & Myles, 1999; Hopkins et al., 2011; Padilla & Pierson, 2015; O'Connor, 2009; Serret, Hun, Iakimova, Lozada, Anastassova, Santos, Vesperini, & Askenazy, 2014; Simpson, Langone, & Ayres, 2004).

A study by Simpson et al. (2004) used embedded video and computer-based instruction to target the social skills deficits of four urban elementary school students diagnosed with autism. The teacher-researcher developed a computer-based instruction program using a program called HyperStudio, which allowed the teacher-researcher to embed video and other multimedia into instruction for use as models for teaching important skills and concepts (Simpson et al., 2004). The program included a series of prompts displayed on the computer. A title card was used to introduce the instruction. One card, for example, read "How to Get Along in School." The next card then showed a simple declarative statement about the target behavior in relation to its function (e.g., "One way to get along in school is to

share.”). The third card presented a short definition in simple language about the target behavior (e.g., “Sharing means to let others use your things.”). Subsequent cards included video clips that served as on-screen models demonstrating the target behaviors. The version of the intervention program used in the study contained 22 different on-screen cards. Video clips of typically developing peers engaging in the examples and non-examples were played for the four target students, and they were tasked with discriminating between appropriate and inappropriate responses. Upon completing the video-based training, the four target students participated in group activities with typically developing peers. This allowed the researchers to gauge social skills acquisition by how well the target students were able to generalize what they learned. Although the sample size was small, all four students showed rapid improvements and were able to generalize what they had learned to the natural environment (Simpson et al., 2004).

SNI have also been found to be effective in improving social interactions for students on the higher functioning end of the autism spectrum. Hagiwara and Myles (1999) implemented a multimedia SNI with three elementary school students who had been diagnosed with autism. They used a computer-based social stories program to teach and reinforce social skills with the ultimate goal of promoting generalization to real-world social interactions. This study was important, according to the authors, because it was the first of its kind to implement multimedia in a SNI. Results suggested inconsistent generalization across subjects, and the authors were not able to establish an empirical effect. However, they do correctly contend that effective interventions which generalize to all youth with ASD have yet to be found. Although this study was implemented with a small sample of subjects, its results suggest that multimedia SNI show promise as a direction for future research on the development and implementation of technology-based interventions for students with autism (Hagiwara & Myles, 1999). As such, it has served as a springboard for subsequent studies.

In addition to SNI being used to promote appropriate social skills, multimedia programs have also been used to promote mental health. Specifically, a case study used social story DVDs to help reduce anxiety in a child diagnosed with both autism and learning disabilities (O'Connor, 2009). The child in this study had difficulty when attending PE class or swimming, specifically with new groups of students. The child frequently ended up releasing tension by hitting others. Whereas many professionals working with students with ASD have to create their own SNI, the use of a DVD presented this student's school with the potential for an inexpensive, convenient method to implement a research-based intervention. However, the researchers realized that the DVD program by itself was not sufficient and that they needed to have the child's teachers carry around a flip-book of traditional paper-based social stories to reinforce what he had learned from the video (O'Connor, 2009). The results of this single subject study, though not necessarily generalizable, suggested video SNI may be less effective than more traditional counterparts for some learners with disabilities. Specifically, the researchers found that the video was not sufficiently tailored to the study participant's specific and individualized need related to swimming, PE, and conversational turn-taking (O'Connor, 2009). This

speaks to the challenge of developing multimedia SNI. While this category of SNI can provide particularly salient means by which to engage learners, the costs and labor involved in their production limits their usefulness and ability to be individualized. This suggests that video could be more appropriate for more general SNI, whereas inexpensive and simple SNI might be more appropriate for tailoring to an individual's specific needs.

In addition to SNI, interactive social skills training programs have also shown favorable results. Specifically, a study by Beaumont and Sofronoff (2008) examined a multicomponent social skills training program titled "The Junior Detective Training Program." This program was designed for higher functioning students with Asperger syndrome. The Junior Detective Training Program included four components: group social skills training, parent training, teacher handouts, and a computer game. The detective theme of this program provided a high-interest format that was well suited for individuals with Asperger syndrome. Students in the intervention group made gains in social skills as measured by parent and teacher social skills questionnaires and rating scales.

Another interactive, computer-based social skills training program called *FaceSay* was the subject of a study by Hopkins and colleagues (2011). The study sought to examine the *FaceSay* program's impact on children's emotions and facial recognition skill development. The study also looked to investigate the impact of the *FaceSay* intervention on social behaviors in the participants' natural, authentic environments. *FaceSay* is a game-based approach that focuses on social skills through the use of animated, anthropomorphic avatars. It includes a certain level of predictability, which can be appealing to students on the autism spectrum. Users interact with avatars in activities that promote social skills, such as maintaining eye contact and recognizing facial expressions. The researchers maintain that *FaceSay* could enhance appropriate social interaction related to paralinguistic cues, thereby leading to enhanced real-world social interactions. Results of their study suggest that practicing simulated facial recognition activities on the computer enhanced the participants' ability to recognize both facial expressions and emotions. These results provide further support for the effectiveness of using computer-based interactive simulation programs to enhance social skills in students diagnosed with ASD.

Although facial and emotional recognition have been the focus of many multimedia intervention programs for individuals with ASD, higher-order recognition skills have also been the target of research. A study by McAleer, Kay, Pollick, and Rutherford (2010) examined whether animacy displays derived from human actions could increase the ability of individuals with autism to perceive others' intentions. According to McAleer and colleagues (2010), animacy stimuli depict "animated geometric shapes such as triangles and circles" (p. 1054) and are often used to study theory of mind and participants' intentions. The program included video displays that showed two actors from two viewpoints: one from above and one from the side. Six interactions were included: chasing, fighting, flirting, following, guarding, and playing. The results of this study indicated that there was no difference between participants with ASD and controls in judging intent based on the video and animacy displays. Although the participants with ASD were able to judge intent based on the

multimedia displays, the results suggest that it is not intentions but, rather, the subsequent mental states that individuals with ASD struggle to comprehend.

Task Analysis and SNI

SNI are rooted in task analysis. It is important to note task analysis is viewed differently in the IDT field than in special education. In IDT, task analysis refers to “a process of analyzing and articulating the kind of learning that you expect the learners to know how to perform” (Jonassen, Tessmer, & Hannum, 1999, p. 3). In contrast, task analysis as applied to special education, refers to identifying the steps required to fully and satisfactorily complete a task or activity (Carter & Kemp, 1996). For example, a first step for initiating a conversation could be to walk up to the person to whom the individual wants to speak. Making note of this difference is necessary since IDT and special education both use the same term but with different meanings. For the purposes of this chapter, our use of the term should be interpreted in the special education sense.

Technological Continuum of Social Narrative Interventions

SNI are designed and delivered by a variety of educational practitioners. As such, they traditionally have taken on low-tech forms and have been created by individuals outside of the IDT field and by educational practitioners without specialized training, including paraprofessionals (Quilty, 2007). These low-tech formats usually consist of hard copy materials such as a single laminated sheet or a book or binder (Doody, 2015). High-tech versions of SNI utilize digital technologies for presentation, include multimedia elements, and can be delivered on a variety of devices. Some of these digital SNI employ text to speech or recordings of the narrative, thus increasing accessibility and making it possible for a broader variety of learners to access materials independently.

Pen-Paper or Typed

Basic SNI are often handwritten or typed. They are often composed by parents, teachers, or other stakeholders, and sometimes with input by students (Goodman-Scott & Carlisle, 2014). A particular benefit of handwritten or typed SNI is that experienced practitioners can compose them relatively quickly (Dev, 2014). As such, this intervention type can be made available for use soon after the need arises or when one anticipates behavioral challenges in response to social situations. The SNI describing trick or treating presented below is situated in the context of a novel

social situation. This SNI was developed by the first author as an example for the purposes of this chapter. It is intended to be used by a child who possesses adequate receptive language abilities but has trouble knowing when to initiate and/or terminate social contact (e.g., introducing oneself). In addition to addressing basic social etiquette such as introductions, the following example anticipates potential pitfalls (e.g., the child taking too much candy or the child becoming angry if some candy is taken away).

My name is Charlie. It is Halloween and I will be going trick-or-treating with my brother and sister. This will be a lot of fun. There will be many kids dressed up in costumes walking beside us along the sidewalks. I will walk slowly and watch where I am going. When I come to a house, I will walk up to the door. If it is closed, I will ring the doorbell or knock. I will quietly wait for someone to open it. When they come, I will say “trick-or-treat” and hold out my bucket. I will not grab candy. I will take only one piece so there will be enough for other kids. I will say Thank you” and walk to the next house. When trick-or-treat is over, mom will look at each piece of candy to keep me safe. She might throw away pieces of candy that are unwrapped or look unusual. I eat some candy and save some for later. I will tell mom thank you. I will have a good time (Hale, 2016).

Stories Augmented with Imagery

The traditional SNI described above are handwritten or typed, but practitioners sometimes augment the narratives with images. Examples may include digital imagery, illustrations, and photographs. Images can serve several purposes. An image that resembles the learner (e.g., a clipart stick figure with similar hairstyle) or an actual photograph of the learner can serve as a concrete example that plays to learners’ strengths in visual media (Dev, 2014; Xin & Sutman, 2011). SNI that employ imagery have been found to be more effective than those that do not (Kokina & Kern, 2010). These images, when combined with text, could, for example, be printed and then cut and pasted onto a hard copy social story. They could also be incorporated into a word-processing program so the practitioner could then display the images and text on a computer, tablet, or other handheld devices. The use of comic strip conversations (using stick figures and speech bubbles in a comic format to provide visualizations of communication; see Fig. 1) to address social skills deficits has also been the focus of some research (Glaeser, Pierson, & Fritschmann, 2003; Hutchins & Prelock, 2006, 2013; Rogers & Myles, 2001). Using images can be motivating to children, provide an opportunity for the learner to take part in the creation of the narrative, and allow for recreation of familiar contexts (More, 2008).

Animation and Avatars

A base of research on interactions with avatars as well as the use of avatar-based interventions is emerging for individuals with ASD. Avatars are virtual representations of people and self (Parsons, Mitchell, & Leonard, 2004) that can be two- or

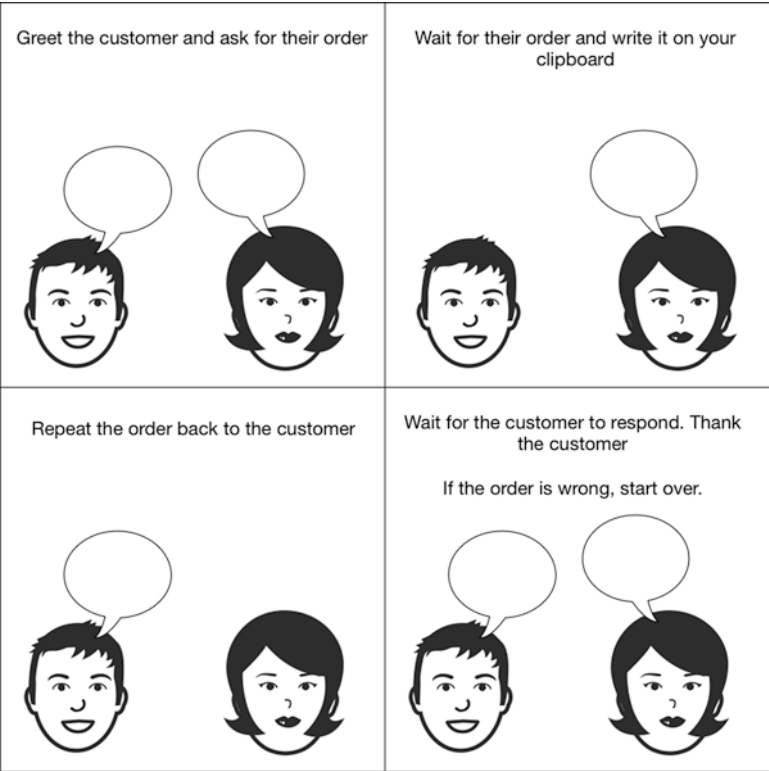


Fig. 1 Comic book conversation depicting a conversation centered on ordering coffee

three-dimensional. Much of the research on avatars centers on emotion and facial recognition. Individuals with ASD are able to recognize when avatars are controlled by humans (Schmidt, 2014) and can recognize emotions displayed by avatars (Moore, Cheng, McGrath, & Powell, 2005). Avatars can elicit verbal and gestural responses from participants but do not appear to be superior to humans at eliciting social interactions (Carter, Williams, Hodgins, & Lehman, 2014). Interactions with animated avatars have been shown to contribute to improvements in social skills for both high- and low-functioning individuals with ASD (Hopkins et al., 2011). A variety of free- or low-cost talking avatar computer and mobile applications are readily available to educational practitioners online and in app stores.

Video Modeling and Video Self-Modeling

Research has shown video modeling can be an effective tool for teaching social skills to some students with ASD (Bernad-Ripoll, 2007; Cihak, Kildare, Smith, McMahan, & Quinn-Brown, 2012; Malmberg et al.,2015; Sherer et al., 2001; Stendal & Balandin, 2015; Xin & Sutman, 2011). Video modeling utilizes video

clips to depict representational models engaging in desired social behaviors (Malmberg et al., 2015). Video self-modeling goes a step further by utilizing video clips of the learner serving as his/her own model. According to Xin and Sutman (2011), video self-modeling in conjunction with SNI can be an effective strategy for promoting targeted skills and behaviors with target learners.

Virtual and Immersive Learning Environments

Virtual and immersive learning environments when applied as SNI extend the incorporation of animation and avatars into fully immersive virtual spaces or virtual learning environments (VLE). A three-dimensional, collaborative virtual learning environment (or 3D CVLE) is a virtual space in which learners can explore the environment, interact with objects and others in real time, and communicate using voice and text chat. The virtual spaces are created with a high degree of realism, resulting in high perceptions of individual and social presence (Schmiel et al., 2012). Research has examined the potential for VLEs and 3D CVLEs to address social skills deficits associated with autism and other developmental disabilities (Moore et al., 2005; Parsons, Mitchell, & Leonard, 2004; Schmeil et al., 2012; Schmidt, 2014; Schmidt, Laffey, Schmidt, Wang, & Stichter, 2012; Vasquez et al., 2015). Parsons, Mitchell, and Leonard (2004) maintain that use of VLEs can result in learners with autism interpreting social scenarios in nonliteral ways. Schmidt (2014) and Schmidt, Laffey, Schmidt, Wang, & Stichter (2012) each assert that the elastic nature of VLEs allows for control of input stimuli and alignment of all aspects of the environment toward the identified needs of learners.

Directions for Future Research: The Next Generation of SNI

Returning to the question of how current trends in the IDT field might be applied to the development and delivery of SNI for individuals with ASD, the focus of this chapter now shifts toward technological applications and approaches that go beyond animation, avatars, video modeling, and virtual and immersive learning environments. Our intent is not to provide an exhaustive review but rather to examine some of the technologies that are emerging and how they might apply to the development of future SNI.

Advanced Feedback Technologies

SNI approaches such as those discussed already in this chapter are typically evaluated based on visibly observable behavioral outcomes. Relatively little attention has been paid to how SNI might impact learners with ASD from a physiological

perspective. Studies using electroencephalogram (EEG) and eye tracking (ET) among individuals with autism are not uncommon (e.g., Boraston & Blakemore, 2007; Oberman et al., 2005) but traditionally have been relegated to medical and clinical (not educational) contexts. This is unsurprising, given the traditionally high cost associated with physiological measurement devices. However, with recent advances, cost is becoming less of a barrier. For instance electroencephalogram (EEG) devices are now available as consumer devices for a fraction of the cost of their clinical counterparts. Granted, these devices do not have the same degree of sensitivity or fidelity as higher-cost units, but that they are readily available opens exciting opportunities for researchers. Similar trends are evident in the area of eye tracking (ET), where devices cost thousands of dollars just a few years ago but where consumer-grade equipment is now available for just a few hundred dollars. Future SNI research might look to biofeedback technologies such as EEG and ET. These technologies have the potential to capture behaviors of learners with ASD that could lead to new design and research directions for SNI. ET and EEG could help researchers and developers determine whether or not students with ASD are attending to relevant features of a SNI and subsequently design mechanisms to render those features more salient, usable, and effective.

Analytics

Beyond overtly observing students' behavior while engaging with SNI, it can be difficult to obtain meaningful data firsthand to evaluate the effectiveness of SNI and the learner experience. Due to the weaknesses in communication inherent in ASD, asking students about their experiences with SNI is challenging. Learning analytics hold the potential to operationalize the experiences of users with ASD in a way their words cannot. Metrics such as showing usage, time spent on each page of a tool, and recording the paths users take through various systems could yield important data. Moreover, analytics tools can be used by a variety of stakeholders, including educational practitioners who introduce and monitor the use of SNI, developers, and the students themselves. Most promising of all, learning analytics can be used to inform the customization of the user experience. SNI tools that incorporate analytics also would have the potential to adapt to the learner. This could result in the user being more motivated to interact with the tool.

Digital Game-Based Learning

Virtual and immersive learning environments are currently used to target key deficits associated with ASD. Additionally, game-based approaches to teach social skills are beginning to emerge (e.g., Blum-Dimaya, Reeve, Reeve, & Hoch, 2010). Game-based SNI would go beyond practicing social skills in alternative realities as

is the case with VLE and 3D CVLE. Game-based SNI would allow for nonlinear storytelling, give the learner control of decision-making, and provide feedback based on those choices. Additionally, features such as earning points, badging, and opportunities for unlocking special features could be incorporated, which might impact learners' motivation. While the potential benefits of digital game-based learning hold promise for individuals with ASD, caution is advised given the propensity of these individuals to engage in repetitive behaviors, their vulnerability to video game addiction (Mazurek & Wenstrup, 2013), and problem behaviors that can arise as a result (Mazurek & Engelhardt, 2013).

Conclusion

The purpose of this chapter was to review the current state of SNI, to provide an overview of learning technologies used in this field, and to consider how emerging trends in the field of IDT might influence the development and delivery of next generation SNI tools. Our discussion of SNI was situated on a continuum of low tech to high tech and considered how advanced technology might be leveraged both to develop and to deliver SNI. The question remains open as to how the next generation of SNI will be designed. We advocate for a collaborative design approach. Generally speaking, traditional SNI have been developed by educational professionals and then delivered to individuals with ASD. However, a growing avenue of research advocates for involving participants in the design process (Benton, Johnson, Ashwin, Brosnan, & Grawemeyer, 2012; Frauenberger, Good, Alcorn, & Pain, 2013; Madsen et al., 2009; Millen, Cobb, & Patel, 2011; Parsons & Cobb, 2014; Parsons, Millen, Garib-Penna, & Cobb, 2011). This participatory design approach includes higher functioning individuals with ASD in the design and development of technology-driven social narratives. Including these individuals in the design of SNI has the potential to increase motivation, promote greater self-awareness of learners' skill gaps, and yield customized tools that are of greater interest to the population as a whole.

We maintain that advanced SNI hold great promise for meaningfully impacting the lives of individuals with ASD and that incorporating trends such as analytics, advanced feedback technologies, and digital game-based learning into SNI has the potential to impact this population in exciting ways. We acknowledge the appeal of these technologies on the design of next generation SNI; however, we conclude this chapter with a note of caution. As discussed previously, low-tech SNI are simple to create, require very little technical expertise, and can be developed in a very short amount of time – factors that have led to wide adoption of this intervention type among practitioners. As one moves toward high-tech SNI, the difficulty to create the SNI, the technical expertise required, and the amount of time involved increase proportionally. These factors serve as considerable barriers to adoption. We maintain that for next generation SNI to be successful, practitioner-friendly tools, training materials, and knowledge dissemination platforms are paramount. Without

these, it is likely that practitioners will continue to use tools and processes that are most familiar to them. Further, while an empirical basis that clearly establishes advanced SNI tools as evidence based is needed, this alone will be insufficient to support the significant cost, time, and effort needed to develop and implement these tools. As advanced SNI become available, researchers likely will look to establish this intervention modality as superior to traditional SNI. While research that focuses on the magnitude of intervention effects is needed, future research should also focus on the quality of the user experience and technology affordances, as well as the establishment of respective design principles.

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Designing for Adult Learners' Metacognitive Development and Narrative Identity

Kathryn M. Wozniak

Abstract Adult learners are often aware of their thinking and learning strategies but tend to need more support in self-regulation, especially when challenged with self-paced learning situations and online learning environments. This research shows how social and persuasive design elements in learning environments can support learners' metacognitive development, in which narrative identities are a key factor.

Keywords Metacognition • Adults • Narrative identity • Self-regulation • Social learning • Persuasive design • E-learning • Online

Introduction

Metacognition is a learner's ability to monitor, reflect on, and improve upon his or her learning activities and strategies; it is a key factor in successful transfer of knowledge and skills to new learning situations (Akyol & Garrison, 2011; Bransford, Brown, & Cocking, 2000; Flavel, 1987). Twenty-first-century employers expect that recent college grads as well as their current employees have strong metacognitive skills so that they can excel in critical thinking, complex problem-solving, judgment and decision making, and active listening (Siadaty et al., 2012; Trilling & Fadel, 2009). Thus, metacognitive awareness, practice, and development are a necessity for learners to be effective and efficient in the workplace, school, and everyday life.

However, metacognition and its usefulness in these contexts are often not directly or intentionally explored with adult learners—those who are beyond traditional undergraduate college age—in educational settings or in informal or workplace learning environments. And while pedagogical practices and learning technologies have been developed to support learners' metacognitive development, most research has focused on grades K–12 and developmental scenarios. Very few studies have

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examined returning adult learners in postsecondary settings or workplace settings, where they may need continued support in developing and transferring their knowledge and skills for success (Veenman, Van Hout-Wolters, & Afflerbach, 2006). Further, studies that have looked at adult learners have done so very broadly and have found that changes in metacognitive awareness continue into adulthood. Research is needed on how to better support adult learners' metacognitive awareness (Justice & Dornan, 2001).

In the e-learning landscape, where adult learners are increasingly appearing, researchers have found that success in online environments is due to "high levels of participation, a supportive facilitator style, and ample opportunities for metacognitive reflection" (Cacciamani, Cesareni, Martini, Ferrini, & Fujita, 2012, p. 874). Educators, designers, and researchers have made strides in recent years to scaffold this type of learning within and beyond the classroom, using social learning, gamification, and other design frameworks. Learning systems and technologies have been developed to support learners in participating in and integrating authentic and personally meaningful learning experiences and for gaining adaptive expertise (Bransford et al., 2000; Shaffer & Resnick, 1999). Additionally, research on learners and learning in digital environments has shown that participation in digital learning environments supports metacognition because of the opportunity for learners to connect with each other via social networks and construct representations of their identity and knowledge so they can then critically reflect on them (Akyol & Garrison, 2011; Bers, 2001; Cambridge, 2008).

Many studies show that technological interventions that scaffold metacognition should not only draw from educational practices concerned with metacognition but also from social constructionist learning theory and a learner-centered design framework. Yet, many of the technologies and practices that claim to support learning and cognitive development tend to perpetuate teacher/teaching-centered rather than learner/learning-centered principles and tools: for example, learning management systems (Dalsgaard, 2006; Dohn, 2009; Wegemer & Leimeister, 2012). For metacognitive development, several existing metacognitive support technologies have been tested on grade school, high-school, and college-aged students (18–24 years old), and it was found they were primarily for assisting learners in particular domains that require structured problem-solving (e.g., math, biology, or chemistry), rather than across multiple contexts (see Veenman et al., 2006; see also Azevedo, Johnson, Chauncey, & Burkett, 2010; Rau, Aleven, Rummel, & Rohrbach, 2013; Roll, Baker, Aleven, McLaren, & Koedinger, 2005). The research on technologies and e-learning systems that specifically support adult learners' metacognitive development is limited.

Considering the gaps in research on adult learners' metacognition and technologies to support them, particularly in e-learning environments, how can we support adult learners' metacognitive development in e-learning environments? This research indicates that a combination of social-persuasive design and an emphasis on leveraging narrative identity in learning experiences is key.

The ReflectCoach Study

A group of online adult learners were recruited to determine if and how an e-learning intervention, ReflectCoach, contributed to their metacognitive development. A mixed methods approach was used. The 24 adult learners who participated in this study were enrolled in a section of a required introductory-level online writing course in a 4-year bachelor's degree program for adult learners (age 24 and older). The ReflectCoach experiment was conducted iteratively over two terms with a control and treatment group in each term. Half of the learners interacted with ReflectCoach (read content, completed assessments, participated in discussion forums) at least once per week for 10 weeks in addition to their regular online coursework. The other half completed their regular online coursework and did not interact with ReflectCoach. Both groups completed (a) a pre- and post-Metacognitive Awareness Inventory (MAI) test that gauged their Knowledge of Cognition and Regulation of Cognition, validated by Schraw and Dennison (1994), (b) a course portfolio that was scored by two external raters who are experts in assessing metacognition, and (c) a post-course interview that was coded by two external raters. Their interactions and system usage in ReflectCoach were also collected and analyzed.

ReflectCoach was designed to focus on metacognitive development using persuasive and social design elements since these have been shown to be effective in learning as well as behavior modification in both commercial and academic contexts (Fogg & Eckles, 2007; Snyder, 2009). ReflectCoach's design elements were also purposely aligned with adult learning principles (Knowles, 2005) since the goal was to support adult learners. See Table 1 for an explanation of ReflectCoach's design elements and how they align with adult learning principles. The goal in incorporating these elements was to encourage what may be labeled "metacognitive behavior modification" for those who interacted with ReflectCoach. The behavior to be modified, in this case, was the thought process or habit of mind relative to one's own metacognitive awareness.

Key Findings

It was hypothesized that the treatment group would improve in MAI score and score higher on their learning portfolios due to their interaction with ReflectCoach. This was the case with both iterations, with a significant difference between control and treatment groups in the second term. But the more interesting results were those that came from an analysis of these scores with the interviews, discussion forums, and system usage data. Learners who were strong in the "Knowledge of Cognition" metacognition factors tended to use the scoreboards and reference the achievement levels the most. Learners who were strong in the "Regulation of Cognition"

Table 1 Aligning persuasive and social design to adult learner principles

ReflectCoach design element or feature (persuasive or social)	Associated adult learner principle(s)
<i>Initial personal assessment form (auto-scoring)</i>	
Learner takes inventory (form) of what he does and does not know about his metacognitive ability (persuasive)	Prior experience
Instant feedback (persuasive)	Readiness to learn
Unlimited attempts/“game the system” (persuasive)	Need to know
	Self-concept
<i>Weekly, auto-scoring self-assessment questionnaires about metacognition</i>	
Multiple questionnaires (forms) on topics of each category allow learner to take inventory of what he does and does not know and gets into the “habit” of reflecting on metacognition each week (persuasive)	Prior experience
Instant feedback (persuasive)	Readiness to learn
Unlimited attempts/“game the system” (persuasive)	Need to know
	Self-concept
<i>Scoreboard w/achievement levels and tips</i>	
Learner sees score and realizes what he “needs to know” to become an All-Star (persuasive) or to meet their peers where they are (persuasive and social)	Readiness to learn
Score with tips (instant feedback) provide direct information on where the learner can improve based on their score (persuasive)	Need to know
	Motivation to learn
	Self-concept
<i>Peer forums with prompts encouraging discussion of personal metacognition</i>	
Learners are prompted to share a story about a real experience that relates to a concept of metacognition and reply to others with a comment (persuasive and social)	Prior experience
Learners can seek feedback or tips from their peers, which mimics instant feedback despite asynchronous setting (persuasive and social)	Need to know
	Motivation to learn
	Learning orientation
<i>Privacy levels/settings</i>	
(All aspects are both social and persuasive)	Learning orientation
Learners can join as guest or user	Self-concept
Can choose username	
Can choose anonymous code for scoreboard results	
Other users do not know other identifying information	
<i>Email reminders/notifications</i>	
Learners receive emails to remind them of next steps to improve metacognition (persuasive)	Need to know
Learners receive notifications when another user has responded to their prompt (social)	Self-concept
	Readiness to learn

metacognition factors tended to use the discussions and reference peer feedback in addition to the independent activities like the questionnaires and scoreboards.

While these were expected patterns, there were also a few unexpected connections between the activity logs and patterns in the interviews. These connections suggested that learners valued the following ReflectCoach elements: privacy, instant feedback, and opportunities to game the system to learn best practices for metacognition. These features, many of which tie back to social and persuasive design principles (Fogg & Eckles, 2007; Snyder, 2009), also align well with Knowles’ adult learning assumptions and allow adult learners to integrate metacognitive

development into their narrative identity. This alignment may have also led to the learners' improved metacognitive development.

Anonymity and Lurking

To allow learners' privacy and customizable notification settings, ReflectCoach has two levels of membership: guest or user. This feature was intentionally incorporated into the system as both a persuasive and social design feature so that learners could (a) review content and participate in the questionnaires without having to create an account or (b) sign up and receive reminder emails about new activities, notifications when something in the site changes or someone responds to their post, or private messages when another user wants to contact them directly. Most (75%) of the treatment group participants signed up to be users. But no matter which of these two user levels they chose, the learners did not have to reveal their identity to each other at any time. They only had to pick a three-digit code by which they could identify their scores on the scoreboard, and, if they participated in the discussions, they could select any username without an association with their identity. This mode of participation is not always possible in many formal learning systems, which typically require learners to, at the bare minimum, to reveal their identity in a class email list. Of the 12 learners who participated in the experiment, only five of them chose a username that included their first and/or last name. It quickly became clear that participants did not always want to be identified. Participants could remain anonymous but still participate in questionnaires, check and compare their scores on a scoreboard, and "open up" about topics that may otherwise have been too personal or confidential to share with other learners.

In fact, participants were quite candid in the ReflectCoach forums; they discussed topics that would in many cases be discussed with a close confidant, not a stranger or a classmate. Topics included strategies for sticking to personal goals like losing weight or making more time for projects, struggling with managing workload at their jobs, and admitting failure and needing to revise strategy. This suggests that learners using ReflectCoach felt comfortable discussing their metacognitive abilities across domains and experiences, rather than stay on topics related to the writing course. While the open-ended prompts in the discussions invited topics beyond writing and school, such as "Describe a time you failed at something," the option for anonymity could be an additional reason the adult learners discussed topics across domains.

Furthermore, because the questionnaires and discussion forums are not graded and do not require completion before moving on to the next activity, and because the scores and posts remain in the application indefinitely, learners can "lurk" in the scoreboards and discussions and still be reflective without actively participating. Research shows lurking is still a strong form of learning for certain personalities and learning styles (Beaudoin, 2002; Gray, 2004). Three from the treatment group

were inconsistent about actively participating in quizzes and discussions, but were still lurking in the discussions and found value in doing so:

I was doing well on all the quizzes, so I didn't really think I needed to continue on those. But it was kind of cool to see what everyone had to say about their jobs and how they organize and plan and stuff, and to see what they said about my posts.

The discussions were interesting. I didn't always respond to the other people on there like we were supposed to because sometimes I was the first one to say something, and sometimes I just didn't have the time, but I read what they said later when I got the email that someone else posted.

The scoreboard was a good way to check other people's scores and see how you did in comparison but not feel bad if you didn't score as high.

The concept of privacy is not mentioned in the adult learning literature, but it can be assumed that adults would appreciate it in online learning experiences because of these three assumptions about adult learners' preferences for learning: (1) prior experience, (2) learning orientation (to authentic contexts), and (3) motivation to learn (which tends to be intrinsic for adults, but can be extrinsic as well) (Knowles, Holton, & Swanson, 2012). Without privacy in ReflectCoach, adult learners may not have felt as comfortable exploring their prior experiences, personal goals and motivations, or strengths and weaknesses with metacognition in an authentic, honest way. Brookfield (2013) has noted that adults do indeed appreciate this type of safety from "exposure" to others in learning environments. At the same time, the privacy also affords motivation because it allows learners to see each other's scores and comments about metacognition and feel an impetus to compete or compare themselves to their peers in an effort to better themselves.

Instant Feedback: Self-Scoring Questionnaires and Peer Forums

During the interviews, participants mentioned that feedback and the timeliness of it was key to a meaningful interaction in ReflectCoach and in their online courses overall. The automated, self-scoring questionnaires and their peers' feedback (which would stream in throughout the weeks of the study) were often brought up in comparison to the 1 week it took for their instructor to give them feedback on their course assignments:

Yeah, I liked that I could just pop through the questionnaires, get my score, see what everyone was talking about, and add my two cents and move on to the next thing. And sometimes I would get a reply from someone that same night because we were both working at the same time. [...] When I wasn't getting feedback from the instructor for, like, more than a week, I sort of lost focus. Plus, I felt like I couldn't move on with homework until I knew if I was on the right track with last week's.

Similarly, the ReflectCoach discussion forums demonstrate that participants were engaged in the metacognition prompts because the conversation, even if it was asynchronous, appeared to them to be ongoing, always open to new ideas and contributions, and, most importantly, personally relevant to them and relatable because it was among a community of peers with shared experiences. The discussion forums received more hits than any of the other pages on the site. One participant stated that the email notifications she received when someone responded to one of her posts, “made me feel like someone else understood and could give me advice, and not just replying because it was for a grade, even if I never met them before.” Another participant, mentioned earlier, stated that these notifications that someone responded to them drew their attention back to the conversation: “... sometimes I was the first one to say something, and sometimes I just didn’t have the time, but I read what they said later when I got the email that someone else posted.” The timestamps of users’ posts on the activity log showed that six participants returned to discussions later the same day; three participants commented on the same topic 3 weeks after they had initially posted.

Feedback that is instant, from one’s peers, and that is relatable and suggests a shared experience (as student, as professional, as a family member, or all of the above) tends to be a key engagement factor for adult learners. Plenty of literature on online learning supports this point—feedback, especially when it is sooner rather than later—and supports reflective practice and learning (Mason, 2006; Van den Boom, Paas, & van Merriënboer, 2007). While not discussed specifically as “instant feedback,” these findings also align with the adult learning assumption that suggests adults have a readiness to learn: Adults are ready to learn what is most relevant to them at a given time. It also makes sense due to their motivation to learn. Instant feedback, whether automated or from a peer, provides just-in-time information that the adult learner can analyze, internalize, and act upon as they see fit while they are already engaged in a process of reflection and metacognitive practice.

Opportunities for Gaming the System

The questionnaires in ReflectCoach confirmed the initial findings about adult learners’ metacognitive awareness and ability. The participants received the highest scores on the ReflectCoach questionnaires about “monitoring and tracking.” From the interviews, most participants felt that they were good at determining when to change direction or at assessing the results of a strategy. Participants received the lowest scores on the ReflectCoach activities about “managing information and seeking resources.” During the interviews, three participants made reference to the need for more information about seeking resources, knowing when to ask for help, and knowing what type of help to look for, so ReflectCoach was modified in Iteration 2 so that learners could read more tips on how to seek resources and managing information.

However, and notably, the activity log for these questionnaires showed that one third of all treatment group participants had a pattern of completing the questionnaires, receiving their score, and then retaking the questionnaire. This was likely an attempt to get a higher score or to see what combination of responses would make them a “Rookie” or an “All-Star.” In a traditional online course, this would be considered “gaming the system,” which adult learners have been wont to do with intelligent tutoring systems (Fancsali, 2013; Walkington, 2013). However, since this was an ungraded and reflective exercise, the learners were probably genuinely reconsidering the metacognitive awareness and seeking a way to improve or picturing themselves as improving. Upon questioning one of the participants who repeatedly completed a questionnaire, she said, “I just wanted to see what it took to be an All-Star.” Another participant said, “I took it over again because I was pretty sure I was good at it [evaluating]. I thought I clicked the wrong button or something and that the score was wrong. But then I realized that I could be better at knowing when it’s time to change my strategy. I think that was one of the questions.” The role of instant feedback (as well as repeated attempts) plays an important role here, since if the learner had to wait until an instructor scored the questionnaire and only had one attempt, he or she would not be able to “see what it takes” or “realizing I could be better” and consider ways to improve.

Narrative Identity and Implications for Metacognitive Support

The scoreboards and discussion forums, both of which were informed by adult learning principles and social and persuasive design, were most frequently visited by the participants and were often referenced in participant interviews. The participants also requested more customized reminders, comprehensive questionnaires on each topic (rather than multiple short questionnaires), and additional opportunities for learning strategies for improving their metacognition. These features of ReflectCoach demonstrate the aspects of adult learning, social learning, and persuasive design that support metacognition.

The adult learners also valued features and allowances that were not closely considered when designing ReflectCoach, but which appear to have contributed to their metacognitive development. The membership levels of the system allowed for anonymity and lurking, the automated forms allowed for instant feedback, and the opportunity for repeat attempts on the questionnaire allowed for users to “game the system.” Comparing these features and elements to what research has determined about adult learning and about metacognitive development, it is clear that adult learners are likely to improve their metacognition if the technology supports integration of the concept (in this case, metacognition) into the adult learner’s narrative identity.

Together, these findings show that the persuasive and social elements of ReflectCoach played an important role in guiding adult learners to adopt metacognition and metacognitive awareness as part of their personal learning “story,” or as it is called in psychology, their “narrative identity” (Clark & Rossiter, 2008; Singer, 2004). Narrative identity is important in learning and particularly in metacognitive development for adult learners because adult learners often have years of professional and personal experiences across domains that most traditional-aged undergraduate students do not have (Clark & Rossiter, 2008; Singer, 2004). These experiences and responsibilities can play a significant role in their learning processes while in college or other formal (or informal) learning environments. In addition, research on returning adult learners at the college level suggests that this population of students learns best through critical reflection on their prior learning and experience at work, home, or in their personal life within an academic context (Brookfield, 1990; Knowles, 2005). ReflectCoach helped adult learners bring their existing knowledge and experiences—their narratives—into a learning context to deconstruct and develop awareness of what they already know and determine how they might advance their understanding (Knowles, 2005). Since metacognition is both personal and introspective, it makes sense that it is approached—from a learning standpoint—as a component of one’s narrative identity.

The ReflectCoach questionnaires, scoreboard, and peer forums provided multiple opportunities for peer comparison, coaching, and friendly competition, as well as self-reflection and goal-setting to reach established levels of metacognitive achievement (Rookie, Pro, All-Star), even if these levels were arbitrary. Adult learners who are developing their metacognition with ReflectCoach appear to leverage the technology to integrate the learning (in this case, metacognition) into their narrative sense of identity. The learner who said that she would go back to retake the questionnaires to try to figure out what combination of answers would put her at the “All-Star” level on the scoreboard is a perfect example. She was attempting to figure out how to write this “Metacognition All-Star” identity into her narrative and used ReflectCoach to do just that. The learners who were comparing themselves to others, lurking, and collaborating to discover a better way were also leveraging the technology to integrate metacognition into their narrative identity. However, in these cases, the role of other people in the development of narrative identity through learning experiences is also clear. Without the opportunity for social exchange and a sense of purpose beyond their own experience, or without any semblance of an audience, the ties to narrative identity may not have been as strong, and the learning experience may have become disconnected or seemed futile. Indeed, our constructions of identity and meaning-making in the world are located and validated in social spaces (Lave & Wenger, 1991).

Opportunities like those in ReflectCoach helped learners to get into the habit of thinking of metacognition as part of their identity, part of how they learn, and part of their lifelong learning story, which is undoubtedly tied to a larger narrative identity of the social spaces they occupy. Moving forward, it is critical that we continue research into the role of individual, community, and even cultural narratives in

e-learning landscapes and the designs that support exploration, integration, and transformation of narrative identity through learning experiences.

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Using the Design Thinking Cycle to Tell the Story of Innovative Learning Spaces

Heather Tillberg-Webb and Ned Collier

Abstract The creation of innovative learning spaces, such as makerspaces, learning commons, and incubators, is a large-scale instructional design problem, which relies on design thinking and effective storytelling to facilitate project success from the start to finish. This qualitative research study analyzes four cases of innovative learning space design in four very different higher education contexts. We identify commonalities in the space design and in how the space connects to each institution from mission to outcomes. The design thinking cycle can assist in leveraging support for space that will transform the learning experience by unearthing the stories of transformation that serve as the powerful mechanism to move these projects forward.

Keywords Design thinking • Storytelling • Space design • Makerspace • Learning common

Introduction

Higher education institutions recognize a need to create opportunities for collaboration, innovation, active learning, creative exploration, and interdisciplinary inquiry. At the same time, the culture of higher education institutions inherently contains structural barriers to providing space for these opportunities. Innovative learning spaces present an opportunity to structure new connections that exist at the center of every institution's two greatest assets—human capital and physical space. Such initiatives require strategic planning and a comprehensive planning process, engaging resources from campus planning, integrating information and instructional technology, and recognizing faculty sponsors/champions, among other key stakeholders. This research study presents four case studies of innovative learning space design that illustrate commonalities of projects that are situated at this intersection of

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collaboration, innovative pedagogy, technology integration, and interdisciplinarity. Through the outcomes and initiatives illustrated by these cases, each tells a story of innovative and active learning at these four institutions.

Design Thinking Cycle for Planning

Design is the action of bringing something new and desired into existence—a proactive stance that resolves or dissolves problematic situations by design. It is a compound of routine, adaptive and design expertise brought to bear on complex dynamic situations. (Nelson & Stolterman, 2012)

Design thinking is an iterative methodology used to solve complex problems by finding desirable solutions. As described by Tim Brown, CEO of IDEO, a design mind-set is not problem-focused; it is solution-focused and action-oriented toward creating a *preferred future* (Naiman, 2016). The design thinking process consists of five phases:

1. Empathize—listening, research, and observation
2. Define—needs, wishes, and goals
3. Ideate—experiment, build on the ideas of others, and storyboard
4. Prototype—build, model, and critique
5. Test—share proposals in the public domain (Dam & Siang, 2016; Plattner, 2010; Waloszek, 2012)

Figure 1 represents the design thinking model with the additional component of implementation added, along with evaluation prior to reentering the model to begin the process again. Those in the instructional design field may see the five stages of design thinking as analogous to the ADDIE model or similar ISD models and the additional implementation and evaluation component as similar to rapid prototyping. There are some fundamental differences, however, between traditional ISD models and the design thinking process. At the outset, while “empathize” may have some similarities with learner analysis and task analysis, there is an affective component that implies an in-depth immersion in the culture in which a design will be created. In addition, there is a requirement of public display of the model as part of testing. Lastly, the richness of the required output of the design thinking cycle is on a different level than for instructional designers working through the ISD model.

Thus, the design thinking cycle identifies the plot, characters, and narrative point of view, through the mechanism of storyboarding. This is conducted through sequential imaging leading to animations, which incorporates the learner’s visual and spatial experiences. The storyboards are the *prototype*, *build*, and *analyze* portions of the design thinking process (Brown, 2009) and are analogous to the *develop* portion of the ADDIE model. Design thinking incorporates storytelling by “structuring a sequence of events that build upon one another, in sequential order, across time” (Brown, 2009, p. 132). Using this methodology, designers rely on storytelling to help put ideas into context.

Storyboards (See Fig. 2), improvisation, and scenarios are among the many narrative techniques that help us “visualize an idea as it unfolds over time”

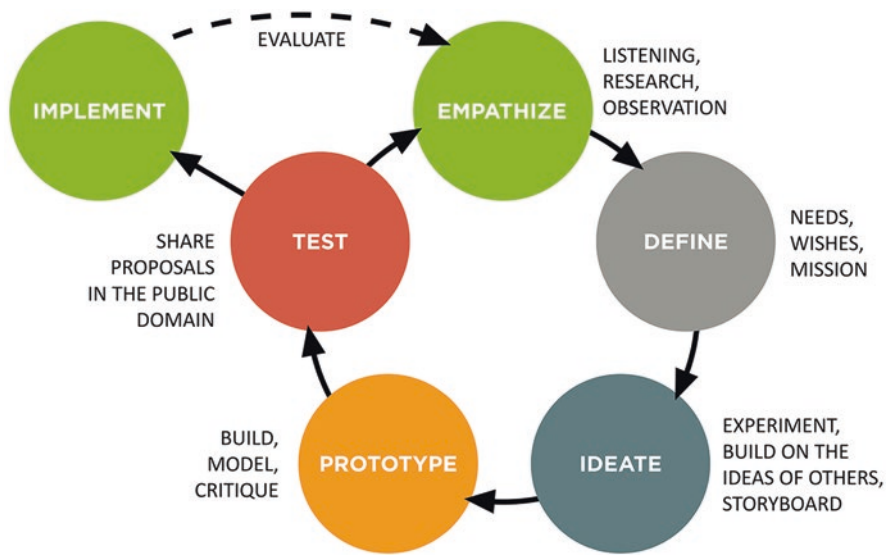


Fig. 1 Design thinking cycle

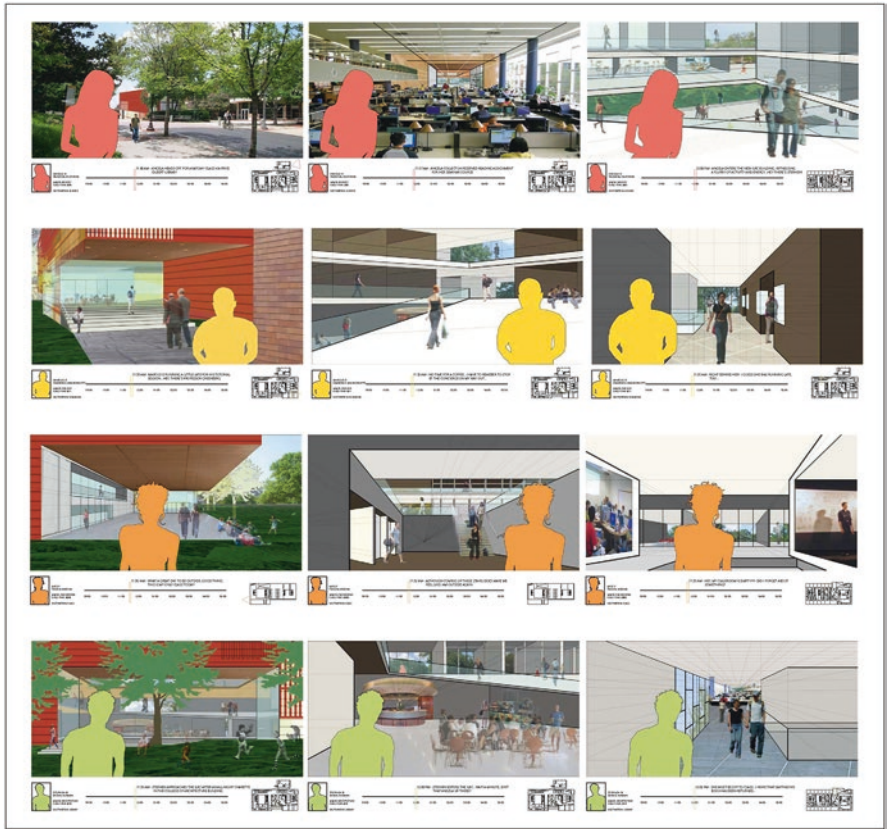


Fig. 2 Storyboard for a learning resource center

(Brown, 2009, p. 132). When architects utilize this technique, they create images of the space with a series of fictional users interacting with the space. Because of the contextualization of the user in the rendering, the architectural rendering gets used in a much different way than a traditional rendering.

The storyboard, which defines the activity and experience of the space, functions in a similar manner to an instructional technologist telling the story of technology pilot, rollout, and implementation through “use cases” (Ambler, 2014). This is a concept which has been derived from software engineering practices. The more flexible the environment, the more critical it is to work through use cases, specifically ways that end users will potentially use the proposed space in order for designers to understand the use requirements, and doing so visually adds additional context to the task. As a tool in the conceptualization and success of innovative learning spaces, storytelling is an important component of creating spaces that users will interact with in collaborative ways and in communicating the value of the interactions that occur in these spaces to continually demonstrate their value to the institutional mission.

Innovative Learning Spaces

In this analysis, we explore both formal and informal “innovative learning spaces” within a variety of higher education institutions—private and public of varying sizes. These spaces are designed to promote active and collaborative learning and may contain formal learning experiences but may also be maximized to create opportunities for informal learning opportunities. By creating learning spaces “that promote growth-producing experiences for learners,” higher education institutions can enhance opportunities for experiential learning (Kolb & Kolb, 2005, p. 205).

In terms of more traditional formal learning settings, such as classrooms, research documents that active learning spaces with supportive technology can facilitate better learning outcomes than traditional learning spaces. For example, in 2005, a study of the Technology-Enabled Active Learning (TEAL) project at MIT, with an *n* of 811 students with small- and large-scale experimental groups, as well as a control group, examined student learning outcomes in an active learning space. TEAL students “improved their conceptual understanding of the subject matter to a significantly higher extent than their control group peers” (Dori & Belcher, 2005, p. 243). In 2011, a similar study at the University of Minnesota concluded that “holding all factors excepting the learning spaces constant, students taking the course in a technologically-enhanced environment conducive to active learning techniques outperformed their peers who were taking the same course in a more traditional classroom setting” (Brooks, 2011, p. 719). For formal spaces, while the data can tell a compelling story, descriptive cases highlighting the teaching and learning within the space, provide a powerful tool to persuade other instructors to teach there.

In contrast to classroom redesign, which is focused on formal instruction, the development of informal innovative learning spaces can include learning commons

(Schmidt and Kaufman, 2005), makerspaces (Dougherty, 2013; Sheridan et al., 2014), and university-based incubation spaces. While many instances of open-ended, design-build spaces in higher education are focused on extending the engineering curriculum (Forest et al., 2014), there are a growing number of examples of informal innovative learning spaces containing an open-ended, design-build concept; however, they are tied to the institution's curriculum in ways authentic for the institutional mission and curriculum.

In a sense, many innovative learning spaces are not just “constructivist” but “constructionist” as well. Wilson (1996) defines “constructivist” as a space “where learners may work together and support each other as they use a variety of tools and information resources in their guided pursuit of learning goals and problem-solving activities” (p. 5). This is a fairly broad definition that helpfully describes the burgeoning movement in defining flexible learning spaces—from active learning spaces to learning or information commons to innovation hubs and makerspace concepts. However, Papert and Harel (1991) take this definition a bit further with a conceptualization of constructionism, where learners produce constructions that others can see and critique, as one would in a makerspace or informal learning space context.

Research Questions

In this study, case studies of innovative learning space projects addressed the following research questions:

- What commonalities do innovative learning space projects have across a range of institutional contexts?
- What is the role of technology within these spaces and what are the challenges in designing technologically rich spaces to support pedagogy?
- What stories about learning outcomes are shared about successful learning space design projects?
- How are the stories of these transformational learning spaces being told?

Methods

To inform the research in this study, data was gathered from each of the innovative learning spaces identified as a case including observations, site visits, architectural renderings of the spaces, and semi-structured interviews with at least one key stakeholder at each of the institutions analyzed in the cross-case analysis. The research method for this inquiry was qualitative case studies, derived from this data from learning space design projects at four different higher education institutions. The institutions implemented very different approaches to creating spaces that provide an opportunity to rethink learning and collaboration in higher education. The cases were selected with maximum variation sampling (Creswell, 2012) to analyze a

broad range of innovative spaces. As with all qualitative research, there are limitations to the generalizability of the data, but the specific details of the cases should resonate and contain data that is transferable to a variety of contexts. (Lincoln & Guba, 1985).

Innovative Learning Space Cases

Each of the cases in the analysis represents different facets of innovative learning space design.

The SCALE-UP (Student-Centered Active Learning Environment with Upside-Down Pedagogies) classroom at a large private, non-profit metropolitan university describes the use of the formal classroom to innovate a science classroom. The second example—the incubator—describes a series of innovation spaces across a large public university, which serves the development of new projects across business innovation and also aligns with the larger development plans for the local city. The third is a makerspace for K-12 teachers and teacher candidates, K-12 students, and higher education faculty at a medium-sized private, non-profit urban university. The last example at a small private, non-profit college describes learning commons designed to provide new opportunities for collaboration across administrative and teaching functions. While most of the spaces in the study were created through engagement with an architect, the makerspace was not.

The description of the cases reveals the common threads to these spaces, despite the variability in both the types of spaces and their institutional context. The case analyses are presented in order of more mature projects to projects at the earlier stages or still being planned.

Case 1: SCALE-UP Classroom

The SCALE-UP classroom at a large metropolitan university is a 2100-square-foot renovated space with nine round tables with nine seats and three laptops at each table, allowing for three groups of three students per table. The SCALE-UP (Student Centered Active Learning Environment with Upside-Down Pedagogies) classroom concept is similar to the TEAL classroom and explicitly adopts a pedagogical stance of student-centered instruction, active learning, and a high level of interactivity between students and instructors (Foote, Knaub, Henderson, Dancy, & Beichner, 2016).

Each table has a seven-foot diameter, providing space for hands-on experiments. Additionally, the room has two small tables for either teaching assistants or learning assistants, which could also be used for breakout work. One of the key features of the room is its technological capability, including five independently controlled Smart Boards. For ease of viewing, there is also a demonstration table with a camera. Whiteboards and frosted glass surround the room for collaborative board work.

There is sufficient space for all 27 groups, consisting of three students each, to solve problems at the boards.

The SCALE-UP classroom requires highly structured collaboration among students as students are grouped in teams of three at tables of nine, and collaborative activities are supported by the instructor and graduate assistants. Compared to a traditional lecture, the in-class activities are much more hands-on, lab-like, and real-time.

How SCALE-UP Tells Its Story

The SCALE-UP classroom was initiated by a faculty member with the specific goal of increasing retention in traditional weed-out courses in physics and has measurably done that. In terms of teaching, by the end of their second year, eight different physics faculty and five other non-physics faculty have taught in the space. Part of the story the SCALE-UP tells is that it measures success first by the improvement of learning outcomes but second from its ability to spread to other subject areas to help students improve their learning outcomes there as well. The success of the SCALE-UP classroom is derived from the intentional involvement outside the original discipline interested in modifying pedagogy.

The SCALE-UP classroom has been deemed a success, based on the number of teachers who have adopted the methodology, the number of disciplines adopting it, and quantitative outcome of improved retention in courses that are intentionally difficult to discourage students from progressing in a major (Rao, 2014).

Case 2: The Incubator

The 20,000-square-foot incubator at a large public institution focuses on creating varied and technologically rich environments for collaboration and providing labs for biomedical startups. The space is organized to create a series of zones or “neighborhoods” with appropriate furnishings and acoustics (noisy, quiet, semipublic, and semiprivate). The “noisy neighborhoods” are near the entrances, food, and bathrooms. There is a mix of movable tables and chairs that can be arraigned to create large function rooms. A large conference room has folding glass walls and, when open, creates a reception and presentation space. The “quiet neighborhoods” are located on the opposite sides of the floor plan (with minimal pass-through circulation). The project includes an acoustically and environmentally separated makerspace and biomedical research labs.

The incubator, as well, was designed to maximize technology in service of the institutional mission. It is a wireless environment with flat screens, with the expectation that users would provide their own technology devices. The biggest investment in technology is the makerspace at the center of the incubator, which provides fabrication equipment such as 3-D digital printers for the small businesses prototyping their designs.

How the Incubator Tells Its Story

The incubator is primarily evaluated on a business model: Will the administration achieve their numerical goals in terms of participants? Will the incubator be financially viable? And, importantly, will they sponsor successful start-up companies? Ultimately, success of the space will be measured by the amount of revenue generated through the number of successful startups.

The incubator has a clear mission and aligns to the business curriculum loosely and in practical ways. It is characterized as an “entrepreneurial ecosystem.” At the undergraduate level, students can participate in a Difference Maker program that recognizes student creativity in solving business problems. A more conventional engineering MakerSpace provides opportunities for students to fabricate prototypes of their own inventions. Beyond the classroom, groups can apply to participate in the incubation space itself. One of the prominent stories that the entrepreneurial ecosystem highlights is the impact on learning outcomes across the informal learning spaces as students move through their studies and beyond. For example, a group of undergraduate students in materials science invented a prosthetic hand that can be manufactured at a fraction of the cost of current prosthetics, a potential game changer in countries where many cannot afford the current options. The undergraduate students moved from developing their product while students to piloting a small business for the prosthetic in the incubator after their studies.

Physical location is a part of how the incubator tells its story. It is strategically located as a part of an urban economic development district on a gateway site. It is adjacent to downtown, within walking distance of all parts of the campus, and visible from the highway. An analogous space for the incubator, and part of the vision for innovation at the campus, is the The Difference Maker Central space that targets undergraduate business students’ innovative projects is prominently located for student visibility on a part of campus that serves undergraduate students and is directly adjacent to a Starbucks, with the engineering MakerSpace in walking distance as well.

The incubator support staff is interested in providing space to bring creativity together, though always in the service of business incubation and telling that story through the visible collaborative spaces infused throughout the location itself. The message of building collaboratively is reinforced by the very visible makerspace area within a windowed portion of the space which includes 3-D printers and fabrication equipment.

Case 3: Makerspace

The makerspace at a medium-size private non-profit institution is a modest 250-square-foot, former administrative office suite, located in a graduate school of education at a private nonprofit urban university. It is also prominently located on a

main hallway and on route to the dean's office and directly across from a prominent meeting room where the university president's cabinet meets regularly. The furniture in the space is highly configurable, allowing accessibility for both group work and reorganization of furniture to create an open floor space. For large groups, overflow is in the hallway. There is a digital 3-D printer, electronic equipment, and a wall painted as a green screen. There are three full-time employees committed to the success of the makerspace, which provides facilities and programming to three distinct audiences—graduate faculty and students in the university, teachers seeking professional development, and K-12 students and teachers working on specific programmatic topics.

The makerspace targets a strategic focus in the curriculum at its institution, with a goal of “infecting” the graduate school with a “maker mindset” (Dougherty, 2013), with workshops and programming that allow opportunities for teachers and K-12 students to experiment firsthand with robotics, 3-D printing, scratch programming, and fabrication opportunities and to demonstrate how elementary school children can be creators. There are other spaces that serve other curricular and innovative needs, but the makerspace uniquely serves education and specifically focuses on the impact of maker activities to transform K-12 pedagogy.

For the makerspace, a minimal initial technology investment was part of the philosophy of the space design. The key concern when launching was procuring tables that could be grouped together or moved aside, along with the availability of digital “making” materials such as robotics kits and “makey makey” kits (Shaw, 2012). The director advises other start-up K-12-focused makerspaces to start small on the technology investment and focus on pain points that arise within the space and meeting audience demands before significant investment. As the makerspace considers its next phase of technology purchases, it will be targeting fabrication equipment such as sewing machines and hand tools that will allow expansion into the work of a prominent institutional alumna who creates assistive technology devices out of cardboard -- work that is cutting edge and central to the institutional mission.

How the Makerspace Tells Its Story

The makerspace tells its story in terms of the number of students served, revenue generated, conferences attended, website hits, and geographic distribution of those hits. Connection with internal stakeholders and external stakeholders in the community is also a measure of the impact of the space. The physical location of the site is a part of how it tells its story, as the prominent location ensures the attention of senior leadership as they pass by the space for regular meetings. The director has noted that even though they could easily utilize more space, she would not give up the prominent location in favor of a larger, but less visible space.

Case 4: Learning Commons

The 57,000-square-foot learning commons at a small private, non-profit institution is a reimagining of a four-level 1971 Brutalist-style¹ academic library. Most notable in the redesign is the second floor learning commons, which is a collaborative work, study, and presentation space. A unique feature is a highly reconfigurable room known as The Forum, a designated high-technology environment with operable glass partitions to enclose the space or open it up to an adjacent lounge and multimedia workstations. Additional floors of the building house key services such as the Academic Success Center and the Center for Teaching and Learning.

For the learning commons, some of the technology needs are still emergent, but there has been a targeted focus on a robust wireless environment. By integrating library research and access services with technology, a learning commons is a shift from a physical repository of information to providing a culture of information literacy and learning to use information appropriately. It is spatially and technologically highly flexible and adaptable and provides multimodal, high-impact active and social learning spaces where students are creating as well as using information while supporting changing pedagogies and technological mobility. Group study rooms will be technologically enabled, but not all will be initially outfitted. Writing surfaces are pervasive, including writable wall coverings, writable glass partitions, and mobile as well as fixed white boards to allow learners to be interactive in the space.

Finally, at the learning commons, collaboration is expected to be more organic. The learning commons program areas will support collaborative assignments and host academic forums with extended hours, professional research and technological support, and tutoring (Fig. 3).

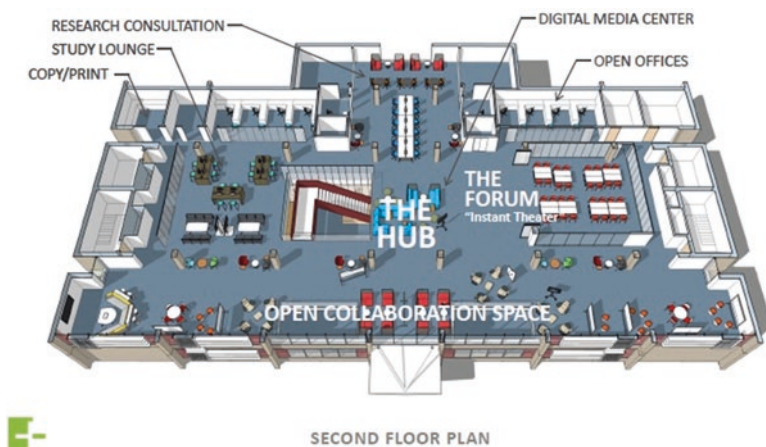


Fig. 3 Learning commons plans

¹Brutalism emerged as an architectural movement in the 1950s and flourished until the mid-1970s. Examples are characteristically fortress-like, with a predominance of exposed concrete construction.

How the Learning Commons Plans to Tell Its Story

The learning commons is still constructing their plan for evaluating success. The spaces are designed to be flexible, with programmatic assignments open-ended. The librarian notes that the college has a narrow curriculum driven by their *humanics* philosophy (mind, body, and spirit), and all the stakeholders are focused on that curriculum, with the space being designed to support workflows and improve the experience for students and faculty needing or designing academic support service, as described by the project lead. The story for the learning commons is the development of new models for collaboration in the institution in support of a robust student experience.

Notably, the learning commons is a top-down presidential initiative. The college is willing to take an “if you build it, they will come” approach, with the perspective that until it is built, there are not models of innovative pedagogy within the space to show faculty and students. Even so, there will be a need to go back to the campus stakeholders for validation and to begin building enthusiasm for unprecedented change to their traditional library. It will be interesting to see the success of the project and whether it can identify champions that align the innovative learning space back to the curriculum.

Conclusion

While these cases represent a range of scale and connections to formal instruction, there are several themes that emerged from analyzing the narratives shared by each of the key stakeholders responsible for the spaces. The following themes emerged from analysis across these cases to create a series of criteria that define innovative learning spaces within higher education for these four institutions:

- Focused on improving learning outcomes
- Characterized by collaboration
- Guided by technology in the service of pedagogy
- Created using the design thinking cycle
- Evaluated by the design thinking cycle

In addition, there are characteristics of the spaces within the larger frame of the higher education institutions. These include:

- Engaged in both top-down and bottom-up buy-in
- Positioned as a hub of managed spontaneity
- Viewed as opportunity for cross-disciplinarity
- Visible as an institutional asset

Innovative learning spaces have gained popularity as institutions recognize a variety of interconnected issues—the need for opportunities for learners to have hands-on experiences with content, the creative idea generation that occurs within interdisciplinary discussions, and the need for collaboration among professional

staff and instructors against the shifting landscape of teaching with technology. As this research demonstrates, even among varied models for inspiring innovation, these spaces have commonalities that stem from their similar purpose in advancing technology infusion into a creative process. This shared purpose can be enhanced through the intentional use of the design thinking process to communicate the stories of success in these spaces. Some of the mechanisms for sharing stories include the physical messages inherent in the space itself, including affordances that clearly support collaboration. Innovative learning spaces need both data and powerful storytelling to initiate support for their impact toward the institutional mission and toward generating powerful learning outcomes. The success of these spaces is dependent on telling stories to communicate their value from inception through continued growth of services.

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Show and Tell: The Steps to Keeping the End in Mind

Cynthia S. Cash

Abstract How do you design an interactive online career exploration program keeping the end in mind? One step at a time. First step, begin with a clear vision of the desired direction. The next step is to provide a clear destination the student wants to achieve at the end. For the student to reach a personal destination includes constructing knowledge out of their own experiences within the online career exploration program. The program will demonstrate not only how showing and telling students the steps to take in career exploration confirms the end result but also the challenges career advisors and teachers have in connecting students early in a college degree program. Instructional designers will learn how they can assist in the development of showing and telling stories by identifying applications to create an active online program. Online requires more than just telling of the material in text but showing and exploring to promote active engagement, responsibility, and independence. Research has shown that using an online self-guided discovery model utilizing a digital storytelling framework provides students with a tailored learning experience anytime and anywhere. According to Frank van Gils, “Six out of the eight students (two secondary school students and six college students) that were interviewed reacted enthusiastically about the idea of using digital storytelling in education.” Students’ attention is increased when information is shared with excitement or enthusiasm regardless of the modality of instruction. In the end, storytelling offers a powerful constructivist approach to educating the student.

Keywords Storyboard • Interactive design • Backward design • Self-guided discovery model • Career exploration

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Introduction

Do you remember taking those first steps into preschool or kindergarten? Most adults do not remember their first steps, but many remember their first job, including the many milestones taken after high school or college toward a career. Reaching a career after postsecondary is part of each step taken toward keeping the end in mind, a successful life. Students who might need some more assistance in figuring out a career direction were invited to use an online career exploration program for supplemental resources to connect the student with a major/career further. “Research on student motivation has shown that students who possess clear goals about the future and concrete plans for how they will achieve those goals are more likely to be successful in school” (Mikelson, 1990). Digital storytelling provided an alternative method of “show and tell” to assist students in identifying goals about their future by creating a new ending to an educational story by hearing, seeing, and doing online. Several steps are taken along the way while attending college; technology has changed the narrative of events and characters into an online digital story. The digital story template has become easier to develop with e-authoring software. The e-authoring software provides a constructivist learning model which engages students in the meaning and knowledge behind the story. “As we listen to a story we apply templates to construct a personal model of the unfolding events and characters. They arrive at our ears as words and we each make them into flesh in our way as we grasp at the unfolding narrative” (Lansky, 2001, p.130). The use of an online narrative story provided the foundation to start designing the six steps toward to keep the end in mind after college: a career.

An investment in education is the knowledge that no one can take away from a person. The investment in higher education may be the most important purchase an individual makes in life. But as with any significant investment, students should make informed choices and consider the costs and benefits of the numerous available options in higher education. According to the Indiana Commission for Higher Education, the average debt upon graduation for a Midwestern University student is \$25,692, which has increased to an estimated \$35,000 in 2016. On average, college graduates earn an extra \$20,000 per year and more than \$1 million over their careers compared to noncollege graduates. Though all degrees matter, some have a greater return on investment (ROI) regarding career options and earning potential. “The highest-value degrees and credentials are those aligned with the needs of the workforce” (ICHE Report, 2013). While the focus has been on ROI, we know according to the Indiana Commission for Higher Education that a college degree brings more job options and a wider range of career opportunities. As students pursue a higher standard of living through a college degree, students should minimize the amount of debt they incur and know their expected monthly payment and how long it will take to pay the debt off. “As a general rule, college students should not borrow more than their anticipated annual starting salary after graduation” (ICHE Report, 2013). How can a university tell their story to ensure the financial investment students make

early on in their college experience meets the students' expectations at the end of college?

Background

"Throughout history, stories have passed from generation to generation as a means of preserving a group's culture, heritage, history, and tradition. Stories teach a lesson as well as entertain. Stories are at the very heart of who we are as human beings" (Lawson, 2016, p.128). Every person has a story to tell, even at a young age, children have fond memories of "show and tell" of days in school. Remember the day when a selected student had an opportunity to take items to "show and tell" at their school? "Come, then, let us make a fable of it, story-telling at our leisure, and so infancy educates our men. What sort of ideas about divine beings should convey to the young through tales and poetry? Then what is the education to be? Or is it difficult to find a better than that which the ages have discovered?" (Plato, 1908, p. 376a).

Before 2011, the career center at a Midwestern University told their story regarding career exploration with incoming first-year students in a face-to-face environment with limited instructions on how to complete a workbook about self-discovery of goals and motivations which were followed up with an online questionnaire survey regarding the book content. During orientation, all first-year students take an assessment called My Vocational Situation, which looks at how bright and confident the student is in their chosen major and career choice. The goal for all first-year students in completing an assessment during orientation is to help them make more informed decisions earlier to reduce the risk of multiple significant changes, all of which can increase the cost of their degree. Students often list the ability to get a better job as an important reason for attending college, which was the primary objective of the career exploration program. "Of course, a willingness to listen to students implies adults want to hear what students think, they respect them enough to listen and learn, and they will be open to suggestions they might make" (Noguera, 2007, p.206). Based on feedback from the students, in 2013 the career center embarked on a redesign of curriculum incorporating recorded videos from the career center faculty along with interactive elements in the learning management system, Blackboard, an online learning management system with the ability to provide engaging tools. "The advantage is that students mostly see a new and more personalized way of practice and training, but the students made it clear that, most importantly, the applications should be realistic in such a way that it is helpful to use and not only a gimmick. The applications also should be easy to use," according to van Gils (2005). A team of instructional designers evaluated several e-authoring software vendors. The focus of their assessment was to ensure the software tool added value to the curriculum for the students to gain practical knowledge to help make sure students were on the right path for their future.

Process of Telling the Story

The initial process of telling the story of career exploration included a face-to-face overview of the worksheet plus basic instructions on completing the workbook. The students did not know how to finish the book or the steps necessary to identify a satisfactory result in college. The issue became how instructional design with multimedia can enhance or highlight relevant information for career exploration with the student without guided instruction to complete a textual guide. When looking at the materials for the course, what elements could tell the story and engage the student in listening to get the student on the right path? “Attention, memory, and higher thought processes are all areas of cognition that we can target by bringing cognitive theory together with technology” (Miller, 2014). Self-guidance in an online environment takes purposeful planning of keeping the end in mind or a backward design of instruction. The idea of incorporating the worksheet with videos online to tell the story within a learning management system was the starting point of the curriculum design. The design of making information available online with videos would encourage students to seek further truths about opportunities in college. Again, the feedback from the students completing the program in 2013 prompted interest in making the program more interactive instead of feeling like another online survey or quiz assignment course. Instructional designers are challenged with balancing interactive elements within textual content but hopefully not at the risk of guiding the educational experience into taking steps in a direction that leads the student off the personalized path of career exploration. As Wiggins et al. (1998) refers to the saying “If you don’t know exactly where you are headed, then any road will get you there” (Wiggins et al., 1998, p. 14). Accordingly, educators know where they are headed in sharing what they like to teach and what activities add to the content yet without a good design approach the student will seek to find the purpose in the journey. Backward design in developing content focuses on the purpose of the journey incorporating different steps to make sure the student reaches a destination.

Each step in design required keeping the end in mind by identifying what the objective of each online unit of the program was to accomplish the student’s goals. The steps would incorporate a multimedia theory as Miller (2014) references:

Multimedia theory provides a robust, empirically supported framework for getting the most out of mixed media, mainly text, narration, and graphics. In general, pictures enhance learning when added to text or audio description, but the devil is in the details: graphics can’t just be decorative and have to be combined cautiously with text because having to switch between two visual inputs at a time disrupts attention and overloads memory. A particularly useful alternative to text plus graphics is audio narration plus graphics.

The redevelopment of the six units into an interactive, self-paced career exploration program required using an e-authoring software product called *Storyline* developed by Articulate® (Schwartz, 2002). The idea behind the design was to immerse the student with an engaging learning experience by telling a story using visual, audio, simulated assignments, or assessments according to the feedback provided

Fig. 1 Animated introduction screen



Fig. 2 Interactive activity



by the students. The first step, deciding on your career path, included information on how to identify the decision students need to make (Fig. 1).

The unit (Step 1) provided interaction, personalized information, plus guidance in the navigation of the course with a tutorial and help button for technology assistance. Also, included in the first step was a video introduction to the overall purpose or the story behind the reason students need to identify the decisions that need making in a degree major. The unit (Step 1) included an interactive element (Fig. 2) that the students' choice triggered a self-guided curriculum focused on the needs of the student to explore options further in majors based on interest, values, and personality. The second step, where to start high, was a unit (Step 2) that allowed the student to gather information by taking a personal assessment to identify interests and

Fig. 3 Sample of reflective activity

Step 3 Consider Your Options

Resources

List what you like or dislike about your career choices.

1st 2nd 3rd

What do I like?

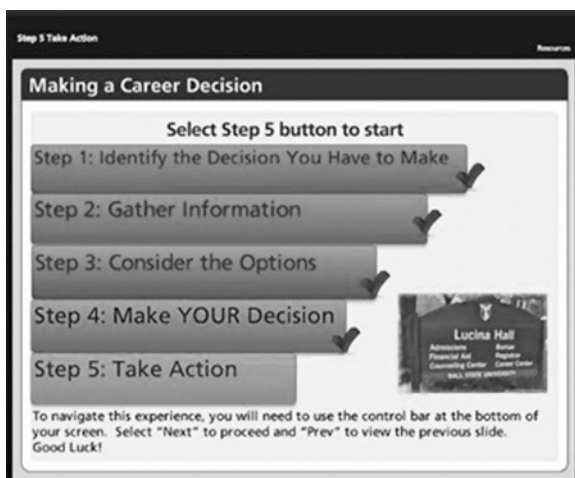
type your text here type your text here type your text here

What do I dislike?

type your text here type your text here type your text here

PREV SUMMIT

Fig. 4 Image of fifth step in student view

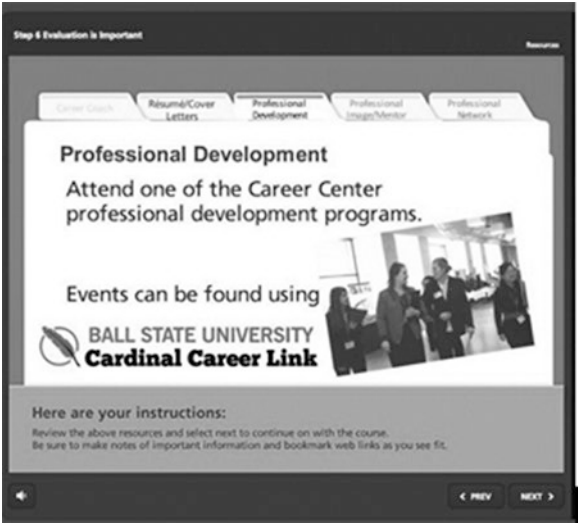


personality types. Step 3, consider your options, included interactive elements (Fig. 3) where students entered their findings. Step 4, make a decision, included video along with interactive reflection activity. Step 5, take action (Fig. 4), showed what measures the completion toward reaching a decision about their career and major. Step 6, evaluation is necessary (Fig. 5), included resources available with an embedded video as if you were walking into the career center. Various resources (Fig. 6) are included with interactive elements, self-knowledge checks, plus videos from the employees telling the story regarding the purpose as related to the objective of the unit. The ability to allow students an opportunity online in a self-guided, constructive approach exploring career choices without penalties or pressure for

Fig. 5 Greeting video embedded



Fig. 6 Resources available with audio



completion provided an alternative method of deciding on a major for their career. While the online six-step program gave students several self-knowledge, reflective assessments, a final evaluation paper is submitted to the career advisor to help monitor the progression of the students. Students were encouraged to complete the program to confirm and validate their chosen path to a successful career.

The Story Continues

“Traditional college graduation rates typically include only first-time, full-time students who finish at the same college they started at, and with the same degree type, they initially sought. Though an on-time degree will always be the most cost-effective path to college completion, the Total Campus Completion Rate includes both students who graduate on-time as well as those who take longer to earn their degrees. The Total Student Completion Rate provides an even fuller picture of college completion by capturing all students who cross the finish line, regardless of where they complete or what degree they ultimately earn. The part-time as well as full-time students, transfer students, and students who change to another degree type. Every graduate brings Indiana closer to reaching its 60 percent educational attainment goal” (ICHE Report, 2014, p.130). According to the Indiana Commission for Higher Education, the state-level completion rate was 68.6% in 2014 at the Midwestern University, and the completion rate was 3.1% higher than the state average due in part to the online program. The initial findings of the success from the redevelopment of the program showed a higher completion rate after the first year of implementation. According to Steinberg (1996) “Yet, clarity about future goals and the motivation to attain them rarely comes from a student by himself or herself, particularly when that student comes from a family where there is no history of attending a college.” Completion rate of the redeveloped interactive online career exploration program over the basic online survey/quiz response program in 2014 showed an 87% increase in clarity of degree program to career choice during freshmen year. “We found the student who had the clearest goals most likely to cite an adult – a teacher, a counselor, a parent, or a relative – as the source of guidance related to future aspirations” (Noguera, 2007). While Pedro Noguera references adults as a source of guidance, the digital story told within the units by adults provides perhaps a virtual connection with an adult.

The preliminary findings in the Centennial Commitment 2015 Annual Report (n.d.) showed overall the persistence rate of staying within the students’ chosen degree program increased to 77% as compared to 67% in the previous years. “Each higher education institution faces different challenges in its efforts to improve completion and student success. Indiana colleges have different missions, different admission standards, and diverse student populations with varying levels of academic preparation. When comparing completion rates, a campus measures its improvement over past performance. In future versions of the Completion Reports, the Commission will highlight innovative strategies on Indiana college campuses that are producing results in increasing degree completion and on-time graduation” (ICHE, 2014, p.128). Midwestern University found in the preliminary findings from student feedback high remarks about the interactive elements within the redesigned program. Midwestern University ranked in the top three, with a 71.7% student completion rate. While additional findings of the redeveloped program (old videos, updated resources) have prompted an alternative modality of telling the story of

career exploration, plans are currently in the development to utilize student resources within the University to create a digital web-based career exploration scenario.

Next Chapter

Taking steps to design instruction by storytelling requires a clear vision or as Stephen Covey (2004) would say, “keeping the end in mind.” The end as human beings’ stories is told from the heart and soul of who we are in the world. The heart and soul of each person’s educational experience have a unique story to share with others regarding their path to a successful career. While universities’ challenges include providing resources to accommodate the return on educational investment, how can the story be told to add value for the student to help reduce debt at the end of college? As each story becomes more digitized, Karen Lawson describes the reasons why storytelling should incorporate into learning: to engage students’ emotion; increase learners’ attention; aid in the retention of knowledge; make abstract ideas, principles, and concepts more concrete and relatable; plus inspire and motivate the student.

“Stories help us change behavior by engaging our emotions and illustrating what we should or should not do in the situation” (Lawson, 2016). Just adding interactive elements to show or tell content ultimately will only provide a means of entertainment in education. The purpose of digital storytelling is to provide an alternative method of engagement with the storyteller.

The goal of instructional designing digital storytelling content requires constant collaboration with the subject matter expert to ensure self-discovery knowledge aligns with the end in mind. As students hear successful stories from alumni and see the results from working hard to stay on the right path, then what they do with their education is the next step to a successful career. According to the Midwestern University 2015 annual report, a total of 2190 1-year alumni and 1332 5-year alumni responded to 2012, 2013, and 2014 alumni survey. While the results demonstrated are not correlated with the redesign of the career exploration program, data reflects 47% of the 5-year alumni respondents were very satisfied with their employment over the 42% 1-year alumni. The future steps are promising for the 2018 cohort students who have had the experience of utilizing an online career exploration program. As described in the Centennial Commitment (n.d.) made by the University (18’ by 18’), which extends 18 major goals for the University to accomplish by 2018 (the University’s 100th Anniversary), the goal is to increase the satisfaction of not only students’ employment but to maintain the 80% first- and second-year retention. Each step (year) includes stories, so begin with a clear vision of the desired direction. The next step is to provide a clear destination the student wants to achieve at the end that will take the student one step closer to a successful future filled with engaging digital stories. The initial project provided a starting point for future developments that includes mobile access for the next generation of students to keep the end in mind, a career after graduation.

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Empowered Guinea Pigs: Stories of Cross-Disciplinary Projects in an Experimental Educational Software Design Course

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Abstract This chapter tells the story of an educational software design course through reflections written by the instructor and student coauthors throughout the semester. The course design was inspired by the instructor's experiences in a software design and development team. Driven by struggles in educational software's rapid growth, the course focused on the *design* (i.e., learner analysis, prototyping, and testing) using a project-based pedagogy. With students from a wide variety of backgrounds, learning is focused on the educational software creation process in parallel with analyzing needs and designing software for real clients in multidisciplinary teams. To understand the experience of the course, the authors wrote and analyzed reflections about their experience in the course.

Narrative themes in the reflections revealed students' and the instructor's distinct but overlapping course goals. While the instructor's goals focused on developing students' knowledge and communication abilities surrounding educational software, students' goals were broader and more idiosyncratic – experiencing the design process, linking knowledge to their prior experiences, and aiding their individual career goals. Students experienced significant, but realistic, challenges that stemmed from working on multidisciplinary teams and working on real projects with real clients. Happily, students recognized these challenges as realistic representations of project work and unique learning opportunities. In the end, students felt that they accomplished both the instructor's objectives and their own personal goals. Although the students saw areas of opportunities for improvement, they were satisfied with their experience. The instructor was satisfied she had both met the course objectives and aided students' personal growth.

Keywords Transdisciplinary • Multidisciplinary • Authentic learning • Realistic projects • Graduate education • Design • Software design

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Introduction

This chapter shares narratives from the first offering of a multidisciplinary graduate course titled *Educational Software Design* during fall 2015. The chapter is coauthored by the students and course designer/instructor as a reflection on their experience. The course focused on the *design* of educational software (e.g., iterative learner analysis, design documentation, prototyping, conducting usability tests, and incorporating feedback, critique, and usability test results into the design) rather than software development. The learning objectives targeted students' understanding of varied disciplinary terminology and processes through a multidisciplinary design project. The course provided beautifully imperfect opportunities to learn about educational software design.

Purpose(s) and Method

The purpose of this paper is to document and weave together reflections from the students and instructor on their experiences with the course. In doing so, we strive to unpack the perspectives we individually and collectively used to make sense of the course. We each brought unique and idiosyncratic goals, attitudes, and expectations about what the course would be like. Our story, told through our varied voices, will inform and demonstrate the breadth of experiences that students and instructors bring to, gain through, and leave with during a studio-like project-based course.

The course instructor (first author) invited all students enrolled in the course to be coauthors. Seven of the eleven students in the course accepted. The coauthors agreed on several writing prompts and wrote reflections in response to each prompt. The first three authors then identified themes and used representative or important quotes to weave together a story highlighting the impact of our distinct perspectives on the course experience.

Course Design and Context

The studio-inspired course was offered by the Learning Design and Technology program within the College of Education at Purdue University. The instructor's own professional and educational preparation inspired the course. The instructor primarily constructed the course around a single, semester-long, team-based project. The project provided students with an authentic problem to grapple with, based on realistic clients' needs. During the first class, three clients presented potential projects to the class and students ranked their interest in the projects, their existing skills, and their knowledge in areas relevant to the course. The instructor formed teams based

on skill and interest. All but two students were assigned to their first project preference.

The three projects that occurred during the course involved (1) enhancing a badging system, (2) reenvisioning a study habits system, and (3) creating a tool to assess Japanese language learners' speech in real time. Throughout the semester, students regularly met with clients and worked with subject matter experts to conduct in-depth analyses of users' and clients' needs, as well as target audiences, stakeholders, and learning goals. In addition to direct interaction with potential users, teams located secondary sources to expand their knowledge about underlying concepts that informed their design (e.g., principles of self-directed learning and motivation, competency-based education models, and common issues non-native Japanese speakers have when learning pronunciation). Following initial data collection, teams created design documents, including detailed requirements and drafts of multiple interface designs. The teams created low-fidelity prototypes and conducted usability tests with realistic users. Finally, they compiled a design report, including their most recent design, findings from their usability testing, and recommendations for future work.

The instructor provided guidance through templates and sample deliverables, as well as regular written feedback and desk critique. Students also engaged in periodic formal peer critique and client reviews. Students were required to summarize and reflect upon the feedback received. Each team gave a final presentation to the class and their clients.

Varying Backgrounds

Students in the course came from a variety of disciplines, including learning design and technology, computer graphics technology, engineering education, and Japanese. The students generally had more extensive and varied professional experience than the instructor had anticipated. For example, several students had experience teaching at the university level. Most also had professional experience in their own disciplines (e.g., instructional design, engineering, web design, statistical analysis, language instruction, or university administration).

Students indicated that their background influenced their understanding of course topics. Backgrounds of the students who coauthored this paper are summarized in Table 1. We have also included a moniker (e.g., "Ali, the game designer") that we will use throughout the paper.

Table 1 Backgrounds of students who coauthored this paper

Name	Description
Marisa, the instructor	Marisa holds BS and MS degrees in computer science and a PhD in instructional systems technology. She is currently an assistant professor in Purdue's LDT program.
Ali, the game designer	Ali's background is in video game development. His research interests include instructional design theories for serious games and computer science pedagogy.
Anthony, the animator	Anthony has been an e-learning developer and instructional designer. He had also worked professionally in movie animation and visual effects.
Blake, the administrator	Blake's education and professional goals are in higher education administration. He currently works at Purdue in an administrative role.
Katherine, the instructional designer	Katherine's background is in education and psychology. Her future interests include creating software for her research, which motivated her to take the course.
Todd, the engineer	Todd's background involved professional design and engineering work but not with software. His interest in the course was experiencing, as a student, the type of class he would like to teach.
Steven, the polymath	Steven's diverse background includes data science and languages, which informed the designs for real-time feedback on Japanese pronunciation. Steven took on the role of de facto project manager.
Yu-Tung, the graphic designer	Yu-Tung brought experience in both graphic design and instructional design. She also has a strong educational background in software design.

Course Goals

Instructor's Goals

The impetus for the course came from the instructor's background, which helped guide its intent and structure:

From the moment I began my career as an Assistant Professor, this was a class I knew I wanted to teach. Before coming to Purdue, I designed and developed an educational software tool based on concepts created by education faculty. Soon I was managing a multidisciplinary design and development team. These experiences left me with an appreciation for the complexity of multidisciplinary teams, with members who not only spoke different languages but also viewed software development through different disciplinary lenses. My dissertation, focused on educational software developers, showed that these individuals play multiple roles, come from a variety of backgrounds, and frequently interface with specialists. These experiences were my inspiration for the class.

I wanted students to be prepared to work on educational software designed within a team that included a variety of disciplines. Students would gain a feel for the larger team process within an authentic project. To do this, they would have to not just understand and respect the process of one discipline, but how all the specialists come together to create a complex, quality piece of software. This means gaining empathy for other team-members and learning enough of the language and the process they undergo to be able to design together – not just as a series of hand-offs, but as a group.

– Marisa, the instructor

The learning objectives derived from these goals, listed below, appeared in the course syllabus.

After completing this course, learners will be able to:

1. *Demonstrate understanding of language, design processes, and techniques used by other fields, including instructional design, software engineering, graphics design, and quality assurance*
2. *Collaborate with peers as part of a diverse design team*
3. *Work through a systematic design process while designing software for real clients and users*

Marisa's wish to use a studio-based pedagogical model was constrained by the confines of graduate course scheduling (i.e., 3 h/week). Further, the skillsets of students who chose to enroll influenced the execution of the course. These constraints drove intentional choices in content planning, project selection, and team organization.

Students' Goals

In this section, the coauthors reflect upon personal goals that they set during the first week of class. These goals were generally nontechnical, indicating a variety of interests and future career intentions. They largely aligned with Marisa's desire to foster personal growth, interdisciplinary connection, and reflection. Examples of goals included:

[To provide a] foundation for what the software development process looked like, how it compared to the instructional design models, and [to] gain knowledge in a very new area which will allow me to bridge the perceived gap in education for areas of interest.

– Katherine, the instructional designer

My main goal was to improve my skills in understanding the client's needs, especially when it is different than what they are asking me to do. Since software design does not always mean starting from scratch, I wanted to challenge myself to modify and enhance an existing design, that works fine, in order to make it more effective.

– Ali, the game developer

Both Ali and Katherine sought to link new perspectives gained in the course to their prior experience. Others, including Anthony, sought opportunities to integrate prior professional and academic experiences:

[My previous] programming courses taught how to program a language from a development viewpoint. The graphic course taught how to design an interface, prototype or storyboard from a design perspective. The instructional design course taught how to create [a] learner analysis, design content, and end of course evaluation from this approach... One of my goals for taking this course was... to see how the entire design process works[and] gain additional insight into how my input can contribute to the software design process from start to finish.

– Anthony, the animator

Yu-Tung selected two of the course learning outcomes for her personal goals. Others described more divergent personal development and research goals. Blake did not see himself as a past or future designer; his interest was in understanding his

role as a client for the type of projects in the course. Todd hoped to gain insight about his own teaching skills by taking this course. Finally, Steven was most interested in the Japanese assessment tool, which aligned with his research on languages and learning analytics.

Project Experiences

Client Interactions

Students found that dealing with real clients required skills best honed with practice, aided by multidisciplinary concepts and techniques. Katherine emphasized working with clients during the analysis phase:

Working with a client provided an authentic context for our project and allowed us to accomplish front-end analysis... that would not have been possible otherwise. This informed each phase of our project and ultimately led to the success of the overall project.

– Katherine, the instructional designer

One team had difficulties with the problem framing provided by the client:

I was excited to work on this project because I heard that our client was looking to use some gamification strategies, but after our first meeting we realized that he did not understand what gamification was and we did not understand the nature of the problem! We suddenly woke up, and decided to do an in-depth analysis, supported by research-based evidence, to develop a testable prototype.

– Ali, the game developer

This led the team to, frustratingly, nearly entirely set aside the client's previous work. However, it also opened an opportunity to help the client see the problem space and potential solutions in a new light and with a new perspective on how to create user value:

[The client] basically hadn't done any formal data collection. They relied on projections of student users by faculty. This was not a new experience for me, but it seemed to be to other team members... The client definitely had a feeling that something wasn't working at a fundamental level, but they couldn't put their finger on it.

– Todd, the engineer

His team felt conflicted, not sure how truthful they could be with the client:

The most problematic event... was coming to the realization, through our learner analysis, that no matter the design, students are still not interested in tracking their academic behavior and productivity [which was the focus of our project] – even with major incentives [because they did perceive any value]. Therefore, it was a little discouraging for our group to come up with a great design knowing all along that the learners, and even ourselves, would never use such an application. I would have liked to be more honest with [the client] about our groups' feelings.... False hope over honesty didn't feel right to me.

– Blake, the administrator

Multidisciplinary Teams

Working with multidisciplinary teams provided opportunities to achieve the objectives of each project collaboratively:

People from various backgrounds usually have different viewpoints and concerns, which may facilitate the process or performance of the projects. For example, in our project, Japanese language learning, four different experiences are grouped: Japanese language, programming skill, instructional design, and graphic design. The [Japanese language instructor's] experience of teaching Japanese language can help quickly catch the key points and ensure the accuracy of learning content. [Steven's] programming skill is useful to provide suggestions of systematic design and evaluate the feasibility of design... Experience of instructional design is helpful to improve or design an effective way for using software in learning and teaching Japanese language. Finally, [Anthony's and my] experiences of graphic design are able to add extra attraction of users by designing an interesting and colorful interface.

– Yu-Tung, the graphic designer

Anthony, Yu-Tung's teammate, reflected:

This multidisciplinary team correlates to what actually happens in the workplace. You don't have one person doing everything on a project. For a project to be successful you need contributing expertise of individuals.

– Anthony, the animator

Others also saw how multidisciplinary teams drove analysis, design, and development:

Working in cross-disciplinary teams was crucial in allowing us to look at different dimensions of the problem, including motivation, usability, and learning outcomes.

– Ali, the game designer

Todd, Ali's teammate, found multidisciplinary value from providing expertise in one area while learning from peers in other areas during the shared learning experience:

It was very strange to be in a class where at different points each of us was a complete expert and at others a complete novice. I am much more used to there being significantly more overlap within a class in terms of knowledge, experiences, and development. It was wonderful to be able to watch expert discussions of different things and sometimes contribute or lead those discussions. The variety of perspectives (and personalities) was incredibly useful to the class.

– Todd, the engineer

However, all teams had their ups and downs:

I learned to focus on other people's strengths rather than my perceived weaknesses... Todd and Ali came into this project with intense enthusiasm and a vast array of skills in design, coding, gamification, research, work ethic, and a drive to do good at Purdue. I learned that enthusiasm is contagious, but so is negativity. We each had "our moment" where the other two just needed to take the controls for a while. Very realistic to the workplace and an excellent learning outcome for the course.

– Blake, the administrator

Marisa's insistence on integrative collaboration was sometimes frustrating:

At first working on the project in a group seemed easy, divide and conquer like so many previous course group projects. We felt that ...draft sharing and alignment was sufficient to get to fully complete ideas, designs, and deliverables. I know better! As we moved through the semester, we became more integrated in our work, and the results were cleaner and more effective. We met in person more, we rotated drafts, and we focused on continuing to co-develop our understanding in sync with our ideas and prototype as a team.

– Todd, the engineer

Other groups continued to consider design and conquer a successful strategy:

Different skills of the team members led us to use a divide and conquer approach. We had two design individuals on our team to create seemingly endless sets of design mock-ups with each iteration of the project. The linguist in our group was a native speaker of the target language, Japanese, and was able to obtain pilot testers of our designs for both types of users, learners and instructors of Japanese. I guess I became the project manager and used my knowledge as a beginning learner of the language as well as insights as a coder to put boundaries on our project (much to the chagrin of the instructor who did not want us to focus too much on the development and implementation of the projects).

– Steven, the polymath

Other Challenges

All three teams found their projects to be time consuming, and several felt that guidance on project management would have helped:

Our team would have benefited from better project management. Since little readings or course content addressed this topic we struggled to define roles, create a unified vision, and leverage our diverse skill sets to work towards the common, identified goal. The process resulted in [an] end result that met client's needs but could have been more effective and smoother if more attention was paid to managing the project as well as completing major milestones.

– Katherine, the instructional designer

Students also struggled with the deliverables and parts of the design process stressed by the instructor:

While I expected the course to be time consuming, a lot of time seemed to be wasted developing alternative versions of the proposed software. In the end, after all these iterations, the end product differed little from our initial conceptions of the project.

– Steven, the polymath

In contrast to Steven's view, Marisa felt that teams could, and should, have considered more divergent ideas:

I hoped to encourage ideation and iteration. I allocated time for this through various in-class activities, and required sketches to illustrate multiple design ideas. With prompting, students spent a fair amount of time sketching designs at several levels of fidelity. However, they seemed to spend a lot of that time refining ideas and quickly focused on increasing fidelity of their work rather than coming up with truly divergent ideas. I was glad the refinements were driven by their analysis and other information sources, but was disappointed that they didn't come up with some really different ideas throughout the semester that pushed the boundaries of the design space.

–Marisa, the instructor

Achieving Course Goals

Students' Goals

In general, students felt that they had achieved their goals. In many cases, those goals also aligned with the instructor's objective of appreciation and understanding of multiple disciplines, even if that was not one of the student's initial goals:

Overall, the course met my needs as I was able to understand the software design process by having an applied learning experience. I was able to better understand the content in readings as I incorporated them into our project each week. The team experience provided project manager experience for me as I worked to manage the timeline, team dynamics, and the client relationship. While this is not initially what I thought I would take away from the course it is perhaps one of the biggest skills I developed over the course of the project. While I left the course wishing I had better software development skills, I gained valuable management skills that would not have been gained in a different setting.

– Katherine, the instructional designer

An important element that I learn[ed] in this... course are the parallels the Software Design process has with the ID [instructional design] Process. I developed [a] chart during the class which gave me a complete understanding of how my ID and Design expertise fits in the Software Design process. Once I gain[ed] this understanding I was able to see how my input contributes to the software design process.

– Anthony, the animator

Ali and Yu-Tung found new perspectives in the course materials. Ali gained a new perspective and abstract understanding of how software and education fit together:

[My] project was an educational software designed to help students develop positive study habits. This was a difficult topic since the educational objectives cannot be easily measured.

– Ali, the game designer

Yu-Tung found insight in a focus on learners during software design:

Even though we...defined the goals and objectives and needs for the software, one of the most different things is that we have to consider more about how to improve learners' or instructors' experiences and performances. User Interface Design focuses on the ease of use, but for educational software, we need to think more and combine learners' and instructors' perceptions with design.

The course is very helpful for people, no matter [whether] they will work in academia or industries. From this course, we learned three important abilities we always use in daily life or work: systematic design process, ability of effectively collaboration, ability of effectively organization. ...When encountering disagreement, how to find a balance between effectiveness and harmony and solve collaborative problems through communication are valuable experiences we should learn.

– Yu-Tung, the graphic designer

Like others, Steven saw similarities across design models, even if his goals of credit and software development were only partially met:

I did get course credit. Overall, I would have benefitted more from a development rather than a design course. While software design has its own process models, if we take a broad view, these models do not differ much from instructional design or other process models.

Different components or stakeholders may have different levels of importance, but the models are not fundamentally different.

– Steven, the polymath

Todd's goal was to experience a project-based design course as a student. The course also allowed him to link his prior theoretical design knowledge to his professional goals:

What I got out of this class largely comes from my metagoal for taking the course, which was what I was most interested in. ...I went into the class hoping to have a chance to practice the process of designing that I now typically look at through a research lens. I absolutely saw the realities of all the things I try and encourage or ask [my] students to do. It is great to talk in abstract about ...what we ask students to do in design projects or courses, but the reality of different priorities in teams is very real. That is what I wanted to gain perspective on, and that is what I saw. It was a nice reminder that the work I am doing at some point collides with the real world, and I valued the opportunity to experience it and remind myself of what it was like to be there and be those students.

– Todd, the engineer

Finally, Blake realized his intended goal, to become a well-informed client – a goal well beyond Marisa's original expectations for the course:

What I got out of the course was much more [than learning how to determine whether I got my money's worth as a client]. I learned how software designers think. I learned how they talk. Most importantly, I learned just what it takes to pull off what it is I've asked for as a client. My understanding of the process has improved my relationships with my colleagues and has greatly expanded my vision of what can be done in the field.

– Blake, the administrator

Instructor's Goals

Like the students, Marisa saw her goals largely achieved. She ended the semester having observed some things she expected, and some she did not. She left with plenty of useful information to continue iterating on the course design:

Going into the semester, I expected a lot of problems relating to resistance to concepts outside of their existing mental model, workload, interpersonal issues, putting clients' expectations ahead of mine, and dealing with clients who really do not understand technology... I was surprised that, although many of these frustrations occurred at some level, students generally did not blame them on me or the course design – rather, they indicated that they recognized their own roles in creating interpersonal issues, and that frustrating client interactions are expected in the “real world.” Of course, in end-of-course surveys a number indicated that the workload was higher than anticipated, but in reflections only a couple felt that the workload was inappropriate.

Reading student reflections at the end of the semester and working on this paper has helped me see the realization of my goals. Students learned from the projects, and from one another. Several clearly articulated the connections between disciplinary processes, and the larger design process that overlay the entire project. While they expressed disappointment in the projects themselves, they indicated they had met personal goals in ways I had never anticipated. And, as a bonus, I had a great time getting to know each of my students and learned so much from them about their disciplines and their understanding of the design process.

I continue to ponder what I will change for next year and how to maintain a reasonable workload for students and myself. I have a feeling that I will continue trying to get things balanced well for many years to come.

– Marisa, the instructor

Conclusion and Discussion

Although we (the student coauthors) saw areas for improvement in the course and projects, most of us were satisfied with our experience. More importantly, the course achieved the stated learning objectives and helped us meet our personal goals as well. While none of us mentioned them specifically, the learning objectives are clearly apparent across our reflections. In part, our backgrounds allowed us to reframe the instructor's objectives through personal experiences and future goals.

For example, Anthony developed a personal process of multidisciplinary sense-making, which transcended Marisa's goal of teaching "techniques." Even students dissatisfied with aspects of their experience, such as interpersonal team issues, acknowledged their own role in that dissatisfaction and found personal growth within. Such a high level of metacognitive awareness and tolerance for the "unexpected" may be attributed in large part to the maturity level of our class.

When planning the course, Marisa correctly predicted some of the challenges we would encounter. However, a tension seemed to arise when our student identities overrode our professional personas. Marisa's push toward collaborative, iterative design models we know as professionals conflicted with our desire to follow a solution-focused divide-and-conquer approach that we often fall into as students. Some teams also struggled with workload and project-management-related issues that so often arise in classroom projects. One group in particular (Ali, Blake, and Todd) spent significant time and energy grappling with their clients' "flawed" project concept. We felt that these issues were not weaknesses in the course design but rich, authentic, learning opportunities mirroring our prior experiences.

As we reflected while writing this paper, we realized that discussing how to build on those past experiences to meet client needs would have been beneficial earlier in the course. Similarly, discussion of teamwork specific to classroom settings may have created more positive collaboration. Nevertheless, those negative experiences were one of the many intangible ways in which we grew and met our personal goals.

This has been a rare chance to intentionally and consciously reflect on our group class experience. We hope that future students have the same opportunity as they live their own project experiences and find their own narrative. As we write, Marisa is teaching a revised version of the course to students with backgrounds very different from ours. We wish those students, and Marisa, luck!

Use of a Content-Based Science Narrative to Develop Situational Interest Within a Digital Game

Ora D. Tanner and Yiping Lou

Abstract Many studies reveal that better learning results when situational interest within a text is high (Schraw and Lehman, *Educ Psychol Rev* 13:23–52, 2001). This chapter summarizes the theoretical perspectives of situational interest, games and narratives, and how their intersection can promote three-dimensional science learning. The development of a content-specific narrative for a digital science inquiry game called *Surf's Up Science* (SUS) was used to teach middle school students about ocean currents' effects on local weather. An iterative design-based research method was used to evaluate and improve the game mechanics and narrative. An analysis of the empirical evidence used to inform the design and development of the game is presented with a focus on the role of the narrative throughout the game design process.

Keywords Game-based learning • Science inquiry • Situational interest • K-12 science • Technology • Digital games • Game design • Instructional design • Game narratives

Introduction

Interest plays an important role in student learning of science concepts (Schraw & Lehman, 2001). Traditional science teaching has caused K-12 students in the United States to disengage from science and perceive it as boring (Lin, Hong, & Chen, 2013; Ormsby, Daniel, & Ormsby, 2011). Teens in particular hold a high interest in science and see it as relevant to their lives; however, they find the way science is taught in the classroom as ineffective. They would like more opportunities for hands-on experiences, to problem-solve and investigate their own testable questions (Amgen Foundation, 2016). To counter this low interest, the Next Generation Science Standards (NGSS) call for students to “actively engage in scientific and

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engineering practices and apply crosscutting concepts to deepen their understanding of the core ideas in these fields” (Schweingruber, Keller, & Quinn, 2012). Research on digital games and simulations has produced evidence that in-game environments support the experiential, motivational, and performance-based learning encouraged by the NGSS by providing authentic scenarios for students to think critically and to “do” the work of scientists and engineers (Boyle, Connolly, & Hainey, 2011; Martinez-Garza, Clark, & Nelson, 2013). Narratives within games can function to provide real-world contexts for science learning, provide a connection with central characters, and progress players through the game by setting goals and challenges (Whitton, 2014). Content-specific stories, instructional text, and feedback can be used to trigger text-based, task-based, and knowledge-based interest in science learning (Schraw & Lehman, 2001). It is hypothesized this interest is enhanced inside of a game environment.

The K-12 Math and Science Partnership (MSP) is a 3-year collaboration between faculty and instructional technology graduate students at the University of South Florida, faculty from Louisiana State University, and science teachers from Okeechobee, Osceola, and Volusia school districts. The major goal of the project is to increase middle and high school students’ academic achievement in science content knowledge and science inquiry practices through innovative approaches to teacher professional development including 5E lesson planning, science inquiry labs construction, integration of technology (i.e., digital games, Web 2.0 tools, etc.), science inquiry assessment, cooperative teaching strategies, and lesson studies in professional learning communities. As part of the project, a set of digital games was developed that address complex science concepts that engage students in scientific inquiry practices. Florida standard SC.6.E.7.3 was identified by teachers as a topic that is not only challenging to teach but also a standard where students in the participating school districts have historically performed poorly on standardized assessments. The standard requires sixth-grade students to “describe how global patterns such as the jet stream and ocean currents influence local weather in measurable terms such as temperature, air pressure, wind direction and speed, and humidity and precipitation.” Teachers requested a game that could provide both student practice and assessment of key concepts associated with this standard. This chapter presents the theoretical framework, iterative design and development of the game, and initial results from prototype implementation of the game.

About the Game

Surf’s Up Science (SUS) is a digital science inquiry adventure game designed to improve student understanding of the influence of global ocean currents on local weather by using the scientific practices of:

- Developing and using models
- Analyzing and interpreting data
- Constructing explanations

In the introduction of the game, learners are presented with a problem and immersed into the role of an oceanographer who has been tasked with locating an “evil” investor who has stolen the main character’s identity. Learners engage in this inquiry-based, point-and-click, adventure game by solving mini-puzzles related to conceptual science knowledge and science practices about global ocean currents and local weather.

To play the game, learners begin in a pre-training level where they have the opportunity to become familiar with the ocean conveyor belt system. Interactions in the game allow the student to build background knowledge about how the ocean conveyor belt transports heat around the earth via warm and cold currents by requiring learners to create a visual model. Learners map the path on a satellite image of the globe by clicking on the areas where the global currents flow using written descriptions as a guide.

In the second level of SUS, the storyline reveals that Wade Waverly, the antagonist, has alluded attempts by the player and is now hiding out in a coastal city of the United States. Based on initial evidence, the student is asked to hypothesize about which city she thinks Wade is in. The student analyzes and interprets data from an East Coast city and a West Coast city (at the same latitude) and draws a conclusion about why one location has lower annual mean temperatures and precipitation than the other. Through investigation the learner discovers the effect of global ocean currents on each city’s local weather. The actions in this level are learner use of data to answer multiple choice questions, selection of map locations, and entering reflections into a science inquiry notebook.

The final level of SUS is a challenge level where the student must apply scientific knowledge and skills learned in the previous two levels. Learners are provided with a list of specifications for a new surf shop to be opened in one of three cities located at the same latitude but in varying regions of the world. Through an analysis of data sources, including annual mean temperature and precipitation tables, an ocean current map, climographs, satellite maps, and models of the ocean conveyor belt, the learner draws an evidence-based conclusion. This final challenge level serves as a summative assessment as there is no guidance or feedback, and the storyline is used only to progress the learner through the task.

Theoretical Frameworks

The game design for *Surf’s Up Science* was based on several conceptual frameworks that relate to learning science, technology-enhanced content, and narratives—namely, situational interest, game-based learning, and narratives in games.

Situational Interest

Situational interest is a short-term, context-specific state of motivation that is activated by unusual or novel information, such as a discrepant event, or an unconventional task (Lin et al., 2013; Schraw & Lehman, 2001). Interest plays a critical role in learning, and findings are consistent across research studies that significant relationships exist between interest and achievement (Lin et al., 2013). Studies in situational interest have generally focused on three aspects: text-based, task-based, and knowledge-based interest (Schraw & Lehman, 2001). Text-based interest addresses characteristics of text that affect interest, while task-based interest refers to learner actions that increase interest. Knowledge-based interest concerns attributes of a learner's background knowledge that augment interest. Results from studies conducted on the aspect of text-based interest have yielded positive effects for texts that use suspense, surprise, or other conventions that create an engaging text. Texts that are well organized and easy to follow and that allow reader's to organize the main ideas also increase interest. The inclusion of high-interest yet tangential information in texts (seductiveness) has yielded mixed results (Schraw & Lehman, 2001). While most studies have investigated the impact of interest on learning achievement, a limited number of studies have focused on identifying sources of generating situational interest of science learning and even fewer on situational interest within game narratives for mastery of science content knowledge and inquiry skills (Lin et al., 2013; Schraw & Lehman, 2001).

In SUS, the storyline was intentionally developed to generate text-based interest at key points throughout the game, while in-game science practices were used to produce task-based interest.

The narrative elements of surprise and anticipation were key characteristics designed to engage the student in science learning embedded within SUS. An example is in the pre-training level as the student creates a visual model of the ocean conveyor belt. An evil laugh is heard, and suddenly the antagonist, Wade Waverly, pops up in the middle of the screen. He taunts the student about her efforts to catch him and then disappears just as quickly as he appeared. Wade makes reoccurring appearances throughout the game in each level, sometimes peeking silently from behind a palm tree, other times leaving a cryptic clue on the beach. The suspense of catching Wade and trying to ascertain his location at any given time is used to propel the student through several levels of science learning and ultimately to complete the entire game experience. Text-based and task-based interest components were strategically placed throughout SUS to help learners construct knowledge about concepts related to global ocean currents and local weather.

Game-Based Learning

Although various methods have been used to increase engagement in science instruction, there still remains a low value placed on science by students, and most do not develop an interest beyond the classroom (Foster, 2008). Digital game-based learning (DGBL) is an instructional method where computer games are used for teaching and/or training purposes. These learning games include both instructional features for engaging a student's cognitive processes and game features to encourage learner motivation (Mayer, 2014). DGBL has been found to help learners to persist with complex content more than with any other instructional method (Tobias, Fletcher, & Wind, 2014). Games for learning also provide environments for learners to interact, experiment, problem-solve, manipulate virtual tools, implement scientific practices, and play (Annetta, 2008; Ormsby, Daniel, & Ormsby, 2011; Whitton, 2014). It is these affordances of digital games that align well with the three-dimensional learning promoted by the NGSS and which could be effective for helping learners to understand a difficult topic like the influence of global ocean currents on local weather. The aspects of interactivity, problem solving, and providing learners a digital space to develop scientific practices were viewed as effective instructional methods for helping learners achieve this learning goal within SUS.

Narratives in Games

There has been an ongoing debate as to the importance of narratives in game design. Proponents suggest games should be considered as narratives because they describe diverse aspects of human activity and are used in introductions and backstory and game narratives often use the conventions found in traditional stories such as three-act story structure, protagonists, plot hooks, foreshadowing, and compelling characters (Whitton, 2014). Opponents believe interactivity is central to well-designed games rather than narratology (storytelling). They cite that games allow input and participation from the player which could create a nonlinear storyline; the stories in games do not translate to different mediums such as movies, books, or theater; and not all games tell a story (Dickey, 2015; Whitton, 2014). A type of tension exists between interactivity and game narrative. Schell (2008) refers to this as a story/game duality. He argues that both gameplay and stories have important roles in games and both are needed to enhance the experience for players and learners.

Overall, there is a paucity of research on how to develop game design narratives and integrate them for educational purposes. The evidence is insufficient to determine whether narratives in games support academic learning or, more specifically, student mastery of science inquiry skills (Dickey, 2015; Mayer, 2014; Whitton, 2014). Dickey (2015) suggests several guidelines for integrating narratives into DGBL:

1. Establish the function of the narrative in the game. Game designers must determine whether the narrative will be used purely to establish the setting or if it will play an integral part of the game play.
2. Decide whether the narrative will be linear, nonlinear, or a combination of the two. While linear stories limit the autonomy a player has in the game, they can evoke strong emotional responses which encourage the player to take actions that uncover more of the story and in turn advance the game. Some games contain both linear and nonlinear aspects such as those that consist of an overarching main quest (linear) but that allow the player through the actual gameplay to take side quests (nonlinear).
3. Develop the plot by identifying the setting, characters, and conflict. Careful consideration should be given to the multidimensional aspects of the setting in DGBL (physical, temporal, environmental, emotional, ethical), the roles of the player and the characters in the game, and identifying the central challenge that will serve as both the goal for learning and the anchor for the storyline.

According to Mayer's (2014) Narrative Theme Principle for Games, "people do not necessarily learn better from a game when a strong narrative theme is added" (p. 159). Mayer found that the use of an intricate storyline within a game can distract learners from game play by producing extraneous cognitive processing. While this assertion aligns logically with multimedia learning principles, further research is needed to substantiate these claims. Based on previous pilot studies conducted with other digital games in this project, we have found that narratives can be used to promote and sustain interest in the content, progress student interactions through the game, and, when aligned with the learning goals, act as a form of science assessment because students perform tasks within a relevant context.

Game Narrative Design

The narrative storyline of SUS follows the wild and adventurous journey of Kody Kahuna, a young entrepreneur who owns a surf shop in south Florida. Kody is in intense pursuit of his nemesis, Wade Waverly, a wealthy and seemingly evil businessman who desires to steal Kody's business and ruin an upcoming surf competition he plans to host. Sixth-grade learners take on the role of a physical oceanographer who has been enlisted by Kody to help find where Wade is hiding and "bring him to justice." Learners use science practices of developing and using models, analyzing and interpreting data, using mathematics and computational thinking, and constructing explanations to "describe how global patterns such as the jet stream and ocean currents influence local weather in measurable terms such as temperature, air pressure, wind direction and speed, and humidity and precipitation." Through engaging in these practices throughout the game, the learner is expected to be able to draw general conclusions about the type of weather that is associated with warm and cold currents.

In the final level of the game, the learner discovers that Wade did not possess malevolent intentions after all but instead is an overenthusiastic admirer of Kody's Surf Shop and only wanted to emulate him but took things a little too far. The player is tasked with finding an ideal location for Wade to open his own shop based on specific requirements. A foundational understanding of the relationship between global ocean currents and local weather will lead the player to use data such as temperature and precipitation tables, ocean current maps, and climographs to select the most feasible location. This final level not only brings all of the concepts from the previous two levels together, but it also serves as a formative assessment for the student to demonstrate conceptual mastery of the standard and use of science practices.

The writing of this science inquiry-based storyline was grounded in situational interest and research on games and narratives (Lin et al., 2013; Tapola, Veermans, & Niemivirta, 2013; Whitton, 2014). Several strategies were used to facilitate motivational interest throughout the game, namely, a linear storyline, setting, plot hooks, compelling characters, and cutscenes.

Linear Storyline

A linear storyline is employed in SUS where the player is introduced to a challenging real-world problem in the beginning game level. The scenario requires the learner's immediate attention and creates the opportunity for the learner to take on the role of a scientist. As was mentioned in the earlier section on "Narratives in Games," one of the major purposes for using a linear storyline is to make an emotional connection with the player and to advance both the story and the action in the game. For SUS, the linear format was used to facilitate interest and to motivate the learner to master complex science content and perform science practices embedded in the game. Another purpose of the linear storyline was for scaffolding and level progression. A linear storyline was used to ensure the learner would advance from lower to higher cognitive levels of thinking and to use knowledge and skills learned from preceding levels to complete successive levels.

Setting

During the initial design of SUS, it was important to create a setting that was relevant to our target audience of middle school students. It had to be a relevant environment, outside of a lab setting, that encompassed global ocean patterns. After brainstorming and researching, surfing emerged as a favorable context for the game (Fig. 1).

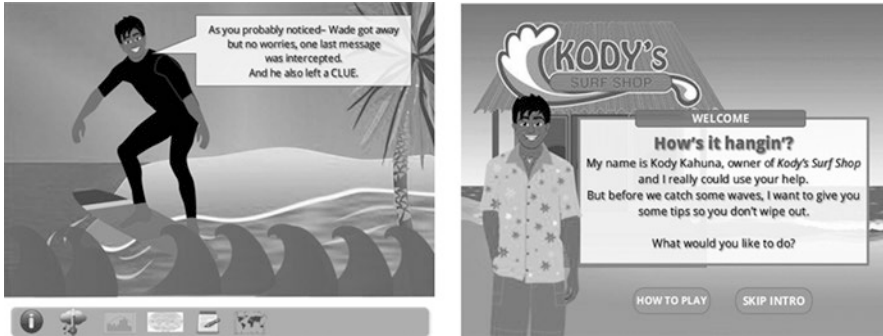


Fig. 1 Context for *Surf's Up Science*



Fig. 2 Kody Kahuna, Wade Waverly, and player's character from *Surf's Up Science*

Plot Hook

In the beginning scene of SUS, the player is introduced to Kody Kahuna who has an emergency situation because his identity has been stolen and he could face losing his business. He needs the player's help to go after the villain in the game, Wade Waverly. The introduction of a real-world problem such as identity theft is meant to evoke empathy and a sense of immediacy and urgency. The call to action to help Kody stop the “bad guy” is used to motivate the player to enter the game without having all of the facts. This curiosity drives the player to uncover more of the story and to become a part of the chase.

Characters

The protagonist in the game is Kody Kahuna, owner of Kody's Surf Shop (Fig. 2). He is a young, handsome, surfer-type entrepreneur who is seeking to stop Wade Waverly. Kody speaks in surfer lingo and is very expressive when it comes to how the player is performing in the game. His facial expressions and comments act as feedback and guidance to the player. While it is obvious Kody is a driven

businessman who aims to make money, as the story progresses, the player learns he has extensive knowledge about the field of surfing, serves his community by hosting the surfing competition for youth, and gives Wade a chance to explain the reason for his actions. These aspects of Kody create a believable character with whom the player can establish emotional proximity (Dickey, 2015). We believe a compelling character is created through humor, likability, and the “small guy versus the big guy” storyline. Further research would need to be conducted to determine if these character features actually evoke interest in middle grade learners.

Wade Waverly is a greedy business tycoon, who has shift eyes and thin mustache, wears a top hat and white gloves, and has stacks of money sticking out of his pockets (Fig. 2). He is allusive and always seems to be one step ahead of the player. Although he only appears a few times on screen, he interrupts the game play to remind the player that they will never be able to catch him, and at a certain point, he even leaves a clue. In the final level, the player actually discovers that the perception of Wade was incorrect. The player will use her knowledge and skills to help Wade find an ideal spot for his own surf shop.

The player takes on the role of a physical oceanographer who is depicted in the game as a young Hispanic woman who has been hired to help Kody locate Wade (Fig. 2). The goal of the character is to analyze and interpret the various types of data and use it to draw conclusions about where Wade is hiding. Later, a different data set is used to locate a feasible location for Wade to open his own surf shop. While the player is able to name the character anything she wants, the interactions with Kody and Wade are through this character. Because the character is “average,” in that there are no outstanding features or characteristics, the player is able to focus on the story and the actions she needs to take to progress in the game.

Cutscenes

Cutscenes are used to advance the storyline, provide additional information to the player, support the tone and mood of the game, and show the consequences of the player’s choices (Dickey, 2015; Whitton, 2014). This strategy was implemented in several instances throughout SUS. In Level 1, Wade Waverly appears on the communications screen of the airplane dashboard to introduce himself during the middle of game play. He then disappears without a trace, almost taunting the player to find him. By solving a problem or answering questions, the player can continue in pursuit. In Level 2, the player is asked to select the location where Wade is hiding based on their analysis. A cutscene is used to show an airplane traveling to the selected city and the results of what plays out for correct and incorrect choices. Also at the end of each level, a map appears that shows an animated path going from the player’s current location to the next location. This type of foreshadowing lets the player know there is another level of game play and the mission is still in progress. The use of animations of Wade popping up from the background or randomly appearing on screen creates a quest-type feel to the game. The player closes in on

the villain; however, he always seems to escape. This air of problem solving and mystery is typical in adventure games. In SUS, the player is required to look at several data sources and draw conclusions. Designing the game using the aforementioned narrative strategies helped activate situational interest and to keep the player motivated enough to interact with the narrative in order to propagate through the game.

Research Method

Design-based research (DBR) was employed in the development of the narrative for SUS. While DBR is guided by theory, it also examines how learning can be improved by an intervention in real time as it is being implemented in the classroom setting (Morgan, 2013). For SUS, the designer wanted to create a compelling storyline that engaged learners in complex science content, motivated them to use science practices, and ultimately helped the learners to achieve both the instructional and game goals. This was accomplished to a degree by creating conditions throughout that maintained situational interest. Teacher and student feedback was used to revise the game narrative through several iterations. The iterative process of DBR allowed for the game narratives to be improved with each implementation of the game.

Iteration #1

The initial game design narrative was heavily text based and required learners to identify testable questions relevant to ocean currents and local weather. The main character of the story was a dark-haired female named Sam who owned a surf shop. In order to promote her business and increase sales, she enlisted the player as a climatologist who would use science practices to help find the perfect month and location for Sam to hold a surfing competition. The narrative for the story was focused on the content, and the tone was more academic in nature. Sam was not a compelling character and served more so as a pedagogical agent that one would expect to find in an online learning module. While the narrative allowed some interaction from the player, there was not a motivation inherent in the storyline.

The first prototype was demonstrated to teachers as a whole group at a 3-day professional development training in May 2015. Notes and feedback were recorded through an open discussion format. Teachers felt the use of a surf competition as the context to teach the concepts was very engaging. They also liked the look and feel of the game and the drag-and-drop activity but felt more development was needed. These comments and other feedback were used to make modifications for the next version of the game.

Iteration #2

In the second iteration of *Surf's Up Science*, the use of data visualizations and models was introduced. The revised game design required learners to analyze and interpret several data tables, climographs, and use of a science inquiry notebook to draw conclusions about the influence of global ocean currents on the local weather of a city. The modified version of the game was played by teachers ($N = 29$) in September 2015 at a professional development training, and feedback was obtained through an online questionnaire. According to the survey, 90% of the teachers agreed or strongly agreed that they “think (my) students in science classes will be able to learn key concepts from playing the game,” and 89% agreed or strongly agreed that they “think (my) students in physical science classes will be interested in playing the game.” When asked about game features they liked in SUS, teachers indicated that it has lots of data to work with, it offers scaffolding and interactivity, it emphasizes to students the need to read and analyze before moving on, it is task oriented, and it has the ability to answer questions in an inquiry notebook. Suggested modifications and improvements included adding more competition, improving navigation with using the multiple data sources, and decreasing the length of the game.

Iteration #3

Major features of the third iteration game design were a pre-training level that included an interactive animation used by the player to develop a model of the ocean conveyor belt, mean temperature and precipitation data charts, an improved ocean current map, climographs, satellite images of specific locations, and a static ocean conveyor belt graphic. Also the inquiry notebook was provided for learners to reflect using open-ended responses rather than selected responses. An offline game board and wraparound curriculum materials were also developed to accompany *Surf's Up Science*.

The third iteration of SUS introduced a villain, Wade Waverly, to the storyline. A major shift was made within the story for this version. Rather than keep the narrative external to the game (exogenous narrative), the narrative was made an integral part of the game with no separation between the content and game play (endogenous narrative) (Dickey, 2015, p. 73). Kody, Wade, and the player were given characteristics that were expected to resonate with middle school students such as Kody's use of surfer lingo, Wade's brief yet cryptic clues, and the conversational style used in the feedback from the game. These aspects were expected to resonate with learners based on initial feedback on an early prototype of the game. The new function of the narrative used the story to promote interest, to encourage student motivation, and to establish emotional proximity through the narrative structures (cutscenes, plot hooks, setting, etc.) and game features incorporated.

The third iteration was piloted with a total of 89 students at grade six, seven, and eight in three schools. Student Perception Survey data were collected from 22 students. Game play logs were collected from 65 sixth-grade students. This data was used to inform iterations in the instructional, technical, and assessment designs of the game.

Discussion and Future Research

Survey results from the preliminary evaluation of SUS showed the content-based narrative story activated and maintained situational interest of middle school students in playing the game and learning the influences of global ocean currents on local weather. Students felt the story, and characters made the game and learning more interesting. They felt connected to the characters of Kody Kahuna and enjoyed the pursuit of the protagonist, Wade Waverly. The story helped to set the context, tone, and mood for the game, facilitated game play, and assisted with students persisting with difficult content. However, due to the small sample size of the survey data, more research is needed to replicate the results.

For future research, the designers would like to study the effectiveness of various narrative structures such as the different types of characters, different plot lines, different types of cutscenes (flashbacks, cliffhangers, red herrings, parallel action), and the integration of backstory on the learning of science content and inquiry practices with digital games. We would also like to examine the use of humor in game narratives as a strategy for learning and the affective experience through gauging student empathy for different game characters. An ultimate goal is to develop guidelines for developing characters, settings, and backstory for game narratives in science learning with digital games.

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Indiana University Plagiarism Tutorials and Tests: 14 Years of Worldwide Learning Online

Theodore Frick, Cesur Dagli, Kyunghbin Kwon, and Kei Tomita

Abstract We briefly tell our story about the Indiana University Plagiarism Tutorials and Tests (IPTAT) from the original design and development in 2002 through 2016. Widespread cheating on the Certification Test in 2012–2013 required us to redesign the test. The changes resulted in a structure that offered billions and trillions of test combinations for undergraduate and graduate students. These more difficult tests indicated a need for improving the tutorial and for incorporation of *First Principles of Instruction*. Next, we briefly illustrate how each principle was implemented. Finally, we summarize the usage of the redesigned IPTAT in 2016 and empirical findings on instructional effectiveness.

Keywords Plagiarism tutorial • Student learning assessment • Instructional design • Student cheating • First Principles of Instruction • MOOC • Online instruction • Online testing • Instructional effectiveness

Early Years: 2002–2015

The tutorial and test on *how to recognize plagiarism* was originally developed for use by students in the Instructional Systems Technology (IST) department at Indiana University, starting in September 2002 (Fig. 1). As other instructors and students have since discovered these online resources on the web, and by word of mouth, tutorial and test usage have been increasing each year, almost exponentially (Fig. 2).

Throughout the 14 years of design, development, modification, and usability testing, the plagiarism tutorial design team has consisted of a variety of members. We refer to the changing group as the plagiarism tutorial *design team* in telling our story. A link to the major contributors is provided at <https://www.indiana.edu/~academy/firstPrinciples/credits.html>.

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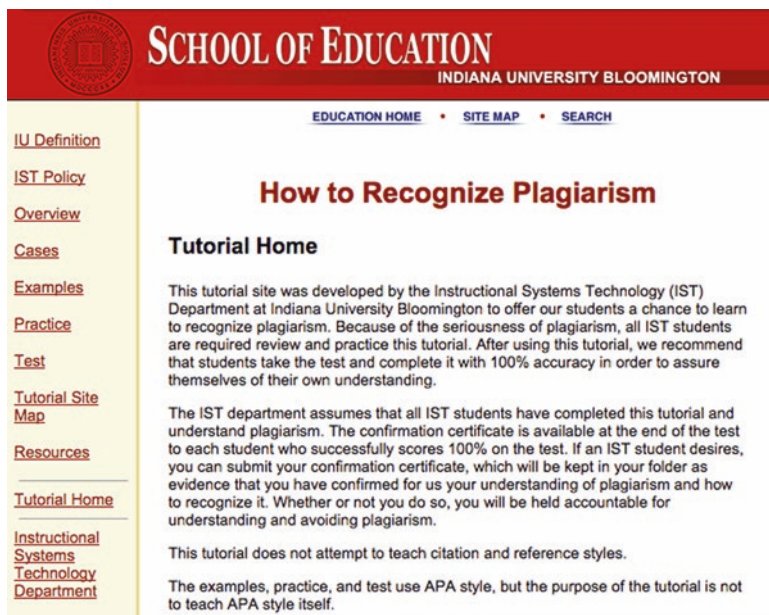


Fig. 1 Home page of the original tutorial, circa 2003

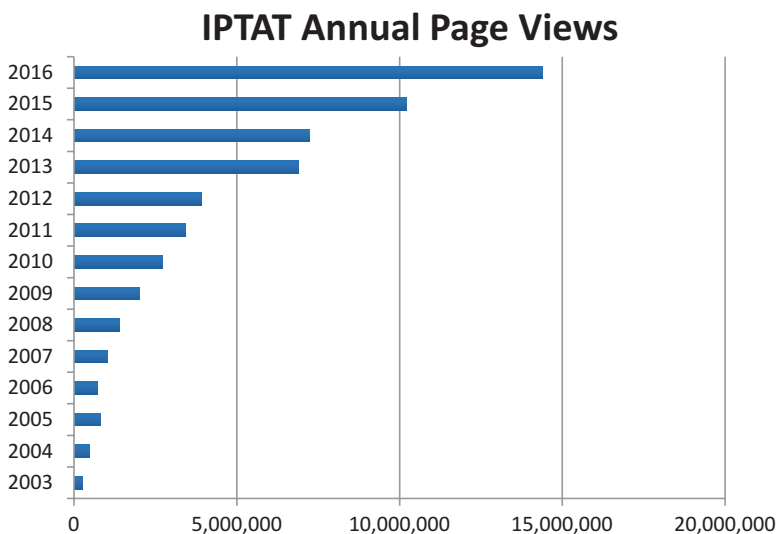


Fig. 2 Annual page views (i.e., total web requests) of the Indiana University Plagiarism Tutorial and Tests, 2003 through 2016

The plagiarism tutorial and tests have undergone numerous changes over the years. To simplify matters, we refer here to the IPTAT, Indiana University Plagiarism Tutorials and Tests. The current version of IPTAT is located at <https://www.indiana.edu/~academy/firstPrinciples/index.html>.

The design team has learned through correspondence initiated by instructors that many now require their students to take this test. We have no control over who uses our tests and for what purposes. Our goal is to help people understand what plagiarism is, so that they do not commit plagiarism in their writing and presentations. At this time, anyone is welcome to use our learning resources and tests for free.

Aside from minor corrections and modifications, the original tutorial and ten-item test remained largely the same between 2002 and 2012.

Recent Improvements in the Plagiarism Tutorial and Tests

Based on feedback the design team has received from college and high school instructors whose students use our online tutorial, we describe major changes between 2013 and 2015. Users normally contact us by clicking on a link provided at the bottom of nearly every Web page in the tutorial. This link goes to a simple web form to complete and when submitted sends e-mail to a hidden address, which we monitor regularly. This primary feedback loop with users, combined with weblogs on tutorial access, provides impetus for making changes to improve the tutorial and tests.

Defeating the Cheating: Major Changes in 2013

Several instructors had sent e-mail in 2013 who were highly concerned about the validity of the ten-item test in the IPTAT. They suspected widespread cheating was going on, and thus certificates granted were highly questionable. They provided a link to a YouTube video, where the answer key was contained in the video. The creator of that video also mocked the test as a useless waste of time, initially posted in late 2012.

In mid-July 2013, Frick changed the order of the ten-item test and renumbered them. Within a few days, comments posted below the YouTube video indicated frustration that the answer key no longer worked. A new post subsequently provided the new answer key, followed by further comments expressing gratitude.

A week later, the test items were scrambled again, and within 24 h, a new answer key was posted. After several more repetitions of this pattern, Frick decided that something different was needed. Meanwhile, access to the YouTube video literally doubled by mid-August and kept increasing daily as the fall semester began.

Developing a Better Test The plagiarism tutorial design team met and planned for how to minimize this kind of cheating. First, a much larger item pool needed to be developed. Second, a PHP script was necessary to present items in a random order, judge the answers, and provide feedback. This was accomplished in about 3 weeks and implemented in early September. There were now billions of unique combinations of ten-item tests.

Not surprisingly, the design team received a lot of e-mail from students who complained about “how hard” the test was, and also from instructors who were unaware of the sudden changes and who had told their students about the previous test. So the design team added explanations on the website which informed users of the changes.

Defeating Test Answer Guessing and Use of the “Back” Button A further strategy for passing a test that had been in use (even before the new randomized tests) was to just guess answers to the ten items, to get feedback on the numbers of right and wrong answers. Then a student would click the “Back” button in their web browser, change an answer, resubmit their test for evaluation, and get further feedback on the number of right answers. Basically, through this trial-and-error strategy, students could improve their results until they passed. In fact, the design team already knew about this strategy, which was confirmed by examination of weblogs on test attempts and passing rates.

The solution to this problem was not simple. Once a Web page is accessed via a user’s web browser, that page is cached locally on their device. When the “Back” button is clicked, the browser just displays the cached page and does not need to make a new request for the page on the website. Scripting a solution to this problem was extremely vexing. Even JavaScript code did not solve the problem, because all a user had to do was to turn off JavaScript in their web browser. This cat-and-mouse game continued between the design team and student users. The motivation for passing a test and earning a certificate was largely due to instructors who required their students to present their certificates for credit in classes they were taking. And students apparently were less interested in learning about plagiarism than they were about finding an easy way to get their assignment completed without spending a lot of time.

The ultimate solution to the problem involved creation of unique test IDs associated with each test attempt. It also required storing a unique file (on the web host site) for each test attempt that contained the sequence of test items and the number of correct answers whenever someone failed a test. Thus, if the “Back” button strategy was attempted, the PHP script would check to see if a file existed with the unique test ID with the exact sequence of test items attempted. If so, no further feedback was provided and that user’s only option was to take a new test, with ten new questions randomly selected from the large pool.

This solution created a very large number of unique test attempt files on the website host and further required a daily maintenance strategy. Literally, as many as 3000 new files were created daily during peak usage times. To prevent very large

numbers of files accumulating rapidly, a Linux “crontab” job was automatically run at midnight to remove each day’s new files.

A further strategy students used to cheat was via collaboration. One student would pass a randomized ten-item Certification Test and receive the customized certificate sent to him or her. Then another student would use the same computer, click the “Back” button several times, enter their unique information (name and e-mail address), click the “Submit” button, and receive their own certificate *without taking and passing a new test*. The design team confirmed this by viewing the weblog of certificates granted, where the design team would see a sequence of certificates with different student names and e-mail addresses but with identical time stamps, IP numbers, dates, and test durations. There was not much the design team could do about this at the time, other than warn instructors to look out for certificates that were the same except for the students’ names (the IPTAT had inserted IP numbers, etc. on each certificate).

One indicator of our success in defeating the kinds of cheating described above was the number of complaints the design team was receiving from students who were unable to pass a test and who were “sure” that the testing system was broken. Our stock answer was that the tests were operating properly, and asked whether or not they had done any of the tutorial and practice tests. Most of the time, the design team just ignored these complaints.

After implementing these changes early in 2013 fall semester, the design team also received more e-mail from college and high school instructors who were getting complaints from their students about the new tests. Many instructors were unaware of the changes the design team had recently made. The design team added a link to the Web page that described the changes, dates made, and reasons why.

A few highly frustrated students did e-mail us who said they completed the entire tutorial and passed 10–20 practice tests, but they *still* were not able to pass an IPTAT Certification Test. Practice tests were similar to Certification Tests but included specific feedback on right and wrong answers, unlike Certification Tests that only indicated whether or not a test was passed.

Overall, the most frequent complaint was: “Why don’t you tell us which questions we missed and why? How are we supposed to learn from the test?” And the design team knew from weblogs that the tutorial pages were accessed relatively infrequently in comparison to the astronomical numbers of test attempts. Students apparently were convinced that if they tried enough times, they would eventually pass. This is not true. They must take time to learn from the tutorial. The design team also knew from weblogs of test attempts that the passing rate was under 10%. The design team also could observe logs in real time, where the same IP number was repeated in succession over a short period of time, resulting in failures until that individual passed a test.

Improving Instructional Feedback from a Test: Major Changes in 2014

The biggest problem that remained with the new ten-item tests, selected at random from a large inventory, was that feedback after failing a test was not helpful to students. Starting in fall 2013, the IPTAT no longer told them which questions were answered correctly and which were missed. This was done on purpose in order to protect the test item pool and to minimize cheating via use of answer keys that were prevalent in the past. From our perspective, the tests were much more valid than previously. From a student perspective, the tests were “too hard.” The IPTAT was violating their expectations for feedback by not telling them about their mistakes and how to correct them. From their perspective, the IPTAT was providing poor instruction, or worse, that the instructional designers were incompetent, lousy teachers. A frequent question: “Why does it [the IPTAT] not tell me how many questions I missed and what the right answers are, so I can learn from the test?”

Identifying Patterns of Plagiarism The solution for providing better feedback without compromising the item pool and to discourage cheating was by identifying patterns of plagiarism in the test for undergraduate and high school students. Frick identified 15 different patterns of plagiarism, in addition to 2 patterns of non-plagiarism. See <https://www.indiana.edu/~academy/firstPrinciples/plagiarismPatterns/>. Each item in the inventory was coded as to type of plagiarism. Each pattern was given a catchy name such as “clueless quote,” “crafty cover-up,” “devious dupe,” “severed cite,” etc. New Web pages were developed for each pattern. Each pattern page provided a prototypical example illustrating the pattern, a detailed explanation of why it is plagiarism, and very importantly modeled how to fix the plagiarism.

This solution not only provided many more examples as part of the tutorial, but also gave us a way to provide better feedback if a Certification Test was not passed. While the IPTAT still did not provide specific feedback on which questions were missed, it instead provided feedback on the *types of mistakes* being made. This was accomplished by providing one or more links to respective patterns of plagiarism on Web pages during test feedback. If a pattern was repeated in the test, only one link was provided. In general, students could roughly guess how many items were missed according to how many pattern links were provided in Certification Test feedback, but it was not an exact count. In a randomly selected ten-item test, it was very likely that one or more patterns would be repeated.

The consequence of this improvement in Certification Test feedback was to double the passing rate, from about 8% to 15% at the time this change was implemented.

Creating Separate Tests for Graduate Students As part of his dissertation research, Andrew Barrett (2015) created a new, even larger item pool designed for master’s and doctoral level students. His dissertation, available online in ProQuest, describes his work in detail. This test was administered on a different website. Test length was not fixed, but depended on adaptive testing algorithms for computerized classification

testing. Thus, items were presented one at a time, unlike the undergraduate and advanced high school student tests, which each consisted of ten randomly selected questions presented on a single Web page.

Feedback on the graduate-level test was different also. Instead of identifying patterns of plagiarism, this test indicated how many questions were missed according to failure to identify plagiarism when it was in fact word for word, when it was paraphrasing, and failure to identify non-plagiarism when in fact it was.

For the graduate-level Certification Test, users complained that on rare occasions an error occurred, abruptly terminating their test with no feedback and requiring them to start a new test. After numerous efforts to trace and correct this problem, the design team concluded that it was likely dependent on the device and web browser being used (often corrected by changing their device or restarting it), or a session timeout occurred because of too long a time interval between answering one question and the next.

Certification Test Registration Added in 2015

Registration for the Certification Test for undergraduate and high school students was implemented in August 2015. This made it easier for test takers to retrieve their certificates by later logging in with their e-mail address and password created during registration. Furthermore, registration before taking a test made it no longer possible to receive spoofed certificates via collaboration and use of the “Back” button. Information entered when registering (name and e-mail address) could no longer be changed after a test was passed. Finally, a spoofed certificate could not be validated as legitimate.

Instructors could also view certificates, as before, by entering the unique test ID provided by the test taker and either the IP address or user e-mail address to confirm the validity of the certificate.

One surprising and interesting finding: about 5% of users had difficulty registering because of errors in their e-mail address. Part of the registration process required them to confirm their identity by going to their e-mail account, opening the message sent from the IPTAT, and then clicking on a link that returned them to the IPTAT. This also explained why some users in the past never received their certificates for passing—they mistyped their e-mail address! And then blamed the IPTAT for failing to send them the certificate they had worked so hard to earn.

A detailed list of the history of changes to improve the IPTAT is provided at <https://www.indiana.edu/~academy/firstPrinciples/recentChanges.html>.

Major Redesign of IPTAT in 2015

The design team redesigned the IPTAT for several reasons: First and foremost, the design team wanted to improve the effectiveness of the tutorial. The new design implemented *First Principles of Instruction* (Merrill, 2002, 2013). Merrill (2002)

had claimed that—regardless of specific content, teaching methods, or programmatic subject matter—student learning would be promoted to the extent that each of the *First Principles* is implemented in design of instruction. In addition to using *First Principles*, the design team wanted to carry out research to evaluate how these five principles of instruction affect student learning. In particular, is Merrill's claim supported by empirical evidence on student usage of parts of the IPTAT and successful learning as indicated by passing a Certification Test?

First Principles include:

1. Provision of *authentic tasks or problems*, sequenced from simple to complex
2. *Activation* to help students connect what they already know with what is to be newly learned
3. *Demonstration* of what is to be learned
4. *Application*, where students try to do the tasks or solve problems with instructor guidance and feedback
5. *Integration* of what is learned into students' own lives

A variety of pedagogical methods can be used to implement each principle, depending on the types of learning objectives, content being taught, and levels of schooling (elementary, secondary, postsecondary). See Merrill (2013) for in-depth description and numerous examples of *First Principles of Instruction*.

The redesign process took place over a period of about 9 months, with the bulk of the development and production completed in late 2015.

Authentic Problem Principle

This required us to design a series of authentic problems in recognizing plagiarism, arranged from simple to complex. We did so, as indicated on the menu at <https://www.indiana.edu/~academy/firstPrinciples/tutorials/index.html>. As can be seen in Fig. 3, problems are arranged at five levels of difficulty in recognizing plagiarism: basic, novice, intermediate, advanced, and expert. At each level of difficulty, we provide activation, demonstration, application, integration, and a practice test.

Activation Principle

We decided to design and develop ten video cases as a means of student activation—providing real-world cases for students to experience vicariously. Storytelling is an instructional method which we implemented in our new design to embody the *activation* principle (e.g., see Andrews, Hull, & Donahue, 2009). View an example of a video case at <https://www.indiana.edu/~academy/firstPrinciples/tutorials/task1/activation.html>. Similar video cases that tell stories are provided at each of the five levels of task difficulty (Fig. 4).

Start with *Basic Level*, and then proceed to more difficult levels.

Basic Level: Recognize the basic difference between:

- *avoiding* plagiarism, and
- *committing* plagiarism.

Novice Level: When *one source is used*, recognize a proper quotation from an improper quotation:

- a *proper quotation* of someone else's words, and
- provision of the appropriate citation and reference.

Intermediate Level: When *one source is used*, recognize a proper paraphrase from an improper paraphrase:

- a *proper paraphrase* of someone else's words, and
- provision of the appropriate citation and reference.

Advanced Level: When *one source is used*, recognize various combinations of:

- *proper/improper paraphrasing*, and
- *proper/improper quotations*.

Expert Level: Put it all together. When *two or more sources are used*, recognize various combinations of:

- *proper/improper paraphrasing*, and
- *proper/improper quotations*.

Fig. 3 Five levels of difficulty in recognizing plagiarism

To begin, watch this brief video of a teacher meeting with a student who has committed plagiarism. Click on the one-minute video below.



Video too slow? [Click here](#) for lower quality video.

Fig. 4 Initial video case in the IPTAT on the starting page, for the activation principle

Demonstration Principle

Here we chose to design 12 screencasts that dynamically portray the writing of a whole, short paper (overlaid with audio explanation of ongoing visual changes in the paper and why they were being made). Examples dynamically show the author committing plagiarism and how he fixes it in order to avoid plagiarism. See, for example, demonstrations at task level two: <https://www.indiana.edu/~academy/firstPrinciples/tutorials/task2/demonstration.html> (Fig. 5).

Word-for-word Plagiarism, and how to fix it so it is not plagiarism.

Click on each video to watch.

Example 1. *When quoting from an electronic book where there are no page numbers but locations.*

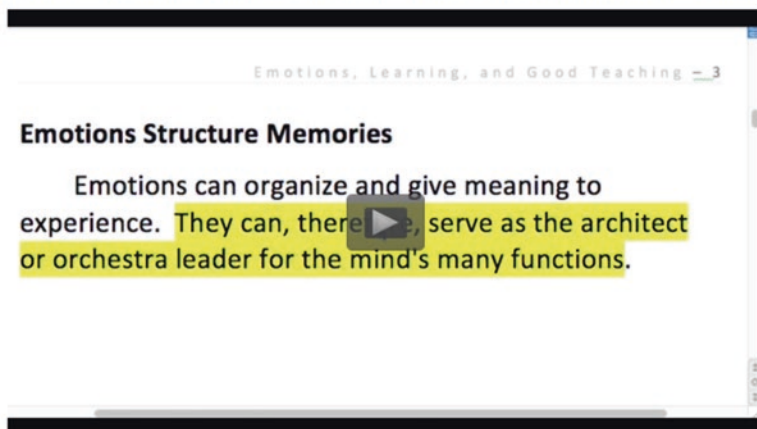


Fig. 5 One of the 12 screencasts that illustrate plagiarism and how to fix it, for the demonstration principle

Application Principle

Here we developed questions similar to those on the IPTAT Certification Tests but with two differences. Question difficulty matches the level of task difficulty at each of the five levels. Immediate feedback on the correctness of each answer is provided. In addition, if the answer is incorrect, a detailed explanation of why it is incorrect is provided. Also if needed, explanation is provided on how to correctly fix the student version to avoid plagiarism. For example, see task level three practice items: <https://www.indiana.edu/~academy/firstPrinciples/practice-Test.php?task=3&item=1> (Fig. 6).

Integration Principle

This was perhaps the most challenging principle of instruction to implement in an online tutorial with no human instructor regularly available. We decided to do this by giving students an opportunity to reflect on what they just learned and how it might be used in their own lives. See, for example, the integration activity at the task four level of difficulty: <https://www.indiana.edu/~academy/firstPrinciples/tutorials/>

Feedback on Question 1 of 4

Question 1 answer is incorrect. Please see the feedback below.

Original Source Material: Instructional design theory requires at least two components: methods for facilitating human learning and development (which are also called methods of instruction), and indications as to when and when not to use these methods (which I call situations). Reference Reigeluth, C. M. (1999). What is instructional design theory and how is it changing? In C. M. Reigeluth (Ed.), <i>Instructional-design theories and models volume II: A new paradigm of instructional theory</i>. Mahwah, NJ: Lawrence Erlbaum Associates.	Student Version: Two components must be present in an instructional design theory. The first component (methods) describes how human learning will be supported, and the second component (situation) describes when certain methods ought to be used.
Explanation: The student version is paraphrasing plagiarism because it contains a summary of another author's ideas, but the in-text citation with the author and date is missing, and the reference is missing.	Correct Version: Two components must be present in an instructional design theory. The first component (methods) describes how human learning will be supported, and the second component (situation) describes when certain methods ought to be used (Reigeluth, 1999). Reference Reigeluth, C. M. (1999). What is instructional design theory and how is it changing? In C. M. Reigeluth (Ed.), <i>Instructional-design theories and models volume II: A new paradigm of instructional theory</i>. Mahwah, NJ: Lawrence Erlbaum Associates.

Please also see the item pattern for Question 1: Cunning Cover-Up.

Fig. 6 An example of feedback to an incorrect answer on a practice question, for the application principle

[task4/integration.html](#). Here we do not provide feedback on what students write in the text input box, but we do store their comments for later qualitative content analysis to be done as part of research studies (Fig. 7).

The production version of the IPTAT is now available at <https://www.indiana.edu/~academy/firstPrinciples/>. A summary of differences between the original and the new design are provided at <https://www.indiana.edu/~academy/firstPrinciples/choice.html>.

Instruction: Reflect on what you've learned at the *Advanced Level*

You should avoid both *word-for-word* and *paraphrasing* plagiarism. Think about a situation in your own life where you would want to write or speak about *someone else's ideas*, where you would want to both directly quote and summarize their ideas.

Click in the text box below, and briefly tell us about this. We will not share your comments with others.



[Continue to Practice Test at the Advanced Level](#)

Fig. 7 Example of a reflection activity, for the integration principle

Use of the Redesigned Indiana University Tutorials and Tests (IPTAT)

Access to the IPTAT in 2016

For the new, redesigned version of the IPTAT, the design team has been using Google Analytics to track and report usage. After the new IPTAT was implemented, Google Analytics indicated data as follows from January 2 through December 30, 2016:

- 725,874 user sessions, 373,877 users, with each session lasting about 24 min, with 48% return visitors, about 86% whom are from the USA, 4% from China, 3% Canada, and the remaining 7% from 192 other countries.
- About 14.4 million page views of which 8.8 million are unique.
- 494,172 video stories have been viewed to completion (within activation and demonstration phases).
- At peak usage times there are typically 250–300 concurrent user sessions occurring in real time. Peak usage times were typically Monday through Thursday and much higher early in spring and fall semesters.
- The most frequently accessed pages are those which provide individual feedback with explanations of right/wrong answers after each practice question (in the application phase), with 1,926,928 page views.

Student Learning Outcomes in 2016

Results from record keeping done via the IPTAT indicated that between January 2 and December 30, 2016, there were 178,386 users who successfully registered; and 145,229 unique individuals had passed a Certification Test. That is, 81% of registrants had learned to recognize plagiarism at a high level of mastery, which is a very

good success rate; overall, about four out of five students successfully learned via the IPTAT to recognize word for word and paraphrasing plagiarism, as well as non-plagiarism.

Results further indicated that *graduate* students were about five times more likely to *pass* a Certification Test when they *agreed* before taking their first Certification Test that they experienced *First Principles of Instruction* and *Academic Learning Time* (ALT), when compared with those who *disagreed* that they experienced *First Principles* and ALT.

Prior to taking a Certification Test, students optionally completed a short survey on their perceptions of Teaching and Learning Quality (TALQ scales) (Frick, Chadha, Watson, Wang, & Green, 2009; Frick, Chadha, Watson, & Zlatkovska, 2010). Students were also asked about which parts of the tutorials they completed. Likert scale responses to TALQ scales were reclassified as to whether a given student agreed or disagreed with statements which comprise scales that, respectively, measure *First Principles of Instruction* and *Academic Learning Time* (ALT, or successful student engagement in learning activities). TALQ items had been slightly modified for use with MOOCs (massive open online courses), where instruction is delivered online and no human instructor is present (Frick & Dagli, 2016). Modified TALQ scales (referred to as MOO-TALQ) were highly reliable. Cronbach *alpha* coefficients ranged from 0.74 to 0.94.

Students were classified according to whether they passed or failed the Certification Test they immediately took after completing the TALQ survey. Correctly answering at least nine out of ten randomly selected questions from large item pools was required for passing a test. We conducted a variant of analysis of patterns in time (APT) to form likelihood ratios to determine odds of each pattern occurring (see Frick, 1990; Frick et al., 2009, 2010). Results below are based on data collected over 20 days in January 2016, only for students who agreed to participate in this study and who optionally completed the TALQ survey prior to taking their initial Certification Test.

For graduate students, 119 out of 300 (0.397) who completed the TALQ survey agreed that they experienced *First Principles* and ALT, and of those, 35 students passed the immediately following Certification Test ($35/119 = 0.294$). Of those 17 who did *not* agree with experiencing both *First Principles* and ALT, only one student passed a Certification Test ($1/17 = 0.059$). Thus, the odds of passing for those who agreed vs. disagreed were $0.294/0.059 = 4.98$, or approximately five to one. Another way of viewing this is that 16 out of 17 students who disagreed with experiencing *First Principles* and ALT failed their first Certification Test ($16/17 = 0.941$). Thus, graduate students were about 16 times more likely to fail the test when they reported that they had not experienced *First Principles of Instruction* and *Academic Learning Time* ($0.941/0.059 = 15.95$).

For *undergraduate and high school students*, the odds of passing were about three to one for the first pattern. There were 1716 of these students who completed the TALQ immediately before taking their first Certification Test. Of the 510 students who agreed that they experienced both *First Principles* and ALT, 146 passed their first Certification Test ($146/510 = 0.286$). There were 192 students who

disagreed with both kinds of experiences, and 19 of those passed ($19/192 = 0.099$). The odds ratio is $0.286/0.099$, or about 2.89 to 1, which means that undergraduate and advanced high school students were about three times more likely to pass their first Certification Test if they agreed that they experienced both *First Principles* and ALT in the IPTAT, when compared with those who disagreed with both kinds of experiences. In a similar vein, 173 out of 192 who disagreed that they experienced both *First Principles* and ALT failed the test ($173/192 = 0.901$). These students who disagreed were about nine times more likely to fail than to pass their first Certification Test ($0.901/0.099 = 9.1$). See Dagli (2017) for further details.

Conclusion

Overall, our findings indicate that when students reportedly do *not* successfully engage in most or all of the tutorials (which were specifically designed to implement *First Principles of Instruction*), those students are between 9 and 16 times more likely to *fail* the first Certification Test they take. If they persist with the IPTAT, approximately 81 percent of them eventually do pass a test.

Approximately 13.4% of Certification Tests taken in 2016 were passed, roughly one out of seven. While multiple tests are taken by most students, pattern analysis indicates that the odds of passing a test are between three to five times more likely when students report that they have experienced both *First Principles* and ALT in the IPTAT.

Thus, empirical evidence that we have collected on worldwide use of the newly designed IPTAT in 2016 supports Merrill's (2002, 2013) claim that student learning is promoted when *First Principles of Instruction* are present.

Afterword

Millions of students worldwide have used our online tutorials and tests and have learned to recognize plagiarism. We have told our story here in some detail, so that readers can appreciate what has taken place over the past 14 years. As described above, modifications of the original tutorial and test on how to recognize plagiarism have been incremental, mostly based on user feedback. Changes became more frequent during 2013–2014, after cheating on the test was reported by instructors who found an answer key on YouTube in 2012. A major redesign of the instruction occurred in 2015, based on Merrill's *First Principles of Instruction*.

Design and development over 14 years has been largely carried out by Frick and his graduate students in Instructional Systems Technology. Through participation in this effort, our doctoral and master's degree students have gained hands-on experience in design and development of online instruction and assessment. Some members of the Frick Research Group have also been using the Indiana University Plagiarism Tutorials and Tests (IPTAT) very recently for collecting data to study the effectiveness of instructional strategies and patterns of student learning that lead to mastery as determined by IPTAT Certification Tests.

To experience IPTAT, go to <https://www.indiana.edu/~academy/firstPrinciples/index.html>.

For details on contributors, go to <https://www.indiana.edu/~academy/firstPrinciples/credits.html>.

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Using Activity Theory in Designing Science Inquiry Games

Yiping Lou and Lucille Moon-Michel

Abstract It's been widely recognized that students in middle and high schools are often disengaged in the didactic science classrooms. Game-based learning has the potential to better engage students in meaningful learning. This chapter describes the design and development of a scenario-based science inquiry game using Activity Theory as a design framework. Evaluation results showed that both teachers and students perceived the science inquiry game positively in increasing the students' situational interests and cognitive learning through active real-world problem-solving activities in a fun and concrete context.

Keywords Game-based learning • Science inquiry • Activity Theory

Introduction

The lack of opportunities for students to explore science and engage in scientific practices has been identified as one of the key problems in science classrooms (NRC, 2007, 2012). The National Research Council (NRC, 2007, 2012, 2013) called for bringing real-life field experiences and hands-on labs to classrooms so that students can learn science meaningfully through scientific practices. Studies on curricula that incorporate content-integrated science inquiry demonstrate that students had better engagement, which resulted in higher learning (NRC, 2007). Many complex scientific concepts are, however, difficult or not feasible for students to learn through hands-on experimentation or field experiences (Prevost, Romero, Moon-Michel, & Lou, 2016). Scenario-based science inquiry games have the potential to engage students in meaningful and contextualized learning (Lou, Hooper, & Blanchard, 2016).

According to a national survey study conducted by the Pew Internet and American Life Project in 2008, 97% of teens aged 12–17 play digital games and 50% play digital games daily or 3–5 days a week for an hour or more on each day (Lenhart et al., 2008). Recognizing the popularity and potential of digital games,

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there is a growing interest among teachers (Fishman, Riconscente, Snider, Tsai, & Plass, 2014), developers (Banville, 2016), educational researchers (Honey & Hillton, 2011; Jabbar, Iliya & Felicia, 2015), and policy-makers (Office of Educational Technology, 2016) in the use of digital learning games to better engage and empower student learning in K-12 classroom. However, more digital games appeared to be used in math classrooms than in science classrooms, which may be due to the availability of appropriate games produced in different content areas (Fishman et al., 2014). In a recent systematic literature review, Martinez-Garza, Clark, and Nelson (2013) synthesized 56 research articles on games for science learning published between 2000 and 2012. The majority of the studies focused on games for content learning (21) and motivation and engagement (16), and only 6 focused on science inquiry skills. This is consistent with the historical central goal of science classrooms that emphasize the learning of separate concepts and discrete facts.

The Next Generation National Standards (NGSS) calls for three-dimensional learning of core disciplinary ideas, scientific and engineering practices, and cross-cutting patterns (NRC, 2013). Effective learning games should align with curriculum and content standards to encourage teacher buy-in and long-lasting impact (Banville, 2016; Fishman et al., 2014). Gaydos (2015) argues that the current way of conceptualizing and discussing game *design* as decontextualized design principles or heuristics, while useful, is inadequate because they miss reflection in action on the design problems and solutions: “Research needs to overcome a major obstacle: How design is conceptualized and discussed” (p. 478). Gaydos calls for educational game research to explicitly define design theories, which can “provide structure to the dimensions of change that are possible for educational game design” and describe the “ways to clearly convey the intentions, the materials, the context, and the interactions between these components as they evolve over the course of development” (p. 481).

This chapter describes the design, development, and evaluation of a scenario-based science inquiry game, *Follow the Heat*, based on situated cognition, Activity Theory, and situational interest as a theoretical framework in collaboration with middle and high school science teachers as part of a Math and Science Partnership (MSP) Grant. The subject matter of the game is heat transfer, which is a core concept often challenging to middle school through college students. Although examples of heat transfer are common in everyday life, students often have misconceptions and struggle to organize conflicting ideas into a coherent understanding and applying them in solving real-world problems (Linn, Davis, & Bell, 2004; Olakanmi & Doyoyo, 2014). Scenario-based science inquiry gaming through narrative storytelling and role-playing can help contextualize the use of science in real life and help students relate to the characters and their activities in the story.

Theoretical Framework

Situated Cognition

According to situated cognition, “knowledge is situated, being in part a product of the activity, context, and culture in which it is developed and used” (Brown, Collins, & Duguid, 1989). Based on this theory, learning occurs from engaging in authentic activities in context (Lave & Wenger, 1990). The learning activities of *Follow the Heat* are embedded in a real-world setting using a narrative story, giving the player the opportunity to connect previous experiences to the subject of thermal energy transfer. The majority of the activities take place in the kitchen, where heating and cooling tools are typically accessible (e.g., stove, oven, refrigerator, freezer, etc.). Players will most likely be familiar with the kitchen setting and functionality of the tools and, therefore, be able to situate their knowledge within the game context.

Activity Theory

The game world of *Follow the Heat* is structured through Activity Theory (Engestrom, 2001), a theoretical framework based on the understanding of how tools and context influence human activity. Six components form the basic model of the Activity Theory: community, subject, mediating artifact, roles, rules, and object. The participants, physical setting, and culture make up the community. The subject refers to the participant who engages in the activity. The mediating artifact refers to the tools used to achieve the object-outcome (the goal) of the activity. The division of labor in the system exemplifies the roles, while the rules provide constraints to the activity (Bertelsen & Bodker, 2003).

Figure 1 illustrates how the six components of the Activity Theory apply to *Follow the Heat*. The diner setting serves as the community component. The player of the game represents the subject, while the food and dialogue among the charac-

Fig. 1 The activity system of *Follow the Heat*



ters portray the mediating artifact. The customers and the server illustrate the roles, and the rules are designated by the fulfillment of food orders via heat transfer. Lastly, the object-outcome is the satisfaction of the customers.

The activity system of *Follow the Heat* uses food and dialogue as the tool for bridging together all the components and ultimately achieving the object-outcome of making the customer happy.

Situational Interest

The level of interest a student has for a subject plays a major role in influencing his or her willingness to learn about it (Schiefele, 1991; Schraw, Flowerday, & Lehman, 2001). Situational interest, the motivational response a student experiences while learning new material (Rotgans & Schmidt, 2014), is explained through two hypotheses: trigger-maintenance and knowledge-deprivation. The first hypothesis posits that interest is “triggered” by a series of events in the learning situation (Durik & Harackiewicz, 2007) and must be maintained in order to facilitate knowledge acquisition (Ainley, 2006). Situational interest can be maintained by presenting information that has personal significance to the student (Hidi & Baird, 1986), providing learners meaningful activities that give them a sense of empowerment (Mitchell, 1993), and including twists and turns to make the information more captivating (Ainley & Patrick, 2006). The knowledge-deficit hypothesis claims that situational interest occurs as a result of the learner’s lack of knowledge in the subject. In this case, the learner’s self-realization of the knowledge deficit inspires motivation to keep studying the information until the knowledge gap is closed (Berlyne, 1954).

The subject of thermal energy transfer might not elicit an enthusiastic response from a student; however, *Follow the Heat* presents this subject through a fun and unique story. The graphics, music, and characters are reminiscent of a 1950s style diner. The concepts of thermal energy transfer are sandwiched within wacky terminology from this era. In addition, *Follow the Heat* integrates the incongruity theory of humor (Berger, 1993; Vandaele, 2002) in the design for the graphical and textual elements of the game. In order to elicit surprise and engagement from users, the requests of the diner customers were designed to be unconventionally picky.

Due to the serious tone educational games tend to take (Dormann & Biddle, 2009), users will presumably expect to read pleasant-natured exchanges of dialogue by the characters in the story. The persnickety disposition of the characters in *Follow the Heat* breaks away from this predictable format to grab the users’ attention and entice them to follow the dialogue.

Game Design and Development

The development of *Follow the Heat* game followed an iterative process based on the design-based research approach (Amiel & Reeves, 2008). It was created as part of a K-12 Math and Science Partnership (MSP) Grant focusing on technology-supported science inquiry lesson development and implementation. The game idea was first inspired by a science inquiry lesson plan, *Investigating How Heat Flows*, developed by one of the participating teachers. The lesson plan (Colon, 2015) includes a hands-on lab where students conduct an investigation that explores what happens when they place a container with hot water inside another receptacle with cold water. While the lab offers a straightforward and constructivist approach to demonstrate how thermal energy transfers between hot and cold liquids, it does not offer the students realistic scenarios for how they encounter this phenomenon in their daily lives.

The game design and development process began by holding a thorough discussion about the original thermal energy transfer lesson plan and then brainstorming for how to transform it into a scenario-based learning game. The following sections describe how the game design aligns with the six components of Activity Theory: community, subject, object, tools, roles, and rules.

Community Context: 1950s Diner

A 1950s style diner called the Big Daddy's Diner was selected as the community context for the *Follow the Heat* game. The player is initially greeted with a catchy rockabilly riff and then transported to a world of 1950s style clothing, lingo, and graphics. This particular time period was chosen for the backdrop of the game because the graphical style is fun and cartoonish, and it offers a plethora of amusing terminology to integrate in the dialogue. According to Dewey (1933), the combination of a playful environment with serious subject matter prompts maximum conditions for learning. If the learner is enjoying the activity, interest in the subject matter is heightened and therefore triggers cognitions for processing the material (Ainley & Ainley, 2011).

Characters and Roles: Waitress and Customers

The main characters in the game include a waitress Beverly Anne, five picky customers, and the owner Big Daddy. The player shadows Beverly Anne as she painstakingly tries to fulfill the requests of the picky patrons. Each customer is featured in one of the scenes.

Object: Fulfillment of Food Order for Customer Satisfaction

The primary object and game goal is the fulfillment of food orders to achieve customer satisfaction. The different customer interactions are segmented into five scenes, each requesting a different food item with picky temperature specifications. Depending on the whim of the customer, Beverly Anne must heat up or cool down a food item with objects in the kitchen. Once this is established, the heating or cooling process takes place, and the food is brought back to the customer for approval. If the temperature does not meet the person's taste, she must go back to the kitchen and try again.

Rules: Heat Transfer

Application of heat transfer is used in fulfilling the food order requests. Each activity requires the player to first determine the best method for adjusting the temperature, declare the direction of thermal energy transfer, and identify what type of thermal energy transfer is being utilized. Once this is established, the heating or cooling process takes place. The variety of scenes offer the player multiple opportunities to explore and apply heat transfer principles in solving the real-world food warming and cooling problems. The climactic Big Daddy scene offers a final embedded and unguided assessment to test the player's knowledge of the direction of heat transfer and forms of heat transfer to help Beverly Anne earn a promotion.

Tools: Food Order and Dialogues

The dialogue of the game is a distinctive element, not only because it incorporates 1950s slang but also because it is humorous and sassy (Fig. 2). The customers' demands tend to be on the ridiculous side, so Beverly Anne's cheeky sense of humor is revealed in her thoughts.



Fig. 2 Scenes from Follow the Heat showing a picky customer's request and waitress Beverly Anne's sassy internal dialogue

In regard to interaction with the user, Beverly Anne exemplifies Clark and Mayer's (2011) personalization principle by employing friendly and informal communication. She gives praise when an activity is performed and provides helpful suggestions for mistakes. Beverly Anne also shows a positive example to students by controlling her frustration with the patrons and maintaining an air of perseverance.

After establishing the 1950s diner setting, server and customer roles, food order scenarios, and sample dialogues with humor, the design process moved to the storyboard and prototype stages. Weekly meetings with the design team were held to examine attributes including functionality, correctness, usability and user experience, legibility, and overall effectiveness following the Successive Approximation Model (SAM) of instructional design (Allen, 2012). In addition to the weekly efforts of the design team, the *Follow the Heat* game underwent several review and pilot testing sessions with the target audience (both teachers and students) to improve usability and game effectiveness.

Teacher Evaluations

A formal teacher evaluation was conducted with a group of 22 middle and high school teachers from 3 districts in Central Florida during a MSP Grant workshop in Fall 2015. Each teacher played the game individually and provided quantitative and qualitative responses through an online survey.

One hundred percent of these teachers strongly agreed or agreed that their students would be able to learn the key concepts from playing the game, and 81% said that the game was very effective or effective in teaching the concept of heat flow. When asked, "In what way do you feel this game is similar and/or different from other games you used with your students," some representative responses included:

- *It is interactive and students practice to make decisions based on evaluation.*
- *It is very engaging, entertaining, and content rigorous. It uses many of these strategies that other games do not use all in one game.*
- *It is different because it uses technology where students can interact in a funny way.*
- *This is a unique game that reflects greatly the concepts of heat transfer.*

In response to the question, "If it's appropriate for your students, when would you like to use it with your students? If not, please describe any concerns you may have," representative responses included:

- *I would love to use it as one of my stations in class during this unit.*
- *I would use it as an engage video to launch the topic to my students and to see what my students know/don't know about the topic.*
- *I would use it to review this standard; however, class time is limited, so perhaps this could be assigned out of class.*

The teachers discovered a few areas of concern in regard to the game's usability. To help clarify the terminology of thermal energy transfer mentioned in the text (e.g., conduction, convection, radiation), the keywords were hyperlinked to a separate glossary screen situated at the beginning of the game. Several teachers expressed concern over this feature because it disrupted the flow of interaction while navigating through the story and activities. To resolve this issue, the hyperlinks were removed from all keywords, but the glossary remained an option in the top navigation area for users to explore at will.

Another issue that disrupted the flow of the game involved the dependence of the "next" button for the progression of events. Initially the exchange of dialogue among the characters and the transitions between the scenes required the user to click the "next" button for every occurrence. The intent of this setup was to give the user total control over the pace of the game, particularly for reading purposes. However, the teachers felt this imposed "too many clicks" on the user and suggested the need for a more seamless progression. To accommodate this issue, many of the "next" arrows were eliminated, and the scenes were formatted to transition automatically. For example, when Beverly Anne speaks to a customer, each dialogue bubble shows for a few seconds before moving on to the next, allowing the user to observe the whole scene after making a single click.

Overall, the teacher evaluation feedback positively confirmed the design, and their suggestions for addressing several concerns greatly improved the usability of the game.

Student Perceptions

Sixty-nine middle school science students from several schools in Central Florida played the *Follow the Heat* game either individually or in pairs depending on the availability of the computers. Data were collected via an online survey comprised of Likert scale and open-ended questions. The survey inquired about student interest in playing the game and their perception of the game effectiveness in helping them understand and apply heat transfer concepts and principles. Overall, the majority of the students agreed or strongly agreed that they enjoyed playing the game and that it was effective in teaching them thermal energy transfer concepts.

Situational Interest

Overall, 81% of the students either agreed or strongly agreed that they liked *Follow the Heat* game. Thematic analyses of open-ended responses indicated several game features that impacted on their situational interest in playing the game.

Real-Life Applications

- *My favorite part was giving you real-life situations.*
- *I also liked how it was set in a diner to help show that people use heat transfer in their daily jobs and how it's a very common thing.*
- *That they didn't grade you on what you got wrong or right and you had to help people in the diner as if you actually work there.*
- *The part when you got to change the temperature of stuff with other stuff.*

Dialogue

- *Sometimes the remarks that the chef made after the customers complain. For instance, she would say how they could do it themselves instead of making her work.*
- *I like that the game gives real-life comments from the customers.*
- *I liked the graphics and wording of the game.*
- *When we heard the customers speak to us.*

Fantasy and Humor

- *I like how you get to interact and make whatever is wrong with the food or beverage for the people who do not like it and how it is set in the 1950s in a diner.*
- *Where the customer was rude and stupid because it gave us positive role models.*
- *The way the characters acted.*
- *Character text. Effort to make it entertaining.*

Game Mechanics

- *The parts of the game I enjoyed most were the game mechanics and the handicaps it gives you (such as the thermometer).*
- *The fact that if we get the answer wrong, it gives us chances to pick the correct response.*
- *When you were allowed to heat up the coffee to your own temperature.*
- *The information of heat going through an object.*

Learning Effectiveness

Results of the Likert scale questions show that 96% percent of the students felt that the game was effective in helping them learn heat transfer, 90% responded that the real-life applications in the game were effective in helping them learn about the direction of the thermal energy flow, and 80% reported that the real-life applications were effective in helping them learn the formats of thermal heat energy flow. In the open-ended responses, students described the features that were effective for their learning, especially active participation and critical thinking when playing the game:

- *When you had to change the temperatures and take freezing point into consideration. The dragging of the answer choices. Because you had to use critical thinking and remember the freezing points. Also, because you were able to participate in the activity.*
- *Being able to interact with it because you can't learn without interaction.*
- *When you drag the arrow to show how you think the heat is transferring.*
- *Hands-on learning, because it helps me learn better.*
- *It explains the choices.*
- *Having to heat the object because it is interactive.*
- *Also, it's a fun and visual game that we can learn from effectively.*

Suggestions for Improvements

A few students, however, wanted to make the character and stories more realistic to see actual real problems. For example, one student suggested that “the stories can be a little more realistic, maybe the guy doesn’t have to be so rude. Another suggestion is to create levels and “have more difficult questions to have us think a little more.”

Conclusion and Future Research

It has been widely recognized that many students in middle and high schools are often disengaged in the didactic science classrooms. This chapter describes the design and impact of *Follow the Heat*, a scenario-based science inquiry game, on middle school students’ situational interest and learning of heat transfer. Activity Theory (Engestrom, 2001) was used as a theoretical framework in conceptualizing and discussing the game design. Quantitative and qualitative survey results show that the scenario-based game was effective in keeping the students engaged and help them learn. Teachers identified a variety of ways that they would incorporate the game in their teaching. These include using it as one of the stations during the teaching of heat transfer, as an introduction to the topic and to gauge student prior knowledge, as a review in class or outside of class. Features identified as contributing to students’ situational interest and learning include simulated real-life applications of heat transfer principles, active student participation and critical thinking, dialogues, and humor.

This case study showed that Activity Theory provides both a theoretical and practical framework for designing science inquiry games. Specifying and explicitly designing the six components based on the Activity Theory ensure that the science concept learning and scientific practices are integrated in a fun and challenging game to solve authentic problems in a real-world context that students can relate to. The framework made the science game design, development, and evaluation more

explicit and fun for the designers as well. More research is needed in the effective design of game-based three-dimensional science inquiry learning and assessment using Activity Theory. More studies are needed in exploring and replicating the application of Activity Theory in the design, development, and evaluation of science inquiry games that support three-dimensional science learning as called for in the NGSS (NRC, 2013).

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An Instructional Designer's Story of Designing Gender and Sexuality Courses

Amy M. Grincewicz

Abstract Stories are the most efficient way of storing, retrieving, and conveying information. This chapter tells the story of an instructional designer's efforts to design an engaging, effective, and high-quality online program for the Study of Gender and Sexuality. The designer created a unique pathway for design success for this program that can be mirrored by other designers. This pathway was created by integrating all the principles of story into the design process. This pathway involves five phases that result in the production of the course story. The five phases are review what has already been done, create a pedagogical framework, capture the student experience, create a seamless course by utilizing a team, and create the story of the course.

Keywords Instructional design • Story • Gender and sexuality • Online programs • Genderful pedagogical framework

Introduction to Story

A story is a narrative account of events. Stories are used to share knowledge, experiences, beliefs, and values. Through story, we explain what and how things are and why they are, and we affirm our role and purpose. These accounts of experience put knowledge into meaningful contexts (Lave & Wenger, 1991). Stories assist with communicating, learning, and thinking by being an efficient way to store, retrieve, and convey information (Gargiulo, 2005). As stories are exchanged, memory structures are built (Schank, 1991). Consequently, we remember what we tell. Stories allow us to explore and appreciate experience from different perspectives (McEwan, 1995). They can also function as a substitute for direct experience which novices may not possess (Jonassen & Hernandez-Serrano, 2002). Stories are used by humans to communicate their experiences, make meaningful connections between those experiences, and advance their development by reexamining past experiences

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in lieu of new information. The importance and power for story narratives lie in their ability to make sense of events, call up memories, teach lessons, inspire empathy and enthusiasm, and suspend disbelief.

Foundation of Storytelling Within Design

Stories have great potential for improving design processes (DeLarge, 2004; Parrish, 2006). Stories help us understand complexity, build recognition and relevance, foster a connection, and build trust (Sametz & Maydoney, 2003). Stories have been used in service design (Kankainen, Vaajakallio, Kantola, & Mattelmaki, 2012), to design medical devices (Gausepohl, Winchester, Arthur, & Smith-Jackson, 2011), and as the foundation for online courses (Hirumi, Sivo, & Pounds, 2012). Utilizing story for design allowed for the exploration of customer journeys to create a flexible pathway for getting input to enhance the design (Kankainen et al., 2012), focus on the user experience (Gausepohl et al., 2011), and increased motivation to participate (Hirumi et al., 2012). Design stories are a useful tool in several of the design steps (Parrish, 2006).

It is clear from the literature that narrative and story, with their practical applications in education and performance environments, are powerful heuristics. Storytelling and instructional design have a lot in common, as shown by their unique connections to story elements. In instructional design we have instructional strategies, theories, and models; in a story we have a plot. The plot is the foundation to the story; instructional designers utilize strategies, theories, and models as a foundation for the design of instruction. In instructional design, we have outcomes, tasks, and processes; in a story, we have a moral or an underlying theme or symbolism. A theme is the story's heart that binds together the other elements. In course design, the course's outcomes guide all the other elements by being the focus of the course. In storytelling, we have characters; in instructional design, we work in design teams with each member having a unique contribution to the course design. Effective stories, like effective instructional design, need to focus on integrating all these elements to create a holistic work of art.

One difference between story and instructional design is that storytellers take the time to provide information on the context and the environment in which the story takes place. Instructional designers typically are designing instruction for a content area in which they have little or no subject matter knowledge. In storytelling, storytellers aim to create connections to the audience; in most design tasks, instructional designers just focus on creating the pedagogical framework and have no connection to the audience for the design. Instructional designers of online courses support faculty rather than students, but they consider students in the design.

Incorporating all storytelling principles into instructional design can improve the design process and create a quality online course. I have applied narrative and story to instructional design models for designing courses within a Gender and Sexuality

online degree program. I have had success in the utilization of story to have subject matter experts designing engaging and effective course content. By going through the story of design, subject matter experts are composing a story for each course module, which in turn becomes the course story. Parrish (2006, p.78) described the following guidelines of design story: (1) utilize stories to explore design and create a coherent learning path, (2) communicate the design of the story, (3) utilize the learner perspective, (4) document a desired vision, (5) include learner reflections, and (6) consider multiple learner perspectives and learning preferences. Each of these elements is included in creating the course story.

Online Gender and Sexuality Program

Once upon a time, a large university sought to establish a faculty-led academic unit that expands and integrates the existing Lesbian, Gay, Bisexual, and Transgender (LGBT) Studies and Women's Studies programs. An innovative associate professor of sociology led the formation of this new unit that integrates the LGBT and Women's Studies programs in the creation of a Center for the Study of Gender and Sexuality. This academic unit will bring the university to the forefront of gender and sexuality research while creating new online courses for the exploration and understanding of gender and sexuality. In addition, the existing courses within the LGBT Studies and Women's Studies programs are being redesigned to create engaging, effective, and quality online courses that stem from the knowledge of stellar researchers across multiple disciplines.

The mission of Center for the Study of Gender and Sexuality is to advance the interdisciplinary scholarly exploration of gender and sexuality and to create and share knowledge with students, scholars, and the public. The Center will advance the scholarly exploration of gender and sexuality through four areas: academic programs, public scholarship, research, and student academic services. In regard to academic programs, the Center supports three independent but linked interdisciplinary undergraduate academic programs: (1) Gender and Sexuality, 2) LGBT Studies, and 3) Women's Studies. The Gender and Sexuality program is new, unlike the LGBT and Women's Studies programs that exist primarily in face-to-face offerings. Existing face-to-face LGBT Studies and Women's Studies courses are being redesigned for online delivery along with the creation of new online courses within the Gender and Sexuality program. The transition to an online delivery offers a variety of educational opportunities to a larger population of students.

During the initial discussions of the creation of the Center, an instructional designer was brought into the conversation to offer guidance in the creation of quality, online courses for each of the three academic areas. In preparation for her new role as the dedicated instructional designer for the Center for the Study of Gender and Sexuality, she spent her spare time working on creating a pathway for success.

Pathway for Design Success

I, the instructional designer, was both energized and anxious to work on a new program in which I had no experience or knowledge. I knew that this program was unique, had the potential to go international, and was innovative. This motivated me to go above and beyond to help create a stellar program. I have a vast knowledge base on instructional design models, strategies, and theories that are utilized to design a variety of learning environments across a variety of delivery options. Would my knowledge of best practices for online teaching and learning work for this program? I wasn't sure. Being an avid researcher, I sought out existing literature on similar online programs.

Step 1: Review Existing Literature

There is limited research on pedagogical models in online courses related to lesbian, gay, bisexual, transgender, and women's studies. Even though there is limited research, what is published reaffirms that the active learning approaches that exemplify best practices in online learning are supported for classes in gender and sexuality. Murray, Byrne, and Koenig-Visagie (2013) discuss an online program on gender studies in South Africa. This finding supports that the Center for the Study of Gender and Sexuality is unique in the pursuit of offering the courses through online delivery since not many programs exist. One publication was not enough to help answer my guiding question, so I took a dive into reading articles focused on effective teaching and learning elements for LGBT students. My thought was that this knowledge would assist me in identifying the needs of students with a wide range of gender and sexual identities in the creation of courses covering this content.

Step 2: Creation of a Pedagogical Framework Document

I summarized my findings from the literature into a handout that I presented to course developers and subject matter experts who were working on designing the online courses within the courses offered through the Center for the Study of Gender and Sexuality. The existing literature provided information about the pedagogical framework and assignment ideas to consider adding to the program that became the pedagogical framework document for the program. I found the creation of this document useful in working with the development team. Many times faculty and staff are resistant to stepping outside their comfort zones in designing online courses. This document provided evidence to support my recommendations on assignment types. The pedagogical framework created a desired vision and learning path for the design of the courses.

Underlining Pedagogical Practice A “genderful” pedagogical framework invites creative possibilities for conceptualizing awareness to the connection to theory and practice. Genderful pedagogy is predicated on the notions of inclusivity, plurality, and heteroglossia (Johnson & Weber, 2011). The pedagogical framework has been successfully implemented into an online gender study curriculum in South Africa (Murray et al., 2013). Strategies for building a genderful pedagogy include (Johnson & Weber, 2011):

- Apply thinking out loud to the curriculum, such as including brainstorming activities.
- Create a learner-centered environment, where students contribute to knowledge building by including a variety of authentic learning activities to go beyond the traditional read text → listen to lecture → take objective test.
- Include a wide variety of thought-provoking activities.
- Utilize multiple perspectives within instructional material, content, and activities.
- Promote respect for difference where students are not forced to pick a side.

Effective Assessments and Activities Gender and sexuality courses place an emphasis on interaction, collaboration, social networking, and student choice to allow student's cognitive flexibility to apply gender and sexuality awareness to a range of cultural contexts. This will encourage students to become gender and sexuality change agents within various life contexts.

Assessments utilize Web 2.0 technologies to encourage students to “develop new scales of global citizenship, empowerment, and voice in formal and informal education” (King, 2009, p. 56). These technologies include podcasting, blogging, vlogging, and virtual communities. Podcasting has empowered LGBTQ communities to voice their opinions (King, 2009). The online courses within the Center for the Study of Gender and Sexuality will strive to include the following types of assessments and activities:

- Student-created podcasts (i.e., interviews, training materials, role-playing, debates, panel discussions)
- Critical dialoguing (i.e., blogging and discussion forums)
- Self-reflections (i.e., journaling)
- Narrative storytelling
- Brainstorming
- Position papers

All the courses to date include reflective journaling that allows for a variety of submission options. Students are encouraged to be innovative, inventive, and resourceful in the presentation of their ideas and can showcase their thinking in a variety of ways including blogging, creating a podcast or video, and writing a narrative (Fig. 1).

You do not need to answer the following questions in any prescriptive order. However, you should cover all of these areas in whatever organizations makes sense to you. These prompts are intended to guide your response; however, you are encouraged to elaborate wherever possible.

You are encouraged to be innovative, inventive, and resourceful in the presentation of your ideas. Here are a few options to consider:

1. Create a 300-500 word reflective post
2. A 3-minute video blog
3. A 3-minute audio podcast

Fig. 1 Example of journal instructions

Step 3: Capture the Student Experience

To fully immerse myself into the program, I attended all the program events I could, including the Gender and Sexuality Forum and an invited speaker event and reception. Both of these events allowed me to become seen as part of the program and provided me the opportunity to talk with existing students about their thoughts on course design. My presence at program events was well received by faculty, staff, and students. These stakeholders could see how invested I was in the creation of this innovative program.

Many of the students I spoke with are part of the LGBT community and had valuable insights to offer. In a typical course design, the learner analysis is considered but not highly utilized. Attending the events allowed me to ask current and future students about their online course design needs and desires. In many cases, instruction is developed without full consideration given to who the learners are. However, by understanding the learners, I am better able to arrange the environment to increase the probability of successful student learning. There are many factors that affect how an individual learns from a particular learning environment. During my discussion with the students, I learned about their previous online experiences, motivation, learning style, and their online learning preferences.

The students confirmed my findings from the literature. One component that was not part of the initial design was the addition of a virtual coffee house into the courses. Students reported that they enjoyed the conversations that happen before and after class that expand on recent events, diving deeper into course topics, etc. Each course contained an instructor blog for the instructor to answer common questions, provide clarifications, as well as provide a deeper level of information on the content.

An additional finding from the students is that they would like to have elements of synchronous communication, including video chatting in the courses. I considered this and recommend the utilization of VoiceThread for some discussions in the program. VoiceThread combines recorded presentations with discussions to allow for a unique way to communicate.

Step 4: Create a Seamless Online Courses with Multiple Faculty

The core courses within LGBT and Women's Studies were developed by a course developer and numerous (3–7) subject matter experts across a variety of disciplines. This interdisciplinary approach to course design aligns with the mission of the program. The course developer and subject matter experts developed individual modules based on their expertise. This posed a unique challenge, and the standard design process I utilized needs to be altered to accommodate the expertise of all the team members.

Many of the subject matter experts are new to online course design and did not have a solid foundation in mission and outcomes of the Center for the Study of Gender and Sexuality. To unite the development team, a kickoff meeting was held that resulted in the following outcomes: (1) introduce the team and describe everyone's role, (2) describe the mission and outcomes of the program, and (3) discuss the course development project plan. In the discussion of the project plan, the instructional designer reviewed the expectations for development and showcased examples of best online practices. The showcasing of best practices in online teaching and learning is grounded in the knowledge-sharing literature that is a component of the performance-based faculty development model (Fang, 2007). Knowledge sharing across the university has the benefit of exposing faculty "to alternative perspectives, including potential improvements in resource and education quality and greater inter-professional awareness" (Maloney, Moss, Keating, Kotsanas, & Morgan, 2013, p. 814). Interprofessional sharing is not common. Sharing is more likely to occur within individual departments. Collaborative knowledge sharing can play a critical role for bringing a variety of people together with the knowledge, experience, and skills to contribute to online community development. This meeting was essential at establishing a collaborative atmosphere and a timeline for tasks.

During the first development cycle of two core courses, many challenges arose in getting everyone to understand expectations and timelines. In order for the courses to meet minimum quality standards, I needed to become a pseudo-course developer by writing module introductions, descriptions, and key questions for content, module learning outcomes, and assignment instructions. I felt comfortable doing this for the introductory course that covered basic concepts but was overwhelmed when I attempted to do it for the theory course. These two initial courses serve as examples that have been utilized in subsequent terms. Providing both good and bad examples of assignments to students improves their work (Lin-Siegler, Shaenfield, & Elder, 2015), so I provided a good course design (e.g., the introductory course) and a course design in need of work (e.g., theory course) to use as guidelines. This helped the team meet the expectations for creating a high-quality course in subsequent development cycles.

Another change that was needed was scaffolding tasks to meet the product of a completed module. Initially, I thought that the subject matter experts could draft an outline of their module, but this was a stumbling block for many of them. Rather than asking experts to create a draft of their module, I broke this deliverable down into the following simpler tasks: (1) create list of learning materials, (2) write descriptions for content items (i.e., readings and videos), (3) draft instructional

materials (i.e., narrated presentations, transcripts), and (4) finalize instructional materials with audio recordings. Breaking up the task into smaller pieces allowed the team to stay on track and have more consistency across the modules, since I provided feedback after each step.

I enjoyed working with faculty across the university and learned a great deal about LGBT and Women's studies from the faculty experts. In addition, conversations with faculty experts provided me with new insights into student online interaction. One expert mentioned that discussions in these courses can be challenging since many students want to remain anonymous and keep their experiences confidential. I needed to think about how to include student-to-student interaction in these courses without utilizing online discussions. After some deliberation, I came up with a possible solution. Integrate reflective journaling into all modules and use discussions sparingly throughout the course, with each activity serving a different purpose.

Reflective Thinking Purpose The act of reflecting on thoughts, ideas, feelings, and their own learning encourages the development of metacognitive skills by helping students self-evaluate and sort out what they know from what they don't know. The process of examining one's own thoughts and feelings is particularly helpful for students who are learning new concepts or beginning to grapple with complex issues that go beyond right and wrong answers. Each of the reflective thinking assignments in the course allows students to internalize the material, enabling them to create their own understanding of the material. Reflective thinking assignments appear throughout the course with similar instructions. A series of questions, thoughts, or statements will be provided within each module (Fig. 1).

Online Discussion Purpose The online discussions are used for students to receive peer feedback on their large-stake assignments and for students to share meaningful passages from some of the required readings.

Step 5: Creating the Course Story

I created a unique storybook for each course that integrates all the components created by the team (Fig. 2). The storybook includes the pedagogical framework that is created during the design phase of the backward design process (Wiggins & McTighe, 2005) (Fig. 3). Backward design is an instructional design method created by Wiggins and McTighe (2005) and is part of the *Understanding by Design* framework (Wiggins & McTighe, 2005). Backward design begins with the end in mind by focusing on the course outcomes and then working backward to develop the module or weekly objectives, assessments, and learning activities. The model has three stages focused on identifying desired results, determining acceptable evidence, and planning learning experiences and instruction. In addition, the book contains all the module components that are created during the development phase (Fig. 4). This book has been effectively utilized by the course instructors to help them facilitate the course.

Fig. 2 Cover page of a course storybook

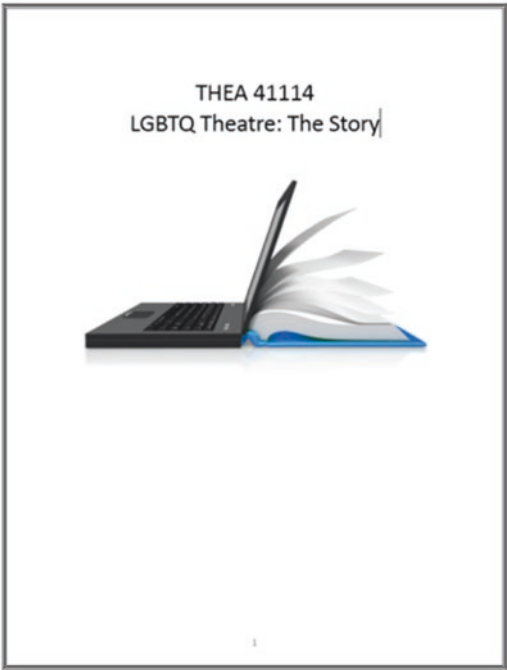


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Fig. 3 Components of the design phase

Discussion

I learned many lessons through working on the establishment of the online courses within the Center for the Study of Gender and Sexuality. The chapter examined my story and the unique steps I took in helping to design a program using design story principles. Parrish (2006) discusses that stories create a coherent learning path. Establishing the pedagogical framework was the start at creating consistency across the program. The framework also helped in the communication of course design to the team by highlighting assignment ideas including the use of student reflection.

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Fig. 4 Learning guide outline for module 4

Capturing the student experience provided the student perspective and their learning preferences (Parrish, 2006). The story of the course is the combined vision of all team members for creating an effective online learning experience for our student audience.

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Minding the Stories We Tell: Acknowledging and Addressing Implicit Narratives in IDT

Amy C. Bradshaw

Abstract What are the implicit stories of the Instructional Design and Technology field? How are they told? Who are the central characters? What is the plot? This chapter considers how instructional design and technology practices can unintentionally convey and reinforce dominant narratives about the world, people, and legitimate concerns. Along with overt, intentional forms of storytelling, less recognized yet powerful implicit narratives are discussed, toward an aim of raising awareness of how our practices may perpetuate injustice or can, instead, facilitate equity and inclusion. A project-based effort to integrate consideration of implicit narratives related to social justice awareness and understanding within the overt IDT curriculum is discussed.

Keywords Storytelling • Implicit narratives • Hidden curriculum • Null curriculum • Instructional design • Social justice • Inclusion

Storytelling in IDT

Two general modes of storytelling are present in the teaching, learning, and practice of Instructional Design and Technology (IDT). One is intentionally conveyed and overtly recognized and includes formal stories with predictable features, such as characters, conflict, theme, and plot. Among other purposes, intentional storytelling may be employed as an instructional strategy to entertain, instruct, aid memory and schema acquisition, and transmit cultural values. Explicit narratives are present even when storytelling is not an overt instructional strategy, in the sense that formal instruction tends to be developed and perceived as having a structured beginning, middle, and end. Examples of explicit storytelling in the preparation for work in the IDT field include stories or vignettes such as B.F. Skinner working with pigeons related to teaching about reinforcement and operant conditioning, Robert Gagné working as a military trainer prior to writing *Conditions of Learning* (1965), and

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Steve Jobs and Steve Wozniak's tinkering in a garage as contributing to the current perceived ubiquity of digital devices in education.

Another mode of storytelling, which is harder to recognize, occurs in the form of underlying narratives that develop, operate, and transmit covertly, often below our conscious awareness. Although generally unacknowledged, this implicit form always operates and may be a corollary of the explicit form. Along with messages about what is normal, moral, or expected within the surrounding culture, the second form may convey unintended messages or lead to development of erroneous perceptions we subconsciously repeat, either of which may be harmful. For example, telling the story of the development of the field of IDT via construction of a development timeline overtly communicates important factual knowledge of the field but—because of its narrow focus—also can communicate implicit information that may be developed into perceptions and narratives that can be mis-educative, such as what kind of people make good leaders in the field, what life roles are available to us individually, or what aspects of our lives and concerns about the world we can include or should exclude from our professional roles and activities (Bradshaw, 2014).

Historical accounts are always subjective and incomplete, and mainstream explicit storytelling tends to replicate and reinforce dominant systems and structures that may be harmful and exclusionary to some people. Acknowledging and addressing implicit forms of story construction and conveyance invites more active presence of multiple subjectivities, which expands our individual and collective understandings of the field, while also helping to make the field more accessible to people from a broader range of experiences and perspectives. In the examples of explicit stories provided above, the central characters (Skinner, Gagné, Jobs, and Wozniak) all are male and white. With mindfulness and intentionality, we can learn about and include contributions from demographic sectors of our societies that generally are marginalized or excluded from the stories of influences on our field's development. In addressing technological advances that influenced the development of the IDT field, including stories about Grace Hopper inventing the first compiler for a computer programming language and contributing to development of high-level machine-independent programming languages, and Valerie Thomas developing the Illusion Transmitter (a 3-D visualizer), adopted by NASA and adapted for use in surgery and in the production of television and video screens, increases historical relevance and perceived accessibility to women. Similarly, Roy L. Clay's contributions to computing, and Mark Dean's contribution to the development of the ISA bus and leadership of a design team for making a one-gigahertz computer processor chip, may increase perceived historical relevance and accessibility of computer technologies to people of color. Many more stories, both past and present, can be discovered and shared, to help mitigate powerful implicit messages about who may have access to and status in past, present, and future developments related to our field.

Implicit Narratives

Two important constructs related to implicit narratives are *hidden curriculum* and *null curriculum*. Coined by Jackson (1968), the term *hidden curriculum* refers to unstated norms, attitudes, behaviors, and beliefs conveyed and learned in instructional settings, not as the formal overt curriculum but as underlying rules that structure routines and relationships (Eisner, 1985; Giroux, 1983). In some settings, individuals may perceive rewards for conformity and compliance and penalties for speaking up, questioning authority, or nonconformity, while in a different setting, the opposite might be the case. Anyon's (1983) studies, for example, indicated stark differences in the hidden curricula of school settings differentiated by social class, in terms of relationships to production, work process, authority, and symbolic capital. In lower SES schools, where students tended to be the children of blue-collar workers, she observed a hidden curriculum that encouraged compliance, respect for authority, and following directions. In contrast, in the higher SES schools, where students were more likely to be the children of CEOs or other white-collar workers, she observed a hidden curriculum that encouraged cooperation, autonomy, decision-making, and problem-solving. Such differences contribute to reproduction of status quo social stratification and inequities in their respective communities.

Whereas hidden curriculum refers to implicit conveyances that are present but generally unacknowledged and unexamined, in contrast, *null curriculum* refers to topics and processes that are completely excluded. Described by Eisner (1985) as the "options students are not afforded, the perspectives they may never know about, much less be able to use, the concepts and skills that are not part of their intellectual repertoire" (p. 107), Eisner also differentiated between two dimensions of the null curriculum: subject matter and intellectual process. Both dimensions have important ramifications. First, the null curriculum limits what topics and issues one should even be aware of or consider, and then, if something from the null curriculum does slip through, the null curriculum limits how one is able to perceive and think about it. The null curriculum "is not simply a neutral void; it has important effects on the kinds of options one is able to consider, the alternatives one can examine, and the perspectives from which one can view a situation or problem" (p. 97).

Identifying and Engaging Implicit Narratives

Instructional approaches that acknowledge the existence of implicit narratives generally involve efforts to make them visible, in order to unpack and process – both cognitively and emotionally – how unrecognized narratives can serve to reinforce and perpetuate oppressive systems. Oppressive systems, themselves, frequently are part of the null curricula. Thus, it follows that instructional approaches that engage implicit narrative also tend to acknowledge and make visible oppressive structures and systems, as well as address how such systems came to be, and how they are

maintained, all of which are crucial for disrupting damaging systems and/or transforming them to be more just and equitable.

Recognizing and addressing implicit narratives in instructional media development courses can be challenging for at least three reasons, each of which warrants unpacking:

1. Addressing implicit narratives and social justice concerns is not part of the typical educational technology curriculum, particularly in a media production course, and thus may be perceived as extra rather than integral.
2. Educational technology courses, for which addressing implicit narratives and social justice concerns may seem especially important, may be perceived as already too full to add any more content.
3. By virtue of a variety of characteristics beyond a person's control to choose or change (such as skin color or physical ability), some individuals may not have been required to fully experience or grasp the nature of unfair and oppressive systems in ways that some other individuals cannot escape, also by virtue of characteristics beyond their ability to choose or change. This is true of and for both students and instructors.

First, with regard to not being part of the typical educational technology curriculum, that something *is not* part of current practice does not mean that it *should not* be. As noted elsewhere (Bradshaw, 2014), the field of educational technology has in the past made substantial changes in recognition of gaps in the field. For example, evaluation was not included in early instructional design models (Ely & Plomp, 1996), and professional standards and a code of ethics were not developed in the field of educational technology until Finn (1953) pointed out that they were necessary for achieving professional status as a field. Today, awareness is growing that ethical practice requires multiple cultural lenses (Bradshaw, 2017) and that, as a field, we must do more to address the complex intersections of culture, learning, and technology (see Benson, Moore, & Joseph, 2017). All instructional design and technology efforts, ultimately, are about facilitating learning among people. Working to recognize and understand the implicit narratives embedded in our educational systems and social structures improves our ability to engage instructional design and technology in ways that are more relevant to and equitable for a greater variety of people.

Second, invoking a framing that courses are too full already to add any more content reflects a tendency to perceive and treat implicit curricula and social justice issues as mere content, such as can be addressed and learned about in lower-order ways and checked off a list. This framing limits our problem-solving abilities to the application of mechanistic solutions, such as reordering, filling in a gap, or replacing or adding a requirement or objectified bit of content. Moreover, add-on requirements themselves can contribute to detrimental implicit narratives. For example, consider that instructional designers and developers are increasingly being asked to add diversity to instructional materials and may attempt to do so by diversifying the characters, themes, or cultural origins of the included stories. The explicit, overt goal is for the curriculum and related materials to more accurately reflect human

diversity and thereby be considered more inclusive. While changing the genders, skin colors, and physical abilities of characters in overt forms of storytelling to be more inclusive is a critically important step toward equity and justice, if this type of diversifying is both the means and the end goal, that is, if diversity is added for the sake of diversity, without recognizing and modifying other powerful underlying narratives that are conveyed, we will not noticeably disrupt structural inequities in the systems we work and live in. We are merely appropriating shallow markers of diversity into the service of continued injustice. If that is as far as we go, we also convey the implicit – and false – message that problems related to racism and equity are so insignificant that simply changing a story character’s skin color should be sufficient to solve them. In addition to conveying that hidden curriculum message, the practice treats as null curriculum the fact that numerous societal structures have been developed and continue to be actively maintained, that direct unearned benefits and advantages to some people, while withholding benefits and even placing hindrances in the paths of others. (For detailed examples of such societal systems and structures, please see Feagin, 2013; Roediger, 1999; and Alexander, 2010).

Regarding the third challenge, we need to recognize that our field reflects the dominant culture of the United States to a large degree. Rather than insisting it does not, and we do not, we need to practice and cultivate sufficient critical humility to honestly interrogate, and also seek input from supportive outsiders regarding, both our own practices and the dominant tendencies in our field. Specific scaffolding in this regard is available (Bradshaw, 2017). We need to acknowledge that the field of IDT in general treats social justice matters as null curriculum and that our doing so supports and perpetuates societal inequities. That our field can be so focused on facilitating human learning and yet practice a nearly total exclusion of awareness and consideration of human access and equity issues such as racism, ableism, nationalism, and other forms of oppression, from and by the mainstream of educational technology teaching, learning, and professional practice, is a clear signal that we need a substantial change. We need to learn how to acknowledge and interrogate stories at both explicit and implicit levels in ways that allow us to teach the important overt content, methods, and practices we intend to convey, while also working to recognize, make visible for others, and transform or disrupt potentially harmful implicit messages that reduce inclusion and equity.

The remaining sections of this chapter describe a project-based effort to integrate consideration of implicit narratives related to social justice awareness and understanding with the overt IDT curriculum. Grounded in the recognition that “ethical practice requires that educational technologists keep culture-related issues such as relevance, access, equity, and inclusion foregrounded in our work” and that we must “reassess our practices and needs for further learning at individual and collective levels in terms of the nexus of culture, learning, and technology” (Bradshaw, 2017), I approached this project with this primary question in mind: How can I better integrate social justice awareness and growth with the important existing instructional goals of my courses, in ways that are relevant to students and that will not be perceived as imposed add-ons?

Project Design and Implementation

An approach to engaging narrative at both explicit and implicit levels was explored in a graduate-level visual literacy for educational media production course focused on design principles and theories that underpin effective visual and media communication. The course is designed to be taken during the second semester in the IDT track of an Instructional Psychology and Technology master program (following an introduction to instructional technology course and a beginning instructional design course) to prepare students for more advanced design and development courses in IDT. Course topics include conceptual and theoretical frameworks of technology-mediated instructional communication and design principles and theories that underpin effective visual and media communication. Applied projects include image manipulation and layout design, beginning animation and audio editing, beginning video production, and development of a web-based portfolio. Assignments include twelve minor projects (focused on the basics of design principles, image manipulation, animation, sound editing, video editing), five major projects (color theory and presentation screen design, infographic, cinemagraph, informational video, and course portfolio), and one exam.

In addition to integrating conceptual and theoretical knowledge of visual design, psychological principles of perception, and practical application and production of media and technology, the course also is designed to facilitate development of visual communication critique and communication skills (in terms of both giving and receiving). Students develop these skills through regular *benevolent critique* sessions, wherein they practice giving honest, direct, and meaningful feedback involving back-and-forth dialogue with both the designer and the instructor, to provide the critics with scaffolding and support for communicating clearly and supportively, as well as providing designers with practice receiving critical feedback, focusing on critique of products, not producers, and scaffolding dialogue for clarification to make sure they understand the feedback and record it accurately. Following the critique sessions, students are expected to revise their projects before resubmitting them for a grade. Revision, revisiting, and continual development are values that are both explicit and implicit in the course. From a content perspective, the course is very full and is quite time-consuming for both the students and the instructor.

Twelve graduate students were enrolled in the course during the semester of the study. As part of the series of media development projects in the course, small teams of students were tasked with gathering information to write a scripted storyboard for a brief informational video. The general assignment to the teams was to select among “key contributions, people, and/or developments” that emerged during a particular decade of the timeline of events in the development of the IDT field and develop a short informational video to tell the story. The initial overt goals of the project were for students to:

- Learn beginning video editing skills and techniques.
- Use video editing to produce an informational story.
- Reinforce students’ knowledge and understanding of some of the key contributions, people, and developments in the field of IDT.

The video project considered in this study had at least one advantage over versions in earlier semesters. In the past, students were encouraged to select their own topics for the project, or to select from a variety of available clients with authentic needs for short informative videos, with the thinking that choice of topic might increase the perceived relevance of the project, and therefore also might increase student interest and motivation related to the project. In contrast, during the semester under study, students were assigned a shared general topic they could particularize, with the goal of facilitating additional knowledge specific to the field to be introduced or reinforced for all the students.

Before the project began, students agreed to write a version of the video script based on the initial assignment and that, following their initial draft, they would be provided additional information and asked to revisit the project from a different perspective. For the first draft of the video script, students were provided a timeline of significant events in the development of the field of IDT and asked to select some contribution(s) or contributor(s) to the field of IDT and tell that story through a short informational video script. Students knew they were going to be asked to write a new version with a different focus, but they did not know what that would be until after they had submitted and received feedback on the first version of the script.

Following submission of the scripted storyboard, students were asked to write a second version of the script, which would be the one developed into a finished video. This second version was to reflect awareness of issues and events in the broader social and social justice contexts and with particular attention to consideration of issues, circumstances, and events that could be considered likely to be hidden and null curricula in a typical telling of the story.

Prior to the script revision, substantial class time was devoted to discussing the constructs of hidden and null curriculum. As part of the class discussion, examples were provided, such as pointing out that in reviewing the typical timeline of developments in the IDT field (as initially presented to them via a *PowerPoint* presentation), students may have noticed that all the key contributions in several decades were made by people who were both white and male. If that implicitly communicated message is not acknowledged and addressed, an implicit narrative can take hold that white males are more capable and better suited to this field than are women or people of color. By taking a closer look at what was happening in the broader society during that particular timeframe, students (and instructors) may become aware for the first time of some very specific legal and social conditions that supported white males to engage certain fields and make particular kinds of contributions, while simultaneously making it difficult or even impossible for people of color to have the same kinds of impact. Specific examples of juxtapositions between social justice-related issues in the broader society and specific IDT timeline events were provided and discussed consistent with Bradshaw (2014) – such as Japanese internment camps and racial segregation in public education and the US Military during the time Gagné was developing his theories of instruction. In addition to extended, in-class discussion of the hidden and null curricula, students were provided with a summary of those constructs via the course management system, as well as direct access to two readings on the topics of hidden and null curricula

(Eisner, 1985; Finders, Noddings, & Thornton, 1986), and a detailed social justice events timeline, adapted from Adams, Bell, and Griffin (2007). Students were asked to specifically consider hidden curriculum and null curriculum as related to social justice, equity, and inclusion, relevant to their particular video project topics. Thus, the video editing project was intentionally expanded to tell a fuller, richer, and more complicated story of our field and our societies at the overt level of storytelling, while also providing space and means for openly interrogating issues and narratives operating at the covert level.

After two versions of the script, with feedback from the instructor on each, and after developing the edited video and presenting it to the class for peer and instructor feedback, students had a limited opportunity to revise the video in preparation for the final class session. Because the time remaining in the semester was so short, students also were invited to write a brief document describing what else they would modify if there were sufficient time to revise the video one more time. At the end of the semester, students anonymously accessed an online questionnaire via *Qualtrics* regarding the video project.

Project Results

The outcomes of this project were assessed in terms of (1) team video editing projects and (2) student responses to the end-of-course video project questionnaire. Twelve students were enrolled in the course and they engaged this project in teams of three. The team video projects developed during the course are summarized below, after which student responses to the video project questionnaire are summarized and grouped by theme.

“History of Instructional Design.” Length 3:31. Features: Natural and added sound, voiceover. Some titling. Original video, Historical photographs with Ken Burns effect. Tells a coherent story. Quality: Pretty strong, although it ends abruptly. SJ Hidden/Null acknowledgements: Acknowledges military setting, early field targeted to white males.

“Notable Constructivist Psychologists: 1900-1950.” Length: 10:32. Features: Natural and added sound, historical photographs, original video clips, titling. Quality: Good. Includes a fair mix of thoughtfully and originally produced video as well as historic still imagery. SJ Hidden/Null acknowledgements: Still imagery and original video clips reflect diversity in terms of race, ethnicity, and physical ability. Questions are overtly raised related to dominant and marginalized cultural groups.

“The Evolution of Computers in Instruction.” Length: 9:03. Features: Natural and added sound. Some titling, Historical photographs, Transitions. Includes a separate, web-based timeline. Quality: Several strengths and a few areas for improvement. SJ Hidden/Null acknowledgements: Really good, thorough job, including contributions by women, and by men of color, and overtly raises questions about equity and inclusion.

"The Evolution of Bloom's Taxonomy." Length: 5:02. Features: Natural and added sound, voiceovers, original video and graphics, titling, transitions. Quality: Very good. Huge improvements in revised version. SJ Hidden/Null acknowledgements: Minor but occasionally overt relating of primary content to SJ considerations.

Learning Basic Video Editing Skills and Using Them to Tell an Informational Story

In response to questions regarding how well the project helped in terms of learning basic video editing skills and techniques, and using those skills to produce an informational story, four students indicated that they had prior experience with video editing, although one added that they were nonetheless challenged by needing to combine material from different sources and used both *Adobe Audition* and *Adobe Premiere* together in order to achieve seamless audio. One indicated they learned to edit video in *Premiere* from doing the individual mini projects prior to this team project and that because of the time constraints, relative strengths of the team members, and their long distances from each other, one person did the actual editing in *Premiere* for this team project. Other students responded that they learned to shoot video, edit together various clips, add music and voiceover narration, set pace and timing, and add titles and transitions. Several noted the benefits of learning to plan and develop video projects, indicating the project gave them ideas for developing videos for use in future teaching efforts. One noted that editing video is popular and a basic skill for instructional designers and that learning video editing will increase their competitiveness for employment upon graduation. A few noted that they were unable to stretch their abilities or take the project as far as they would have liked to because of time constraints. Some spent proportionally more time learning to use *Premiere* and were unable to spend as much time as they would have liked to on polishing the project and ensuring excellent technical quality of the final version submitted. One responded that although they had very little video editing experience, they found using *Adobe Premiere* as required for class was fairly easy. Several students commented that preplanning was a big part of the video experience and that they needed to balance the various challenges. For example:

The historical nature of the project made it difficult and challenging to create an informational story.

Because we had to do a historical video, we had to rely heavily on photos. It was challenging to find an interesting way to present these photos while also conveying our information.

... the way we try to organize the storyboard and script will encourage us think all around. / using a clue across the informational story, it is an opportunity that students integrate the text and video to apply their learning, such as how to reduce cognitive load and improve learning efficiency.

Students also noted the value of the peer review and feedback sessions with the other teams' video projects:

I really love [another student's] video. The way she made it is very professional. Through viewing the other group's video, I know what skills or method I need to develop in order to make a more professional video.

The feedback of my team and other teams' videos was the most useful portion of the project. I got to see and hear a lot of different elements of video that worked well and did not.

Linking IDT and Broader Social and Social Justice Issues

Four questions were asked about how well the project reinforced understanding of key contributions, people, and events in IDT, how well it helped them understand historical developments in the field in relation to issues and events in the broader social contexts (with particular attention to social justice), whether it challenged their perceptions regarding significant individuals and events in the field of IDT, and whether it had an impact on the way they think about relationships between professional work in IDT and social justice issues in the broader society. Responses were generally positive that the project helped them learn more about the field in addition to learning to plan, edit, and produce a video. As one student expressed, "It expands my knowledge, which makes me feel confident. More skills will improve the competitive advantage." Several students indicated that doing the project helped them gain a deeper understanding of the particular people and events they were focused on in their video project; that their research for the project increased their knowledge of key contributions, developments, and people in the field of IDT from basic to expert. One student responded that the process of designing and developing the video also helped reinforce their prior knowledge because they needed to apply learning theory and design principles. One indicated that more energy was spent planning and developing the video than learning about contributions in IDT. Another noted: "I definitely learned more about the history of instructional design. It wasn't comprehensive, but that's not a bad thing. Had it been comprehensive I would have been extremely overwhelmed." Students also indicated that they were able to learn more deeply about other scholars and events in the IDT field from viewing other teams' projects, as well as from their own:

As a team, we had the opportunity to learn and research about people, tools, and organizations that helped bring instructional design to business and education. The video being historical helped us make connections rather than talking about just technology.

The project helped reinforce my knowledge because we had to do a lot of research, synthesize in the script, and then find matching visual materials. This iteration helped enforce the key concepts regarding our chosen topic.

Ten students indicated they found the blending of IDT events and broader social and social justice contexts to be beneficial. Some noted that while it is challenging to mix them, doing so helped them learn a lot and that they learned both by engaging in their team project and by seeing and providing feedback regarding the other teams' projects. Several students expressed appreciation for the emphasis on inclusion, with one adding that whether or not their knowledge of IDT and social contexts was increased, they appreciated that they were challenged to put the two together. Four students specifically referred to the hidden and/or null curricula:

I never heard about null curriculum and hidden curriculum before.

I think I realize more than the field of IDT within social contexts, how important it is to be aware of null curriculum and social implications to how we teach or train people.

Again, it was very eye opening to think about the null curriculums throughout history. For example, earlier educational studies were conducted on mostly white males, so we really had no idea if these learning styles applied to females or those of differing national origins.

I would have preferred that the topics were less varied so we could have more class discussions to illuminate more of the hidden and null curriculum.

Seven students indicated that the project didn't really challenge their own perceptions regarding significant individuals and events in the field of IDT, with one clarifying: "Once I learned about the null curriculums, it made sense. Those that we studied likely did not realize that they were excluding information or relying only on white males for their information. It was a subconscious bias. We are all guilty of it." Another responded, "Enlightened, but maybe not challenged." Three responded that they had learned more about the specific people included in their project, and two of these responses indicated that the students had been reflecting on how the individuals in their projects were impacted by their social contexts and whether their influence on the field and education broadly might have been different under different social circumstances.

Eight students indicated their experience with the project had impacted the way they think about relationships between professional IDT work and social justice issues in the broader society. For example:

Yeah. I didn't know there was a such thing as null and hidden curriculum.

Yes, I am more aware of wanting to know where certain theories come from, not just taking them at face value.

... at times, we do discuss new federal regulations, such as the new Overtime Expansion rule that was recently released. In those instances, I definitely try to think about the broader perspective.

One student asserted that we always need to consider social justice issues as important factors in doing professional work. Another said that their experience with the project had provided them with language to help them address some of the

biases they had observed among professional instructional designers they'd worked with, and that they would now be better able to address problematic issues related to graphics and contexts with information and specific terminology.

Learning About and Addressing Hidden and Null Curricula

Three questions asked specifically about the concepts of “hidden curriculum” and “null curriculum,” including asking how familiar students were with the terms prior to the project. In their responses, three students indicated that they had heard about the concepts *hidden curriculum* and *null curriculum* prior to taking this course, although one of the three acknowledged that prior understanding had been erroneously limited to thinking of the hidden curriculum as an intentional means of passing down values, such as loyalty to country through the teaching of historical events. Eight students indicated that this project had altered their views about instructional designers' responsibilities related to “null” and “hidden” curricula, with six indicating the concepts were completely new to them.

Eleven students indicated that thinking forward to future instructional design and development projects, they were likely to intentionally address issues of hidden and null curriculum, including:

I will make an effort to look for the null and hidden messages in the curriculum.

I think it will be important to facilitate discussion so I can find hidden and null curricula from a variety of perspectives.

I hope it is something I can keep as a standard way or quality of working and thinking.

A few students elaborated that considering hidden and null curriculum should always be included in the design process. One added that the experience prompted them to be more aware and reflective of their own bias during the analysis phase.

Valuable and Challenging Aspects of the Project

Six students indicated that learning about the hidden and/or null curriculum and/or broader societal issues was the most valuable aspect of the project. For example:

The most valuable part was researching the information and learning the null curriculum from history. It was a completely new concept to me.

... understanding the development of ID with wider social history

Four indicated video editing skills and learning to edit and produce video from concept to product were the most valuable aspects. Two referenced working in teams, and one referenced reinforcing key IDT concepts.

Seven students indicated that the most challenging aspect of the video editing project was time management, with three of these specifically relating the time management issues to working in teams. Five students indicated that the most challenging aspect was selecting information and materials and deciding how to tell the story. Only one student indicated that learning to edit the video was the most challenging aspect of the project. One student noted that, while they may have understood the concept of null curricula, they did not necessarily know how to incorporate that in their script writing, given that this was their first experience writing a video script. Another student noted that although the added stress from altering the project may have impacted learning for some students, it also simulated the way clients may change the direction of a design by altering the requirements.

Asked whether there was value in the way the project unfolded for them relative to their multiple roles as educator, instructional designer, developer, and learner, 10 students responded positively, citing the value of the required preliminary planning phase related to writing the script, selecting and sequencing images to be used, and planning ahead for video shots and audio quality. Students also noted the benefits of experiencing the project from the different roles and perspectives, learning to work well in their group, and engaging in project management. Some students also focused on the value of considering the larger social context:

It led me to consider the big social context in which the significant events of education and instructional history were achieved. I never think about this topic.

This was very insightful to the potential null curriculums that resulted. It's something that really opened my eyes. I try to think about what null curriculums that may occur in my trainings for my job. It was definitely an epiphany.

In response to whether the projected should be modified for future students, seven expressed desire for more and earlier class discussion of hidden and null curricula and social justice concerns. One of them added that they appreciated how well-thought-out the team groupings were and wished the teams would have been identified and formed earlier in the semester to allow more time to work through issues related to the null curriculum. A few students also expressed a preference for having all requirements at the same time, rather than getting some new information just prior to changing focus for the second version of the script.

Seven suggested that scriptwriting for the video project should begin very early in the semester so students would have more time to produce a more polished video project. One of these added that the project should be the main project of the class, through which to explore instructional message design. One said they wished they could have taken the video through one more cycle of revision, feedback, and improvement.

Asked if they had any additional thoughts regarding their experience with the project, one student said, "The issue we ran into was a very fuzzy conceptual idea for the video, footage that wasn't entirely aligned with the concept (I take full responsibility), and then poor planning on how and when to get the video done, leaving one person to do majority of the work while changing our idea to fit the

needs of the project.” Another responded, “Patience: must be spending a lot of time at the computer. So we must have patience for the final build up.” Others responded that the project had provided an opportunity to learn many things they had not expected to, not only hands-on skills, but issues related to social justice, which they had not previously considered. Five students responded that the project was a positive learning experience, using descriptors such as “amazing project,” “great experience,” and “I definitely think you should continue to do this project.”

Discussion

The impetus to design and implement this project was the question “How can I better integrate social justice awareness and growth with the important existing instructional goals of my courses in ways that are relevant to students and that will not be perceived as imposed add-ons?” Results of implementing the project, in the form of the actual team video projects, as well as individual responses to the video project questionnaire, indicate that this project offered a viable response to that question.

Positive Outcomes

Given the short time frame and full syllabus, it is notable that none of the students in the heavy media production course expressed negativity about the inclusion of content related to the implicit curriculum and social justice or the requirement that students learn about and apply awareness of these issues to the team video editing project. Responses to the video project questionnaire indicate that the focus on implicit narratives and social justice contexts as related to the video editing project was not just accepted by students, but welcomed, with several students indicating that learning about the null and hidden curriculum was the most valuable aspect of the video project. Although detailed demographic data were not collected for this project, a high proportion of students in the class were female and/or international, which may have been a factor in their favorable reception.

The shared general topic specifically selected to reinforce knowledge in the IDT field also was positively received. One student wondered whether it might have been better to require all teams to develop a video on the same specific focus so there could be deeper and more focused discussion of the particular issues of hidden and null curriculum related to that specific story. However, students also appreciated the flexibility that allowed the individual teams to negotiate and focus on specific topics they found most interesting and relevant. The different topics within the shared general focus also allowed students to see how recognizing and considering hidden and null curricula and addressing issues of equity and inclusion presents different kinds of challenges for different contexts and topics, even within the same general domain.

Another notable outcome is that students wanted to take the project further than was feasible. Because the course is very full with many projects, requiring different software programs and processes, there was not time to focus as deeply and exclusively on the team video project as several students would have liked. This project would likely be even more successful in a course with a narrower focus and fewer projects. Because of the limited timeframe for focusing on this project, there was not time for any of the video projects to be superb in every aspect, and different projects had different strengths. This turned out to be a positive outcome as students were able to appreciate and benefit from the strengths of each other's projects, as well as their own.

Changes for Next Time

This project-based curriculum modification effort was very successful. Still, changes for future iterations of the course have been identified:

- Make sure the intentional integration of social justice issues is clearly reflected in the course syllabus.
- Move discussion of implicit narratives and social justice contexts earlier in the semester.
- Assign groups as early in the semester as will allow for thoughtful and equitable grouping.
- Introduce the video project earlier in the semester to increase time available for topic negotiation, scriptwriting, planning, and materials collection (prior to beginning shooting video).
- Consider how other existing projects in the course might be transformed to facilitate deeper consideration and appropriate application of issues related to equity and inclusion.

Factors That May Have Contributed to the Successful Outcome

Several factors may have contributed to the success of this curricular design and implementation endeavor. Perhaps most importantly, a goal of the course from the outset was to facilitate development of a trusting, authentic, learning community. The instructor was intentional and reflective in efforts to model the kinds of cooperation and respect she wished to see from students. Effort and energy were focused on establishing and maintaining a supportive class culture that would be conducive to exploring potentially challenging issues raised during the video editing project.

With regard to understanding and engaging the social justice issues raised, the goal was to facilitate growth, without pushing so hard as to unnecessarily invoke resistance. Similarly, with regard to facilitating learning of video editing and story-

telling skills, growth and process were emphasized rather than focusing primarily on the end project. Flexibility and adaptation had to be balanced with the constraints of a finite course calendar. This was a beginning development class, and not a capstone course. Just as developing quality media production skills must begin prior to the capstone stage, learning to grapple with and integrate issues of equity and inclusion in IDT practice also must begin and develop prior to the capstone project.

Specifying a shared general topic that was relevant to the field yet also allowed room for particularization served to support further development of field-specific knowledge for all class members, while also allowing teams to negotiate and pursue specific issues of interest to them. The instructor prepared in advance of the course to ensure adequate scaffolding and support, not only of technical processes but of sociocultural issues related to the project as well. This is especially important in addressing social issues that are new to or unusual in a particular class or field. Instructors must take care that social justice-related content is sensitively addressed and accurately handled and that they are prepared to engage and support the cognitive and emotional needs that may emerge as a result of their inclusion. Just as appropriate scaffolding is important in terms of both technical skill and social justice issues, quality feedback and correction also are necessary, both in terms of technical quality of the video projects and in terms of social justice-related content and issues. Although advance preparation by instructors in understanding and addressing social justice issues is needed, one should not wait until one has “arrived” in a social justice sense to begin engaging these kinds of multidimensional projects.

Closing Thoughts

Together, the null curriculum and hidden curriculum cloak structural oppression and systemic injustice. The null curriculum dictates that we do not teach about social justice issues in certain classes. The hidden curriculum assures that if social injustices rise to our awareness, we can dismiss them back to null using mythologies such as meritocracy and social neutrality.

This project was intended to support critical consideration of our work in IDT and how it relates to broader social issues by acknowledging and addressing implicit narratives in our field. Important additional goals include facilitating development of more critical dispositions regarding our roles as learners, instructors, and instructional design professionals and supporting increasing awareness of some of the systems and structures in which we operate that we have been conditioned not to see or that we dismiss as being beyond our proper role to engage.

Although these long-term goals will not be achieved as a result of a single project or course, instructional approaches that acknowledge and address both explicit and implicit levels of storytelling can help open space for more critical dialogue within specific courses, in the broader learning community of the program, and hopefully expanding to the field in general.

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Designing for Narrative-Like Learning Experiences

Michael T. Matthews

Abstract Recent emphasis in instructional design literature on the aesthetic qualities of learning experiences can be enhanced with tools and resources from other design fields similarly focused on designing experiences. Disney Imagineers create theme park experiences around some sort of story, and they often use storyboarding and methods like it to design the experiences beforehand. Though instructional designers likely do not have Disney’s physical or financial resources, this paper suggests that designers can nevertheless design for learning experiences that follow a narrative-like arc. Recommendations from instructional design scholars as well as others are brought to bear on the potential for narrative-like sequencing in designing for learning experiences. Practical support for designers is also offered to aid designers in making small but significant changes in their typical design work.

Keywords Design • Disney • Experience • Narrative • Experience design • Experience economy • Sequence • Storyboard

Introduction

In designing theme parks, Disney Imagineers aim to produce memorable, engaging, and even “magical” experiences revolving around simple stories. And they generally succeed in doing so; customers constantly and repeatedly enter their theme parks to experience “Disney Magic.” Meanwhile, as educators, we struggle to define, measure, and design for engagement in educational activities (Reschly & Christenson, 2012). How do Imagineers create “magical” experiences for their customers? And can instructional designers reasonably hope to do something similar—especially without a Disney budget? In this paper, I will review key Disney theme park design practices and suggest how they can be applied to instructional design. Specifically, I will describe how a focus on the lived experience of the learner can enable instructional designers to design for narratively sequenced learning

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experiences in the courses they design. I will also offer practical suggestions for how instructional designers can sequence the activities in their courses to follow patterns of narrative movement.

The Notion of Experience in Instructional Design

Although Kolb's (1984) experiential learning theory has been among many possible approaches to instructional design for over three decades, recent years have seen an upsurge in discussion of the experiential dimension of learning, including research emphasizing the priority of emotions in learning (Immordino-Yang, 2016), theorizing about experience (Goodyear, 2005; Wilson, 2013) and transformative experiences (Wilson & Parrish, 2011), initial efforts to design experiences (Parrish, Wilson, & Dunlap, 2011), and discussions of how well-equipped practicing instructional designers are to handle the very idea of experience (Boling & Gray, 2015; Gray, 2015). Patrick Parrish wrote that "learning experiences are always much more than the cognitive processing of well-planned subject matter and structured learning activities. They also encompass how the learner feels about, values, and ultimately, establishes a level of engagement with the instructional environment" (2008, p. 92). "These learning experiences are not equivalent to the 'learning objectives' guiding them, just as they are not equivalent to the materials supporting them" (Boling & Gray, 2015, p. 109).

Many of these writers who have explored aesthetic and experiential possibilities for the field of instructional design have recognized the need to expand the scope and vision of what is being designed in instructional design contexts (similar to Krippendorff's trajectory of artificiality, 1997). Instead of focusing on the process by which designs are produced, or the eventual products of instructional design processes, those concerned with the aesthetics of instructional design are focused more on producing experiences for learners. For example, Parrish et al. (2011) wrote that in a broader experience-centered view of instructional design, "educators might begin to see themselves as *experience designers*" (p. 20; emphasis in original). However, the very idea of designing experiences, without some important clarifications, can be problematic.

Several instructional design scholars have critiqued the notion that human experience could be designed, created, or engineered. Boling and Gray (2015) noted that "the learning experience seems to be considered something that we expect to create, or determine in advance, not a potential for experience that we hope to shape using naturally occurring and not entirely manageable [phenomena]" (p. 110). Wilson (2013) explained that a "planned strategy," when carried out in a particular context, becomes an "enacted activity," with which participants can have a variety of "lived experiences" (pp. 38–39). He wrote that "[P]eople undergo *experience* as activities unfold. Experiences are *transactional* in that they are mutually co-constituted by participants and the world they live in" (p. 39; emphasis in original). Boling, Eccarius, Smith, and Frick (2004) found that even something as simple as the

interpretation (the “experience”) of instructional illustrations could not be guaranteed to be understood as intended. Gray (2015) summarized these critiques: “the learner’s experience of or response to [a] designed intervention cannot be deterministically defined beforehand” (p. 200). Accounting for the agency of each learner as a co-contributor to their own experience of a designed intervention or enacted activity, then, means that there is an inescapable element of uncertainty and indeterminism when planning a strategy and enacting it to achieve some experiential outcome. The very idea of designing experiences, it seems, is like trying to drop a penny onto a precise spot on the bed of a flowing river. The most that an “experience designer” could hope for, then, would be to design sets of activities that, when carried out in context, contain the possibilities for the kind of participant interpretation and lived experience the designer intended in the first place but is unable to guarantee.

Designing and Providing Experiences

Despite its inherent indeterminism, in areas outside of instructional design, the idea of designing, creating, and providing experiences for customers has drawn considerable attention; and efforts at actually doing so have been met with some success. In a 1998 issue of the *Harvard Business Review*, Pine and Gilmore contended that “experiences are a distinct economic offering” (p. 97) beyond goods and services and that the most successful businesses have found a way to “experientialize” their offerings. Famous restaurants like Planet Hollywood or the Hard Rock Café provide a service as part of a larger, themed, and somewhat theatrical staging. Indeed, the subtitle of Pine and Gilmore’s eventual book was *Work is Theater and Every Business a Stage* (2011). In their initial article and in their book, the Walt Disney company is referred to as the “experience-economy pioneer” (1998, p. 99) for their ability to sell customers’ experiences using all the theatrical elements of Disney theme parks.

Practicing instructional designers could learn much from adopting resources, tools, and even perspectives from those focused on providing experiences. Doing so would involve reconceptualizing courses, units, modules, and even class periods as sequences of experiences to be staged and executed with as much style and imagination as Disney Imagineers (Prosperi, 2016).

Storyboarding Experiences

Speaking for his fellow Disney Imagineers generally, John Hench wrote that, “We use storyboards ... to assist us in developing each attraction or show, and we use similar processes to lay out each of the lands and the park [Disneyland] as a whole. Storyboards enable us to design sequences of experiences that take guests to peak moments” (Hench & Van Pelt, 1998, p. 67). The storyboards Imagineers use to

design for theme park experiences are not the storyboards discussed in instructional design literature as images of software product interfaces (Jones, 2008), nor are they the storyboards of camera shots in the production of videos (though both kinds of storyboards may be used when software products and videos are needed in an attraction). Instead these storyboards are simple depictions of the practical activity of the theme park guests: where they will walk, what they will see, who or what they may interact with, and what the guests may be thinking. Practicing instructional designers may want to experiment with storyboarding the experiential aims or outcomes of a lesson, unit, or module and then deriving specifications for videos, assignments, and other materials from the initial learner-experience-focused storyboards. This, as opposed to storyboards focused on cognitive objectives or psychomotor processes, as in Bunch (1991), or on behavioral flowcharts, as in Knauf, Sakurai, Tsuruta, and Jantke (2010). Though Disney Imagineers have significant physical and financial resources at their disposal, their tactics can be used to design for more modest experiences as well.

Sequencing Learning Experiences

Instructional designers who use storyboards to depict the intended experience for learners, and who are interested in creating coherent unified sequences of activities (and hopefully experiences) for their learners, will have to consider each individual frame of activity and experience, as well as the transitions between each frame. A designer aiming for a coherent learning experience across many activities should work to create the possibilities for such experiential unity at the level of a single assignment; within a unit, module, or lesson; and potentially even across a whole course. But there is not necessarily one optimum way to sequence learning activities to achieve the greatest learning—it all depends on the kind of overall experience you hope your learners will have.

Possibilities for Sequencing

As part of normal instructional design work, designers pick lesson and unit topics and sequence them, and many notable scholars in education generally and instructional design specifically have already provided excellent organizational schemes for sequencing course activities. Jerome Bruner (1960) introduced the idea of a spiral curriculum, where a student learns a topic in increasing depth over time as repeated trips covering the same subtopics are given deeper and deeper treatment on each pass. Similarly, Reigeluth's (1999) elaboration theory repeats coverage but at greater levels of authenticity and complexity with each pass. Van Merriënboer, Kirschner, and Kester (2003) 4C/ID model also follows this logical progression,

with the added dimension of the amount or degree of support provided by an instructor, tutor, or guide.

The organizational schemes recommended in these models for designing instruction seem to be based on the movement of simple-to-complex, on the logical relationships between topics within the course content. However, designers can better focus their attention on the experiences our learners may have by moving toward an organizational scheme that is not conceptual-logical, but temporal and experiential. Dr. Eugene Lowry, a scholar of homiletics (preaching), wrote the following about sermons, but it can apply equally well to courses of instruction:

We have been trained to see the [course] as a *thing*, and hence [course design] typically has consisted of ... organizing [courses] on the basis of the logic of their ideational ingredients. But a [course] is not a logical assemblage; a [course] is an event-in-time (Lowry, 2000, pp. 6–8).

We might also say that a learner's experience of a course of instruction is an event-in-time that takes place over time.

Narrative Sequencing

One of Ralph Tyler's original questions to be answered when developing any plan of instruction was: "How can educational experiences be effectively organized?" (1949, p. 1). Patrick Parrish's answer to this question is that an organization that has a narrative-like arc and dramatic movement (like good stories do) will provide the most engaging and effective organizational scheme or sequence. Parrish (2009) wrote that heightened, aesthetic learning experiences have narrative-like beginnings, middles, and ends.

Beginnings His recommendations about beginnings were to confuse or disrupt a learner's sense of how things work (relevant to the subject matter of the course), so that learners will genuinely and persistently seek the resolution experience that the designed activities will provide: "To generate tension, instructional situations might begin with conflicting ideas or theories. For example, an instructor might post or elicit a commonsense mental model and then offer conflicting evidence" (p. 518). In many fields of study, there are core debates about fundamentals in a discipline that could be productively introduced, even to a novice audience, to provide a foundational tension or dramatic question for each to student to answer for themselves as they learn the course content. For example, the significant issue of human agency versus determinism (Matthews & Yanchar, 2017a) could be raised as the main tension or dramatic question to be (possibly) resolved while critically examining various theories of learning and their positions on the issue. The deep question of agency versus determinism could potentially provide the motivation for learners to explore and analyze the theories of learning that constitute the course content.

Middles While a good beginning can provide the initial impetus to start a learning journey, enhanced conflict can maintain and even increase learner engagement. “Carefully introducing new tensions, surprises, and increasing complication is one way to achieve engagement” (Parrish, 2009, p. 519). Cates and Bishop (2003) wrote about what they called the “physics of learner engagement” by likening a course of instruction to a bobsled course. A good bobsled course has more kinds of movement than simply straightaways—it would also contain turns both hard and soft, uphill and downhill inclines, and variety in the texture of the surface the sled passes over to at times increase and decrease friction and resistance. As they note, “In instructional terms, a curve is a change in direction from the one previously pursued. For instance, activities calling for divergent, rather than convergent, thinking may act as curves” (p. 299). The conflict in the beginning and the complications along the way can be reflected in the nature of the sequence of activities learners will complete in learning course content. What another scholar of homiletics, Dr. Fred Craddock, has written about sermons applies equally well to the sequence of a course:

If it is observed that the ideas [or the topics in the course content] are invariably joined by *and*, the [instructor] should be warned thereby. Any traveler knows that long, straight stretches of road are dangerous because they induce sleep. (2001, pp. 123)

Instead of a simple logical progression of “and and and so,” the experiences we hope our students will have learning course content could be structured into more of a journey that includes “but,” “however,” “and yet,” and “therefore” in addition to “and.” Returning to the example of the question of human agency as it applies to learning theories, the designer of such a course may choose to present theories that, on the surface, seem to acknowledge some sort of human agency (seemingly resolving the question and dissolving the tension), but which, on further analysis, turn out to be varieties of “soft-determinism” (Matthews & Yanchar, 2017a; Sappington, 1990), and thus do not actually resolve, but intensify, the debate between human agency and determinism. If course content were explored deeply enough, and carefully selected and sequenced, the possibilities for twists and turns could increase.

Endings Finally, Parrish (2009) suggests that the endings of aesthetic learning experiences are culminations of everything that has gone before, tying up loose threads and bringing a coherence to the entire experience: “The ending needs to justify the effort it takes to engage from start to finish, and it does this by unifying the work” (p. 520). Anchoring course content in the resolution of a major debate or fundamental concern can help to have this unifying effect, as long as the ending of the course somehow involves a recapitulation or revisiting of all the previous efforts to resolve the tension. Final exams can potentially have this effect, since they are often cumulative and integrate a majority of course content in their questions, and the exams are often administered at the end of a course.

If our learners can experience a real journey through a course—for example, truly inhabiting certain theoretical positions and then moving on to and eventually arriving at others—then they will be more deeply engaged, and their understanding can be transformed because of the critical thinking required to truly go on such a journey. “To be narrative-like ... means conveying the sense of movement *from* one

place *to* another” (Craddock, 2002, p. 117; emphasis in original). Engaging beginnings, turns soft and sharp, genuine complication and meaningful resolution, all presented through a narrative-like sequence for a course, can help our learners to develop the critical thinking we hope for them while still covering the required content and achieving the required outcomes set in a course and containing possibilities for learners to have engaging and even aesthetic learning experiences.

Where to Start?

A recent study of designer practices revealed that instructional designers are often implicitly and explicitly asking themselves questions while in the act of designing courses and elements of courses (Matthews & Yanchar, 2017b). I offer here some questions instructional designers can ask themselves that may help reveal and evaluate possibilities for narrative-like sequencing of content in courses being designed.

- Might learning course content be experienced by learners as following an “and and and so” movement? Where might they experience turns like “but,” “however,” “and yet,” and “therefore” in what they learn?
- What foundational conflicts, dilemmas, alternative perspectives, and/or complexities exist, in the subject matter and in practice in the field, that could be followed throughout a course?
- What complications could enhance or deepen this initial conflict or dilemma?
- Does my handling of the content of my course contain both subtle and sharp “turns”?
- Does my course cut quickly and only critically through alternative perspectives? Or are the strengths of these perspectives also allowed to be fully explored and contrasted?
- Might the ending of my course be experienced by the learners as a meaningful culmination or as an abrupt drop-off?
- How can I use storyboards to partition my course while still building an overarching narrative?
- What kinds of transitions between frames (or storyboards) will be required to maintain learner engagement?
- If the frames of my course (or lesson/unit) were drawn out as a comic strip with my learners as protagonists, would it be a very interesting story?

Though some kinds of courses (such as those covering the history of a discipline) may lend themselves more readily to a narrative-like arc and movement through course content, the content of any course, if explored deeply enough—and the practical realities and complexities faced by practitioners in any field—can provide sufficient challenge, movement, and resolution to be crafted into an engaging narrative to structure a course around.

Conclusion and Caveats

Disney theme parks use stories and narrative sequencing to create magical experiences for their guests. In this paper, I have suggested that instructional designers can follow their lead by focusing on the lived experience of learners as they complete course activities. Though we may never have Disney-level resources and physical space, one way to begin emulating Disney theme parks is in the sequencing of course content, to follow a narrative-like arc. Our learners can experience an engaging course and be transformed in both their understanding of the subject matter, and potentially personally as well, if the sequence of the course activities is designed to have a narrative-like flow with genuine conflict and genuine resolution. Designing such narrative movement into the sequence of a course will require creativity on the part of designers, and call upon their individual judgment and sense of movement and overall flow, to produce narrative-like courses that are engaging and stimulating. Instructional designers seeking to design carefully sequenced learning experiences may have much to learn about good storytelling techniques from atypical sources of professional development, such as the crafts of narrative fiction writing (see Parrish, 2014) and even preaching (Craddock, 2001, 2002; Lowry, 2000), among other sources.

Narrative-like sequencing of a course does not guarantee that learners will experience the course in exactly the way the designer intends. As was mentioned previously, “the learner’s experience of or response to the designed intervention cannot be deterministically defined beforehand” (Gray, 2015, p. 200; see also Boling et al., 2004). In this sense, if the experience of a course (or a lesson or a specific assignment) can be like a narrative, then learners as co-contributors to their own experiences can be thought of as coauthors of the narrative, along with the designer (and possibly even instructors). If designers hope to increase the likelihood of their designed activities being experienced a certain way by learners, then they will need to get to know their learners beyond mere demographic information. But even then, “the individual qualities of learners, and how these will contribute to an experience, are always only half-known, and not something that can be directly impacted” (Parrish, 2014, pp. 264–265). As recommended by other authors (Cates & Bishop, 2003; Parrish, 2014), much depends on a thorough learner analysis and deep empathetic understanding of the learners who will travel the designed course.

But although narrative-like sequence does not guarantee learner engagement, it seems to be a feasible first step that many designers can take and one that does have some promise based on the results from Disney theme parks. For designers hoping to increase learner engagement, but are constrained in resources, narrative-like sequencing in course design can potentially help learners engage deeply and thoughtfully with course content and be transformed as a result of their experience.

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Use of Precedent as a Narrative Practice in Design Learning

Elizabeth Boling and Colin M. Gray

Abstract In this chapter, we discuss narrative as a tool for designing, with regard particularly to how narrative may characterize precedent. Precedent is a critical form of design knowledge, comprising the designer's awareness and experience, direct or vicarious, of existing designs. Precedent informs an understanding of a design space, affords the generation of design moves within those spaces, and facilitates the creation of new solutions. We describe the narrative character of precedent and illustrate the narrative nature and use of precedent via an empirical study of masters-level student designers as they began to understand and attempt to articulate the precedent relationships that were informing their design activity.

Keywords Precedent • Design knowledge • Narrative • Instructional design

In this chapter, we discuss narrative as a tool for designing, with regard particularly to how narrative may characterize precedent. Precedent is a critical form of design knowledge, comprising the designer's awareness and experience, direct or vicarious, of existing designs. Precedent informs an understanding of a design space, affords the generation of design moves within those spaces, and facilitates the creation of new solutions. We describe the narrative character of precedent and illustrate the narrative nature and use of precedent via an empirical study of masters-level student designers as they began to understand and attempt to articulate the precedent relationships that were informing their design activity.

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Precedent in Design

Lawson and Dorst (2013) define precedent in design as “... knowledge of design solutions and other related sources of design inspiration” (p. 101). Lawson (2012) previously characterized this form of knowledge as a “vital, crucial and critical part of the design process” (p. 96). Precedent knowledge is frequently brought into play during designing as a means to generate abductive hypotheses—or “gambits”—within the design situation that point toward a potential solution (Lawson, 2004). Precedent knowledge exists in parallel with other forms of design knowledge, including the designer’s professional judgment and flexible, context-dependent use of methods, as well as disciplinary instantiations of declarative knowledge (e.g., theory, principles, and models) (Nelson & Stolterman, 2012). As a form of knowledge, precedent can be both formal and informal in origin, from a selection of curated works studied in architecture school to an example of typeface noticed while watching a film. It is not confined to any specific domain of design and it is not invented or constructed for specific purposes or to satisfy learning outcomes in the sense that teaching cases usually are.

The knowledge embedded in precedent, interpretable by the designer who has experienced it, and the analogic utility or affordance of the precedent are not propositional; that is, individual elements of precedent knowledge *cannot* be reduced to statements of principle or to prescriptive theory. Precedent experiences may be organized over time by an experienced designer into schemata “that enable [designers] to recognize underlying structures in design situations that allow them to employ and adapt gambits” (p. 12). However, such forms of mental organization of previous precedent experiences are never fully prescribed by a field, even though many such schemata are readily identified in many traditional fields of art and design as varying forms of canon that articulate specific topical, chronological, material, or other themes. These schemata are externalized and discipline-specific. For example, an industrial designer may reference a category of furniture designs such as “mid-century modern” with a fair amount of precision, sharing key characteristics of this period of furniture design with fellow designers. Schemata also manifest in a highly personal form, allowing individual designers to express their understanding of the world through organizational schemes that are not wholly disciplinary, relating simultaneously to their own lived experience, and connecting elements of disciplinary knowledge.

Precedent knowledge is stored as *episodic memory* (Lawson, 2004), more particularly *autonoetic memory* which allows humans to retrieve memories of personal experiences that are specific to time and place. This form of memory may be further understood in contrast to *semantic*, or *noetic*, memory which stores propositional, or general, knowledge (Tulving, 1993). Both forms of memory are applied to designing, but the key distinction between them translates into the difference between unique, specific referents in analogic thinking supported by the autonoetic system, for example, “the quizzes in this module could earn higher and higher scores—like the levels in the *Big Ole Car Heist* video game,” and generalized

principles applied by designers supported by the noetic system such as “motivation is heightened through frequent success [which is represented by these increasing scores].” The habit of noting and storing episodic memories becomes second nature to competent designers in fields where this form of knowledge is valued. No specific or conscious present or future use needs to be anticipated for precedent knowledge at the time it is collected, and in the final analysis, precedent knowledge is fully realized *as precedent when it is used* (Lawson, 2004). Before that point, any individual instance of precedent is, by definition, a memory with the potential to be used as precedent.

Narrative Qualities of Precedent

Episodic memory is narrative by its nature. However brief it may be, an episodic memory contains several of the primary elements of narrative—*place* and *time* and, in the case of precedent memories, *character* (Abbott, 2008), because the designer making use of the memory is always present within it. In direct use, these elements may or may not be articulated, but if the precedent memory is deconstructed, these narrative elements can be found. In many instances of precedent use, the memory may be a minimal and repetitive narrative, of the form “I once experienced a design in which there were some relevant characteristics for the design situation at hand.” The narrative may also be enriched with actions; how the precedent design was encountered or experienced by the character (the designer). It may contain sequences of action or even plot, in cases where tension and transformation are involved either in using or appreciating the precedent. This narrative quality cannot be separated from the precedent memory because time, place, character, and sometimes action or plot are integral to the episodic memory. This relationship of narrative to precedent is at least partially explained by the chronological and other narrative cues that are easily accessible by most humans, particularly in relation to experiences that were especially profound, moving, or otherwise pivotal. Episodic memories tend to form and be maintained when there is an emotional connection. When one is asked about their first experience visiting a city, using a computer, or engaging in a specific type of learning experience, their recollection of the event almost naturally takes the form of a narrative in which they are an actor. For designers, experiences that are “moving” or “pivotal” may, with experience, increasingly include experiences of designs or experiences relevant to design.

Narrative also characterizes the representation of precedent within the individual designer or in communication with others. This is easily seen when the precedent experience is not of a particular design, but of another type of event which is perceived in the moment relating to the design situation at hand. Visser (1995) points out that “the designer often verbalizes a link relating [design data in use] to a particular episode which was their ‘experiential’ source” (p. 173). The example she provides is of a designer working on a carrier to be attached to a bike; in this scenario, the designer recalls how he had carried items on his own bike in his youth: “in

fact when I biked around Hawaii as a kid, that's how I mounted my backpack" (p. 173). In this example, we observe a drawing together of personal experience and the material of precedent in a specific design situation—where episodic memory of a backpack used as a child in an ad hoc manner informed the creation of a purpose-built design to accomplish similar purposes.

In extended and formal representations of precedent, termed *design cases* (Boling, 2010), the narrative element of *character* comes strongly into play. The narrative can be viewed from multiple subject positions, observed by Gray (in review) to include: "the role of the author [of a design case] as utterer/addresser, the reader as the addressee/interpreter, and the constructed role of the artifact and user/audience" (p. 9). Someone involved directly in the case, or currently acting as documentarian, tells the story of what a particular design is like and of selected moments during the process of its creation and (sometimes) its use. Which moments are selected and how they are sequenced—the curatorial aspects of a design case—are also narrative aspects (Abbott, 2008).

Use of Precedent in Design Learning

In the context of higher education, design learning is a complex performance involving multiple forms of knowledge. In traditional art and design disciplines, precedent serves as backdrop for all design learning, informing both students' recognition of canonical examples of design activity (e.g., chronological periods, philosophical movements, key artists/designers) and students' development of a personal precedent vocabulary with which to express new work within an existing space. In poetry, for example, this is commonly expressed through poems "in the style of" (allowing the author to discriminate their approach as more E. E. Cummings and less Edgar Allan Poe), but there is equal reliance on precedent in other art and design disciplines. The architectural canon, buildings considered by a significant portion of the profession to be masterpieces, is debated on the grounds that it is irrelevant and rigid, but defended on the basis that it is valuable and fluid (Breitschmid, 2010), and it is widely employed in architecture education as a collection of precedent deserving of intensive study.

Despite the fact that "students of design everywhere are exhorted to keep sketchbooks and learn to draw to record what they see" (Lawson, 2012), the scaffolding of canon and categories is frequently the only direct form of enculturation into precedent students receive, providing them with a structure for present and future episodic memory that will then allow for communication and generative design action. However, the connections between individual artifacts or experiences and these broader categories or schema—what Gray, Seifert, Yilmaz, Daly, and Gonzalez (2016) refer to as one's *conceptual repertoire*—are frequently left unarticulated, and students are left responsible for building these connections on their own, through repetition and practice.

Although the importance of precedent exposure, use, and articulation is clear within traditional art and design settings, there are substantial gaps in the literature in other disciplines, including instructional design. The existence and use of precedent are not considered central to the conception of design within our field (Smith & Boling, 2009). These gaps include a lack of understanding of how students' conceptions of precedent are established, how precedent use intersects with and builds (rather than discourages) appropriate engagement with specific design problems, and how one's understanding and use of precedent change over time. In fact, anecdotal evidence accumulated across several decades of teaching in the field of instructional design suggests that instructors may be wary of exposing students to overt precedent materials through fear that the students will simply "copy the example" and therefore fail to engage adequately with a design problem, a concept known as *fixation* in cognitive psychology. In this study we examine students' use of precedent in an instructional graphics studio course through the lens of the episodic quality of precedent in instructional design, focusing on the question: what does the precedent use of students in an instructional graphics studio course, and their documentation of that precedent use, reveal about the narrative qualities of this design practice?

Narrative in Student Precedent Papers

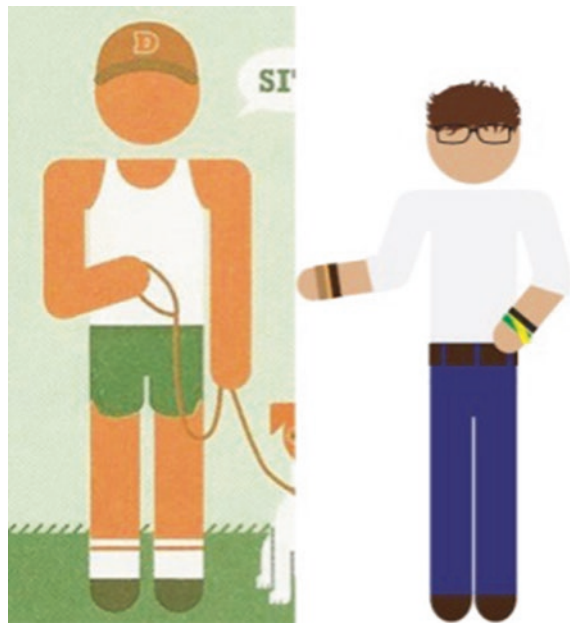
The studio course serving as the setting for the study is a masters-level elective in an instructional design curriculum aimed at the preparation of practitioners and has been offered each summer for the past decade. It is open to nonmajors and routinely draws roughly equal enrollments from instructional design and human-computer interaction design students on the campus of a large research university in the Midwest United States, with a few doctoral-level participants from instructional design and a few masters students from telecommunications or library science. Only one or two of the students each summer have much, if any, experience in visual design. Since its inception, this course has attempted to include precedent material as resources for the students (Boling & Smith, 2014; Boling, Gray, & Smith, 2015). These sources have included a library of over a hundred design titles placed in the classroom and dozens of visual instruction images covering the walls. Pedagogical efforts to direct students' attention to and interest in precedent materials have included the requirement to collect a portfolio of images during the summer term, a searchable catalog of the classroom library online, a Pinterest board of images relevant to each students' ongoing project compiled by the instructor in real time during the course, relevant selections of books laid out on tables in class each week, relevant books pulled off the shelves and shown to students during desk critiques, and, finally, the precedent paper serving as data for this study. None of these efforts has been fully successful.

In this study, precedent use of nine students studying instructional graphics design in the summer of 2015 was examined via two data sources. The first was

the draft and final forms of an assigned paper showing and discussing the precedent knowledge each student used for one of the two primary design projects they completed during the 8-week course. The second was 84 pages of handwritten field notes (an average of 3000 words per class session) recorded by the instructor (first author). These notes documented observations of and discussions with the students regarding their projects and the precedent papers as they were composed and reviewed. The data were analyzed via thematic analysis in which repeated readings of both sources yielded preliminary insights that were cross-checked between one source and the other, then refined in discussion between the two researchers.

Despite an introduction in the syllabus and at the first-class session, during an open discussion with the class about midterm, the students' draft papers discussing precedents revealed that the awareness of precedent and its use were weakly established or not established for these students (Boling et al., 2015). One of the students ventured his idea of what the precedent paper should be: "It should be describing their process for creating their project, how they had made their decisions and so on" (FNp38). This was not what the paper was supposed to be. Despite the instructor's use of another student's clear, direct use of precedent (Fig. 1) as an example in this discussion, when the students' drafts were handed in shortly thereafter, they focused primarily on the design moves each of the students had made to bring their work to its current state (Fig. 2) and not on the precedent inspirations for those moves. This has implications for the remaining findings in this study. The students first had to recognize that they *were* using

Fig. 1 Aaron began the course, and repeated on the last day, that "he usually tells his teams that he's not a visual thinker – they have to take that part" (FNp84). He was nervous about his instructional booklet project, therefore, so "I grabbed *The Dog Owner's Manual* from [another student's] table. He loved it immediately" (FNp28). He used this book as a direct source from which he adapted his own illustrations



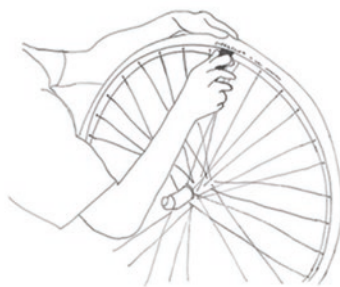


Fig. 2 Sandy's draft was typical in its focus on the methods she had used to create the images for her instructional booklet, annotating this image as follows: "I adopted the method of freezing a frame from the video of a bike maintenance class, printing it out and then tracing out the parts in focus for the activity to create a magnified learning experience"

precedent before they could describe *how* they were doing so. Observation of students' use of precedent served, therefore, as a stronger source of data than their own reports. However, when prompted, the students were able to recognize the ways in which they were using precedent, and their final papers and continuing discussions between the instructor and students revealed several ways in which students' use of precedent was narrative in nature.

Episodic Memory and Precedent

As students described sources of visual affordance or inspiration that had been unrecognized at the time they were experienced but that were—at my request—being pinned down to loose time frames and locations, it was clear these were bound to narrative content. Hana described her many experiences in crafting, which began when she was 6 years old and which had connections to her mother's career in designing instructional materials (Fig. 3).

Likewise, Cecil focused entirely on what he was doing in terms of the content of the images, until he eventually mentioned that he loves cartoons, especially *The Simpsons*. Once he and I noted that this was a precedent for him, he was able to focus on the formal properties of his work, and he did so while recounting enjoyable experiences with cartoons (Fig. 4). These narratives were not fully formed stories, but the precedents were directly or indirectly identified with times, places, people, and events.

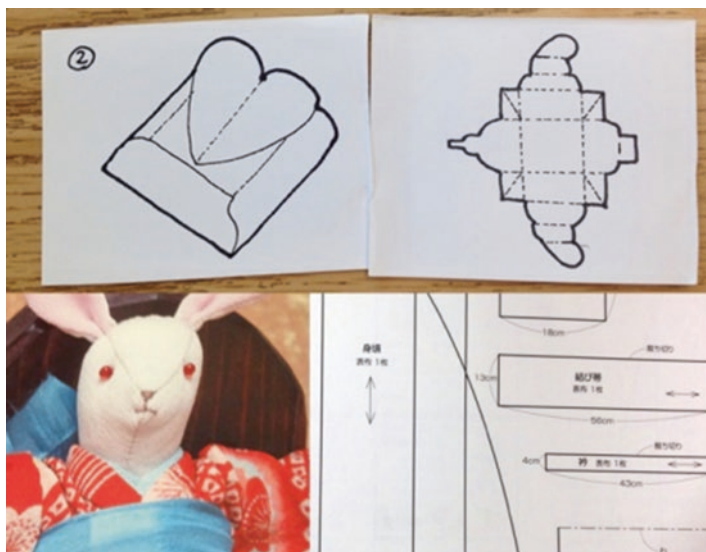
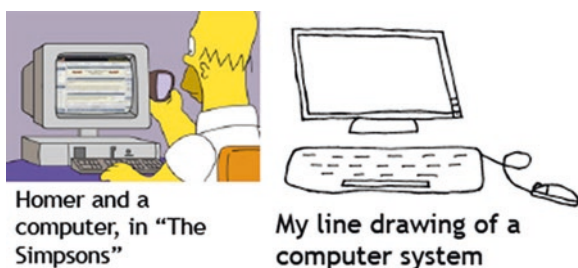


Fig. 3 At the draft stage of her precedent paper, Hana “had simply shown about 18-20 of her [project images; top image] ... and ... for each one ... said something about why she chose it, did she find it difficult, and so on ... it became clear to me that she thought ‘precedent’ meant ‘the thing you looked at to draw the picture’” (FNp51). “I asked her about her own background and the crafts she had done since she was six – didn’t [the instructional materials for these] use images with Dark lines. Dotted lines. Arrows ...?” (FNp.51–52). In her final paper, Hana showed a craft book from her home country (lower image) to illustrate this indirect use of precedent

Fig. 4 The episodic quality of Cecil’s precedent was evident in the way he was clearly recalling pleasant memories of watching cartoon shows and expressing his appreciation for the visual style of them



The Designer as a Character in the Narrative

We also identified narrative bound to the “immediate use of precedent” (Boling et al., 2015, p. 10), meaning precedent use in which the student looked purposefully for artifacts that would offer affordances immediately and directly applicable to

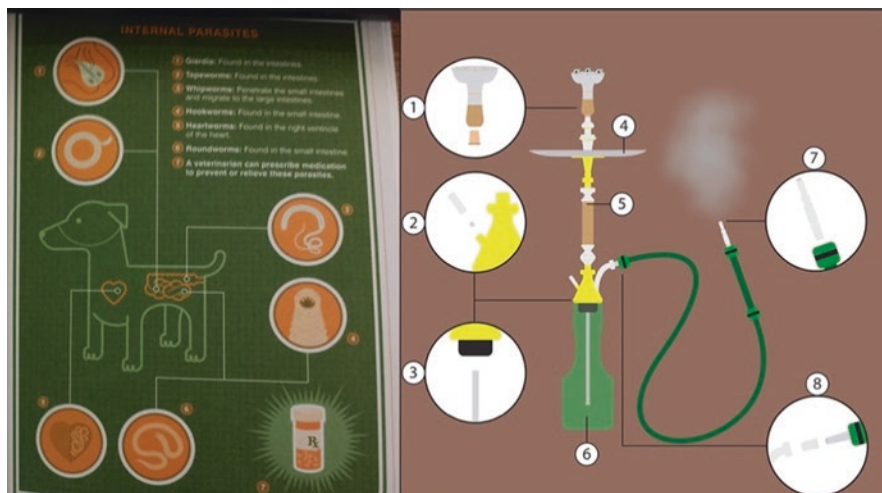


Fig. 5 Aaron described not only the moves he made to follow the precedent design from which he was working. He referred to the designers of that precedent as actors in a story including himself; he narrated his decision to make a different design move than the other designers had made. “*The Dog Owner’s Manual* made use of call-outs in its illustrations ... I used the same technique for many of my illustrations ... Where I differed from Kepple and Buffum [sic], however, is that they would also then have some information on the illustration page which related to said call-out ... I opted to keep said detailed information exclusively on my textual pages ... I made this choice to help prevent images from seeming too busy.”

their current design situations. These narratives contained strong elements of action and action sequences. The stories they told when asked about the precedents they had used were clearly bound up in an immediate sense with the design moves they were making—not constructed post hoc—and married those moves to themselves as actors, essentially as designers in the same narrative space as those designers who produced the precedents. Aaron explained to the first author in detail how he drew an almost fully intact model of style from a single illustrated book to apply to his own project and how he poured over that book to note specific affordances applicable to his project. In the final paper, his narrative included himself as a designer making different moves than those he saw had been made by the designers who created the precedent materials (Fig. 5).

Bhodi also worked from a book to photocopy, scale, trace, and adjust a figure depiction which she then used for her instructional booklet on basic meditation technique. In her narrative of precedent use, Bhodi herself figures as a strong character. Her experiences with meditation and adaptation of images are based on an internal sense of what she determines to be “peaceful.” She was an active design actor in this story (Fig. 6).



Fig. 6 Bhodi told the story of adapting these figures from a general how to book in class as she hung them on the wall, asking her peers for input on “which seemed most peaceful.” (FNp50). Part of this adaptation included referring to the color treatment of the precedent material and noting “they used shades of one color and no outlines” (FNp50). In both cases she made her own decisions about the peaceful look she wanted—using lavender for the female’s yoga pants and gray outlines instead of no outlines for the figures

Precedent Narratives Merged with Studio Narratives

Studio learning experiences like the one forming the context of this study can be seen as characterized by narratives; these are typically implicit, but nevertheless influential for students and instructors alike (Boling, Smith, Siegel, & Parrish, 2013). One of these is the canonical narrative form, “character goes on a journey,” in which one or more of the learning activities in class represents a challenging quest. Chen illustrates how this narrative might merge with the immediate narrative of precedent use. As he started his instructional booklet, he told the class that he aspired to a style he had seen used in his human-computer interface (HCI) program by other students and that he would like to learn himself for use with his HCI program teams. According to the field notes, though, “he’s worried this will not work” (FNp60) and later “he complains repeatedly about the amount of time it takes (he may be thinking that this will be a problem for teamwork in HCI)” (FNp79). In other words, he had taken on a challenging quest involving the use of a particular precedent, merging the two narratives and playing the same role in both. In the studio narrative, his peers played the role of critical but encouraging bystanders. “The Informatics students ... acquainted with the style ... gave him a little bit of a hard time—why could the style not be adaptable?” (FNp60). Aaron and Ken played the role of squires in this narrative, one demonstrating from his own project how it might be done, and the other, clearly the technical leader in the class, speaking up, “pretty firm on how doable it would be” (FNp60). Chen’s precedent narrative echoed the larger one; he showed in class each step of his adaptation from the precedent to the final work (Fig. 7).

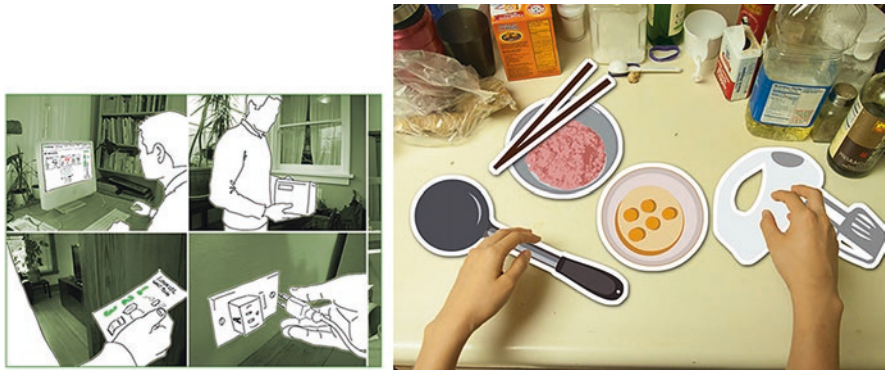


Fig. 7 Chen started from precedent he had seen students in his program use, shown in his report (left) in which images of users were shown in sketch form against photographic backgrounds. He started with photographs from which he planned to sketch, then decided to use flat drawings versus sketches for the materials of his process (making dumplings), placing them against the photographic background. With this done, he decided to deviate again from the precedent by using photographs for the human elements of the images

This example illustrates the generative role of precedent, not only stimulating design possibilities by allowing the designer access into a design space but also serving as a provocation that questions other design assumptions—making the design situation more complex, but perhaps more meaningful as well.

Discussion

In the examples of precedent use by students presented here, the move of the maturing designer from vast stores of precedent to usable schema described by Lawson (2004) is not present. The roots of precedent stores are discernible, however, and a tight coupling of individual experience—in class and out—with precedent is apparent. Descriptions of mature designers show that this tight coupling is retained; schemata are not divorced from their origins even when designers are experienced (Lawson, 2012; Oxman, 1994). This indicates that the first form of narrative practice observed in these students is part of their development as designers, not just their status as learners. We also note that the second form—designers as characters in the narrative of precedent use—distinguishes the practice of mature designers as well. This is evident in design cases written by experienced designers, in which descriptions of precedent use display the narrative features of time, place, and actors (Smith, 2010). Precedent narratives merged with studio narratives may be specific to the learning environment, although the question of whether professional design projects may be viewed through a narrative lens is open for future study.

One implication of considering precedent use as inherently narrative is that this form of knowledge has to be established anew in each designer and design team, even if a curated canon of precedents exists from which all design students also learn. (It is worth noting that the field of instructional design possesses no such

canon.) The individual narrative bound to precedent use makes this form of knowledge unavailable for translation to declarative form. Therefore, student designers should be afforded opportunities to recognize and produce quality narratives around precedent as part of developing their essential ability to design and be encouraged to value this dimension of their practice on a par with the use of principles and models currently foregrounded in instructional design practice. Should these opportunities be provided and the habit of noting, storing, and using precedent be established during design education, practitioners in the field may begin to engage in the robust collection, curation, and publication of precedent that characterizes all established fields of design.

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Promoting Creativity and Critical Thinking Through Digital Storytelling: Perceptions of Undergraduate Students

Albert S. Akyeampong

Abstract Creativity and critical thinking are important parts of the college experience. Colleges offer courses that aim at helping students to develop creative and critical thinking skills. The current generation of students belongs to the millennial generation. The millennial generation refers to those born between 1981 and 1999. This generation has grown up immersed in technology. The millennials are growing up with the World Wide Web and digital technologies including laptops, cell phones, text messaging, and video games, but do not necessarily develop creative and thinking skills just because of this. To develop creative and critical thinking skills, a digital storytelling course was designed for freshmen in a Midwestern university in the United States. Digital storytelling is the art of combining images, audio, and sometimes video to tell a story (Frazel, Digital storytelling guide for educators, International Society for Technology in Education, Washington, DC, 2010). Research shows digital storytelling improves engagement, critical thinking, and creativity. This research reports on experiences in a transition course designed to help freshmen develop critical and creative thinking skills, transition to college life, and understand college-level work ethics.

Keywords Digital storytelling • Storytelling • Creativity • Critical thinking • Millennials

Introduction

The millennials who have grown up in average and well-to-do households around the world have access to more information than any generation in history because of Information Communication Technology (ICT) (Foehr, 2006; Lenhart, Arafeh, Smith, & Macgill, 2008). The millennials have spent their entire lives surrounded

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by and using various technologies, including video games, computers, digital music players, video cameras, cell phones, and all the other toys and tools of the digital age Prensky (2001a, 2001b). The millennials have been raised in an era of instant access to information. The common method of communication is text messaging and instant messaging as well as cell phones and social media.

Though very skillful at “multitasking in the use of technology the millennials learn differently and struggle to understand course texts, written instructions and assignments. They expect learning to occur in an active format, and are quick to ‘change channels’ when their active learning expectations are not being met” (Saulnier, 2007, P.5). Digital tools can help motivate them.

A large number of educators have not yet found meaningful ways to integrate emerging technologies in their classrooms despite the fact that young people continue to use emerging technologies in their daily lives. A major challenge for educators is how to make what is familiar everyday in the lives of the millennials into a subject of study that promotes critical thinking and challenges students to view a problem from more than one perspective. In higher education, learners must not only acquire knowledge but actively and critically analyze, reflect, and make meaning from the knowledge.

Conversation on improving educational benefits through video (a medium particularly well-suited to storytelling) use is not new in education. Marx and Frost (1998) underscored the influence of videos to engage students by heightening arousal and motivating students to become more responsive to content being presented. In higher education there is a need for learners to critically engage with new knowledge and make meaning from this new knowledge. Digital storytelling is one way educators can engage students and facilitate meaningful learning.

Critical Thinking Framework

Critical thinking is the art of conceptualizing, analyzing, reflecting, and evaluating with a view to improving a concept. Paul and Elder’s (2010) framework constructs critical thinking into the intellectual standards, the elements, and the intellectual traits. The relationships between these are that the intellectual standards of clarity, accuracy, precision, relevance, depth, breadth, logic, significance, and fairness are applied to the elements as we learn to develop intellectual traits. Intellectual traits include intellectual humility, intellectual courage, intellectual empathy, intellectual autonomy, intellectual integrity, intellectual perseverance, confidence in reason, and fair-mindedness. These traits are acquired through consistent application of the standards of thinking to the elements of thinking. Habitual utilization of the intellectual traits produces a well-cultivated critical thinker who is able to raise vital questions and problems; formulate them clearly and precisely; gather and assess relevant information, using abstract ideas to interpret it effectively; come to well-reasoned conclusions and solutions, testing them against relevant criteria and standards; think

open-mindedly within alternative systems of thought, recognizing and assessing, as need be, their assumptions, implications, and practical consequences; and communicate effectively with others in figuring out solutions to complex problems (Paul & Elder, 2006, 2007, 2010).

The Project

To develop the creative and critical thinking skills of freshmen in a Midwestern university in the United States, a Transitions Experience (TREX) course in digital storytelling was designed. Through critical reflections and discussions of selected readings, as well as digital documentaries, students tap into their creative abilities and develop strategies for critical and creative thinking in their major area of study. The students use digital storytelling as a tool for empowerment in telling stories within the community environment. The topics range across issues related to equity, gender, poverty, and access to technology.

Participants

Participants for the research were undergraduate students enrolled in a transition class in a Midwestern university. Transition classes are required courses for all freshmen.

Settings

Many students wonder if they have what it takes to earn a 4-year degree. The Transitions Experience (TREX) courses are designed to help freshmen understand how to think critically, reason analytically, and make connections between disciplines—all skills needed to be successful in college. Students demonstrate critical and creative thinking through critical responses to selected documentaries, articles, and literature, considering multiple perspectives from selected readings; thinking about personal, social, cultural, textual, cognitive, and/or political factors that have affected their interest in, and capacity to make sense of, the readings and documentaries; and finally creating a digital story. Teaching strategies included interactive discussion, debate, modeling, questioning, reflection, self-evaluation, role-playing, problem solving, simulation, and informal presentation. The methods used include interactive lecture, questioning, discussion, small-group activity, and student involvement. Assessments include reflective writing, project presentation, peer evaluation, feedback, and self-evaluation. Students produce a digital story as part of the class.

The course goals include enabling students to:

- Transition to college life and understanding of college-level work.
- Realize the connections between the general education program and their course work in their major area of study.
- Develop college-level skills and habits within a variety of course projects that reflect critical and creative thinking.
- Understand themselves as a reader, writer, inquirer, and critical thinker.
- Critically read and discuss community issues and documentaries.
- Consider situations from multiple perspectives.
- Identify key issues and convert them to problem statements.
- Identify and evaluate information.
- Formulate big ideas related to issues of race, gender, diversity, education, and technology or another idea in their major.

The digital storytelling course was designed for freshmen as part of a transition college class. Students research and identify a problem or relevant topic in their lives or community. Students analyze the problem and create a digital story to tell the story. Instructor and peer feedback was part of the process. A draft of the digital story is presented to peers for feedback. Students analyze and use the feedback to finalize the story. Finally, students write a commentary paper, which allows them to deconstruct the issue (look at it critically). Students reflect on how the representations of the issue affect them.

The grading of the paper was based on the critical and creative thinking rubric that includes the following criteria: problem identification, research and analysis, and solution development.

Data Collection

Data collected included quantitative and qualitative forms. An online survey was designed as the quantitative data collection method. The survey examines the perceptions of the participants regarding the critical thinking skills. Qualitative data collected included open-ended questions on digital storytelling, the commentary paper students produced, class observation throughout one semester, class discussions between students, and field notes.

Creative and critical thinking was integrated throughout the course. Students had to think critically about issues by consistent application of the standards of thinking to the elements of thinking throughout the semester. During discussions and reflections, students frequently utilized the intellectual traits raising vital questions and problems and formulating them clearly and precisely. Students learn to gather and assess relevant information to interpret and come to well-reasoned conclusions and solutions. Students read articles and viewed digital stories. Students critically read and discussed the articles and documentaries and considered situations from multiple perspectives. Students also identified key issues and converted them to problem

statements. Students researched, identified, and evaluated information. Students through assignment and class discussions formulated ideas related to issues of race, gender, diversity, education, and technology. The six elements of a good digital storytelling were adapted as guidelines for discussions of digital stories and student project. According to Porter (2005), there are countless approaches to creating stories, depending on the purpose and the audience. The six elements are considered fundamental to digital storytelling.

Living inside your story: The story is told in first person perspective using your own storytelling voice.

Unfolding lessons learned: The uniqueness of this element is that each story expresses a personal meaning or insight about how a particular event or situation touches the writer, the writer's community, or humanity.

Developing creative tension: The premise for this element is that a good story creates intrigue or tension around a situation that is posed at the beginning of the story and resolved at the end, sometimes with an unexpected twist.

Economizing the story told: A good story has a destination and seeks the shortest path to its destination using the fewest words possible while preserving the essence of the story.

Showing, not telling: A picture is worth a thousand words, the adage goes. Images, sound, and music can be used to show part of the context and provide emotional meaning not provided by words.

Developing craftsmanship: Use media resources in a meaningful way, not just as a decoration. A good story incorporates technology in artful ways in communicating with images, voice, sound, animations, special effects, and transitions.

The digital storytelling project of the students involved the following steps:

1. Brainstorming to select a topic
2. Conducting research on the selected topic
3. Writing a script
4. Gathering images
5. Recording narration or voice-over and choosing background sound where appropriate
6. Editing the audio and video in Audacity and Movie Maker or iMovie, respectively
7. Sharing
8. Reflecting

The majority of the students followed the above steps. However, if a student was having difficulty writing the initial script, the student was encouraged to tell the story verbally and record before writing. The student could then tweak the script after peer review and the instructor's final review before proceeding to complete the digital story. The idea of telling the story verbally before writing was reported to be beneficial by a few students who had difficulty and were allowed to tell their story aloud before writing. Research by Bogard and MCMackin (2012) supports this finding.

During the brainstorming session, the students start with an idea. They discuss the idea or topic with their peers in groups we call story circles. Students explore or research the idea to learn more about the topic. They create a repertoire of information relating to their story. Students learn to validate information or bias and ask questions and look at the ideas or themes expressed.

During this process, students learn both about validating information and information bias as they delve deeper into a topic. Students use mind mapping tools or index cards to organize their information. This process helps students to keep track of the important information. After gathering enough information, students begin writing their scripts. There are two peer review sessions of scripts. Students are given guidelines on how to comment and give constructive feedback. Students participate in small-group story circles. Each student shares his or her ideas and provides constructive feedback that can be used to improve the scripts of their peers before adding images. Images form an integral part of the digital storytelling process. After completing the script, students gather images and start putting the image, text, and sound together on a template. This is known as storyboarding.

Storyboarding is where the students transition into visual media literacy. Storyboarding helps and challenges the student's creative and critical thinking ability toward understanding sound and images in relation to their script. Students have to decide, question, and analyze what image and sound to put together to make meaning and communicate the story to their audience. After storyboarding students use the storyboard which is their blueprint to put the final movie together to create their digital story.

Students record their narration using cell phones or laptops or computer. The sound files are imported into Audacity, an audio editing software to edit their narration. The images and audio are put together in Movie Maker software to create a digital story. Some students with personal Mac laptops use iMovie, which has similar capabilities. A draft of the digital story is presented to their peers for feedback. Students use the feedback to tweak the digital story for final digital story presentation. Students are given guidelines to help them through the review process.

The guidelines for students include:

1. Flow. The story must flow and make meaning.
2. Narrative arc. Every story has a beginning, a middle, and an end. The beginning tells the premise of the story, the middle outlines conflicts along the way, and the end is the destination where the revelation occurs.
3. Narrative voice. How clear and consistent is the narration voice? The voice quality of the narration must be consistently audible and conversational throughout.
4. Background sound. The music must be appropriate to the movie and stir emotions that match the story line.
5. Photos. Are the quality of photos optimum? Do the photos create a distinct atmosphere and communicate symbolism and/or metaphors?
6. Economy. Is the story told with the right amount of detail and does not seem too short or too long?

7. Pacing of voice. The pace (rhythm and voice punctuation) fits the storyline and helps the audience really “get into” the story.

Student share their final digital story with the class. The final part of the class includes reflection and feedback. Students submit their reflection and feedback as a commentary paper.

Commentary Paper

Students are required to write a paper explaining the critical element of their digital story. Students provide the context of the issue within the movie and deconstruct it by looking at it critically and answering how the representation of the issue affected them as a future educator, engineer, pharmacist, etc. The commentary paper grading is based on the critical and creative thinking rubric that includes the following criteria: problem identification, research and analysis, and solution development developed by the university.

Results

Results of the research were obtained from one instance of an undergraduate transition course in digital storytelling offered in a face-to-face setting during the spring semester of 2015.

The results from the survey on digital storytelling are displayed in the tables below (Tables 1, 2, and 3).

Table 1 Percentage of participants aged 18–19 years and 20–21 years

Years	Number	%
18–19 years	16	76.2
20–21 years	5	23.8
Total ($N = 21$)	21	100

Table 2 Number of participants by class standing

Item	Number	%
Freshman	20	95.2
Sophomore	0	0
Junior	1	4.8
Senior	0	0
Total ($N = 21$)	21	100

Table 3 Number of participants by gender

Item	Number	%
Male	11	52.4
Female	9	42.8
Other	1	4.8
Total (<i>N</i> = 21)	21	100

Table 4 Responses to perceptions of digital storytelling questionnaire (*n* = 21)

Item	Strongly agree/ agree %	Neutral/disagree %
Before this class, I did not know much about digital storytelling	81	19
Digital storytelling is a useful tool in helping students to think through written/audio/visual materials in a more critical manner	86	14
The sample digital stories I watched in class were useful	95	5
Digital storytelling class will teach me how to think through and critically analyze media	72	28
I am very invested in my digital storytelling project process	67	33

Freshmen accounted for 95.2% with juniors accounting for 4.8%; see Table 2.

Responses to the Likert scale questions are displayed in Table 4. The Likert scale consisted of four choices: strongly agree, agree, neutral, and disagree. Responses to strongly agree and agree were aggregated; responses to neutral and disagree were aggregated.

During the interviews, the majority of students commented on the use of technology in the class. Digital storytelling involves the use of technology. In the digital storytelling class, students use various technologies to create the digital stories. These technologies include Movie Maker, iMovie, Snagit, photo editing software, GoAnimate (an animation creation software), Audacity (a sound editing software), and a number of free online software tools. Students' reflections indicated that the course has given them new insights into the use of technologies in education. Alice's reflections are one of the examples:

At the beginning of the semester I didn't really know how to work the technology that went with digital storytelling. I feel like I now know more about technology and I appreciate technology more now. Without this technology you wouldn't be able to make digital stories and people wouldn't be able to get their stories out there. When you think of technology and how it affected everyone's life today you think of many positive things and digital storytelling is a very positive effect of technology. Digital storytelling make me appreciate technology more now and make me feel better about using technology now.

- Alice

John expressed similar sentiments:

Digital Storytelling has changed my outlook on technology very much. I never knew how much crazy and enhanced stuff you can do on a computer in order to make a movie. I never thought how advanced our technology has really come until just recently. Digital storytelling definitely made me appreciate technology more and has made me more interested in it.

-John

Another result that came out of the qualitative data analysis is the issue of strength and weakness of digital storytelling and the process. John and Ben discussed their strengths and weaknesses in the digital storytelling process. This supports one of the cardinal elements in critical thinking process:

I believe my digital story showed an important moment in my life that provided me with many great memories and friends. The strengths of my story I believe was the soundtrack, was well fitted to the story. Also that the pictures were original and out of my own collection which connected it more on a personal level. The weaknesses of my story were the narration of my video could have been better. If I added more enthusiasm it would make it more interesting to listen to. I think I could have made the video long also if I were to add more to my script to extend the length of the dialog and pictures. Overall I believe that my digital story was a good story for it being my first ever created story. Next time I use this program and skills I think I will be well prepared to make an even better story.

-Ben

The effect of digital storytelling on the participants was one of the areas that the majority of students commented about:

Digital storytelling has showed me that I actually can do whatever I put my mind to as well. Coming into this class I didn't know a thing about computers and thought I was going to struggle but with the help of my fellow peers and professor I came out successful. Also you can use these tools for the rest of your life in the working field. Digital storytelling is definitely a class I would recommend. If I had to say some of the weaknesses of digital storytelling I would say that it is very time consuming and it takes a lot to develop a movie correctly. It is much easier to just create a PowerPoint rather than a movie...This class has definitely built my confidence and has made me a better student. Critical thinking is definitely a strength to digital storytelling.

-John

The importance of reflections was one of the themes that stood out after the qualitative data analysis.

The characteristics of a well-cultivated critical thinker are the ability to raise vital questions and problems, formulating them clearly and precisely. They should be able to gather and assess relevant information, using abstract ideas to interpret it effectively and come to well-reasoned conclusions and solutions (Paul & Elder, 2010). The digital storytelling process included students brainstorming and coming up with a topic. During the process, vital questions and problems are raised, and through group discussions including feedbacks from story circles, solutions are formulated. Student's commentaries contain nuggets of this critical thinking element. Jennifer, Janice, and Ben's reflections attest to this.

Another theme that emerged from the qualitative data is *thinking deeper*:

The whole process has made me think a little deeper about life and the digital story process as a whole. Digital storytelling has made me dig into the deep world of my past. My story begins with the idea that my father was a member of the United States Navy, hence making me a military brat. I talk about my childhood while he is in the Navy. From living overseas and being with him, to living in a city in Ohio and him always being gone. Once he retired I figured I would get him back in my life. I thought I would finally have the father-daughter relationship I have longed for. In my case that did not happen. Since he retired from the Navy he has worked at two different jobs. The hours he works make it really hard to see him, or even associate with him. Whenever I am home he is either working or sleeping, no in between. He missed my childhood, me growing up, and me playing softball. He missed my life. It tears me apart when I have to think about him and the relationship we have. My parents typically fight, which threw me into a dark place for a while. I have recently come out of that state of mind. I have realized whatever is wrong with my father is not my fault and I have importance in this world, so I am going to take that and make my life worthwhile. Digital storytelling has made a huge impact on me and the way I think about different aspects of the world. The whole process has made me think a little deeper about life and the digital story process as a whole.

-Jennifer

My digital story made me think about who I am by allowing me to open up and express my feelings about being bullied. I was open to tell people about my story and in the process I was able to make myself feel better. It let me realize how far I've really come since then and that's a very comforting feeling. That's something I may not have been able to realize for years if it wasn't for digital storytelling. That's something I will always be grateful for.

- Janice

My digital story showed me that I have much more to learn about myself. It showed me that I will come across many experiences in life that will change it forever. I now know to cherish each moment like it may be my last. My story also showed me the potential I have to be a creative person and a critical thinker. This project allowed me to be able to see that I am capable of making a good project using this program... In digital storytelling I have learned to create personal stories to me, grow as a critical thinker, and realize I am more creative than I think. This class will definitely help me later on in life no matter what I got into. It is a great method of sharing and explaining stories using pictures and a narration to help people better connect to your story. This class has also showed me other programs that have helped me become more computer savvy. This is very useful because of society is always becoming more technically advanced and it helpful to keep up to date on technology.

- Ben

Digital Storytelling has made me a much better student here at Ohio Northern University and has made me look outside the box often. It has made me work through problems I didn't think I could and has made me very successful thus far. The activities we do in here can help us further on down the road. We can make a digital story for anything. When it comes to presenting projects I will continue to present my digital stories.

- John

Regardless of which type of story a student conjures, the most powerful digital stories are the ones with a strong personal connection. The heart of all stories is the importance of expressing your story (Porter 2005). This is true of the digital stories in this research. According to Lambert (2009), deep storytelling which includes listening and being heard is not only beneficial, but it motivates students into doing

their best work, thus acting as a natural vehicle for reflection, understanding, and conveying learning. Mia, Alice, and Patrick's reflections throw more light on the deep storytelling that ties in with critical thinking as they talk about their digital story:

My Digital story made me think a lot about whom I am and how I want to present myself to others. When you make a digital story you need to keep in mind that it is an exact reflection of yourself and your personality. Keeping this in mind, I always wanted to do my best work and present it in the best way possible. This is why digital storytelling really made us dig deep into our own lives and made me think a lot about who I am as a person.

- Mia

Digital storytelling made me think about who I am as person in many ways. One way that really stands out to me is when deciding what to do my digital story about I thought about what really matter the most to me in life. The think I pick was my family. It made me think about how I don't tell the people in my life what they really mean to me. My parents for example pay my tuition, my phone bill, my sorority bill and my gas for my car. I don't remember the last time I really thanked them for that. It made me think about me think about how much I really don't really show them how much I appreciate them. I hope by making this digital it will really show them how thankful I am for them. Also I hope by making this digital story that it will make me realize all the little stuff they do for me.

- Alice

Problems were also discovered after the qualitative data analysis. The most problematic parts of the digital story was the timing of my voice and pictures. It took hours of changing the time of photos and recording until I could move on to other areas that contributed to the story. Choosing the music was the smoothest process because I frequently listen to music, so I already had a desired song before I started creating my digital story. After the finalization of my story, I watched it five or more times and I was satisfied with my work. The experience through this process was fascinating because of how much I enjoyed it.

- Patrick

Discussion and Conclusion

Survey responses to quantitative forms and answers to open-ended questions, as well as commentary papers, offer insights into student's perceptions and experiences in digital storytelling. Students' comments indicate that critical thinking was part of the digital storytelling process. Students throughout the semester demonstrated critical and creative thinking through critical responses to selected articles, literature, and documentaries. Students considered multiple perspectives on issues including the digital story topics and scripts. Students were asked follow-up questions to help them think about personal, social, cultural, textual, cognitive, and/or political factors that have affected their interest in and capacity to make sense of the readings and documentaries.

Technology was a conspicuous aspect of the digital storytelling course. It is important to mention that the technology should not be the focus. Frazel (2010) states that the digital storytelling project has dual focus, the story and the application

of technology. Digital storytelling is a valuable tool that invigorates students and motivates participants to work collaboratively to construct and personalize digital narratives (Yang & Wu, 2012). The story is the heart of the matter. The application of technologies and related resources supports digital storytelling (Frazel, 2010). It appears digital storytelling has the potential of promoting critical and creative thinking. However, more data is needed to draw any broad conclusions.

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Changing the Narrative of School: Toward a Neuro-cognitive Redefinition of Learning

Phillip Harris and Donovan R. Walling

Abstract How learning is defined affects our national narrative of school, broadly conceived as how and what is learned and to what extent learning is accomplished as well as through what means. The narrative of school has broad ramifications for fundamental operations, such as how schools are architecturally conceived; the organization of learners, classes, and subject matter; and how learning accomplishments as well as learners and teachers are evaluated. The purpose of this work is to explore—and to encourage others to explore—a new definition of learning that is based on neuro-cognitive research and how such a definition might change the narrative of school. In the use of neuro-cognitive, the curriculum theory toward self-reflection authors link existing theories of cognition to new research emerging from neuroscience. When cognitivism was proposed in the 1950s, the study of the brain was in its infancy. Now, however, scientific understanding of the brain is growing exponentially. Therefore, it is reasonable to explore the link between our growing knowledge of neuroscience and our understanding of cognition.

Keywords Behaviorism • Cognition • Digital Age • Industrial Age • Narrative • Neuroscience • Reconceptualism

Introduction

The national narrative of school is outmoded. *Narrative* refers to how education writ large—i.e., “school”—is conceived and actualized through a representation of learning that reflects an overarching definition and its ramifications for practice.

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A Digital Revolution began at the mid-twentieth century, ushering in the current Digital Age, an era fundamentally different from the preceding Industrial Age. However, the Industrial Age narrative of school has not disappeared nor have values and practices associated with that narrative been left behind. Quite the opposite is true. We are prepared to question in full Industrial Age assumptions that undergird our current national narrative of school as we discuss how teaching and learning might be reconceptualized for the Digital Age and thereby create a new narrative.

We begin with *to learn*, which seems like a simple verb that embodies a straightforward concept, involving moving from a state of not knowing something to knowing that thing. However, in actuality, learning involves a highly nuanced and variable set of processes. As Albert Einstein is reputed to have declared: “Any fool can know. The point is to understand.” And *understanding* is highly complex, but it is essential to true learning. The phrase that we and others use—“knowledge and understandings”—embodies this fuller sense of what it means to learn.

The purpose of this work is to explore—and to encourage others to explore—a new neuro-cognitive definition of learning that would shape a new narrative of school. In the use of *neuro-cognitive*, we link existing theories of cognition to new research emerging from neuroscience. When cognitivism was proposed in the 1950s, the scientific study of the brain was in its infancy. Now, however, scientific understanding of the brain is growing exponentially. Therefore, it seems reasonable to explore what neuroscience can contribute to our understanding of cognition; and so the term *neuro-cognitive* denotes newly emerging knowledge and understandings that should be shaping teaching and learning in the Digital Age.

Our focus will be on prekindergarten through undergraduate studies. We also are focused primarily on public education, particularly in the United States, although much of the following discussion will apply to other countries, particularly Western or Westernized nations.

Rather than proceeding from an established learning theory or collection of theories, we propose to examine the roots from which learning theory in its broadest sense has sprung. To this end, we delve into two questions that compose the subsections that follow. First, what are the *origins and definitions* of learning—in other words, what traditional, cultural, social, scientific, and educational history undergirds our current narrative about what it means to learn? How have such understandings changed over time, and how might a new definition of learning fundamentally transform our narrative of school?

Second, what *ideas and research* shape a neuro-cognitive definition of learning? The prevailing definition of learning today is behavioristic in its origins and implementation, operating in concert with the sensibilities and realities of the Industrial Age and contributing to the development of the factory model school. Today, new and rediscovered ideas and recent, relevant research are providing both impetus and foundation for a new definition of learning that will profoundly change the narrative of school.

Origins and Definitions

Our narrative of school is shaped by the words we know and how we use them. How is the definition of learning constrained by the etymology of the word *to learn*? In popular usage *learning* encompasses many forms of knowledge acquisition, from learning how to tie one's shoes to how to solve quadratic equations. But the verb *to learn* was far narrower in its origins, some 900 years ago. The modern English word traces to Middle English *lernen* (a cognate of the German verb *lernen*), from the Old English *leornian*, meaning to learn, read, or ponder. It is akin to *lesan*, meaning to glean (a cognate with German *lesen*, meaning to read). The commonality in these English and German origins is reading—that is, to read is to learn. *Reading* and *learning* are virtually synonymous, which bestows on the act of learning, in its original grammatical sense, a connotation of scholarship. To learn means, in this connotation, to acquire knowledge and understandings through formalized study. In Britain's universities today, this close connection can still be heard in the phrase “to read,” meaning in the American sense “to study,” as in “I’m reading Economics at Oxford.”

Leaving aside the literal definition, there remains a more fundamental definition of learning to be considered. Looking historically to education in Ancient Greece, often considered an archetype of modern education in the West, it would be a mistake to consider only formal education, which was provided to males of certain classes, usually in the form of a public school or by a private tutor. Learning, in a different, larger sense, also was valued. Girls, for example, received informal education from their mothers on topics ranging from music and dance to housekeeping. Manual laborers and slaves learned trades, such as carpentry, from the masters of various crafts who were their teachers. To none of this informal education could the scholarly connotation of learning as “reading” be applied. Indeed, actual literacy was not a factor in informal education at all in many earlier eras. Yet informal education was vitally important learning in the context of civil society, which was based on a broader, more egalitarian, functional definition of *to learn*.

A dichotomy of definitions of learning—one for formal education, another for informal education—has persisted across the ages, but at root the result has been the same: acquiring knowledge and understandings. However, that result has been stratified through secondary definitions detailing the nature of the learning acquired and often depending on how it was acquired, such as whether by attendance at the academy or through vocational effort. Such stratification continues to feature in our narrative of school, marking out elite learning, or scholarship, and the institutions that support it in contrast to vocational learning and its institutions. The lowest stratum is reserved for non-institutionalized learning, not because the learning may be inferior but because such learning is not institutionally validated. While educators often extol the virtues of “independent” learning, truly independent learners are seldom esteemed.

In the past ages, scholarly, or formal, learning was not necessarily validated by specific behavioral evidence. Learners in Ancient Greece studied philosophy,

literature, history, rhetoric, or poetry, for example, not necessarily to become poets or historians but to attain a state of knowledge that would shape good character and support citizens' engagement in public discourse. This notion of shaping character and fostering citizenship proceeds from an interiorized, or intrinsic, definition of learning—that is, learning is the acquisition of knowledge and understandings that shapes how the learner thinks and lives. The contrasting notion, which governed informal education, proceeds from an exteriorized, or instrumental, definition of learning, meaning that the learner's behaviors in particular instances are formed by experience in those areas. For example, when individuals learn to cook, their behaviors change because of new knowledge and understandings. A novice might sauté onions in butter at too high a temperature and so burn them, but a person who has learned to cook, perhaps through working with a master chef, will choose the correct temperature. Whereas intrinsic refers to a means to attain knowledge that shapes the learner's fundamental character, instrumental learning refers to a means to acquire knowledge that changes the learner's behaviors in specific ways.

With the advent of the American common school in the nineteenth century comes not only formal schooling that is accessible to more segments of the population—notably women and manual laborers—but also schooling that is increasingly formulated to accord with an instrumental definition of learning. The term *behaviorism* would not be coined until 1913, when John B. Watson published a philosophical manifesto that proposed abandoning the so-called introspectionist focus on consciousness—in other words, intrinsic learning—in favor of focusing on behavioral manifestations of intelligence (Watson, 1913). However, the roots of twentieth-century behaviorism, which came to be the dominant organizing philosophy of public education in the United States, reach into the ground of the common school and its emphasis not only on egalitarian education—Horace Mann, the “Father of the Common School,” called it “the great equalizer” (Cremin, 1957, p. 65)—but also on practical education. This behaviorist shift significantly reframed the narrative of school as it existed previously into a form that now predominates.

The focus on intrinsic, or introspectionist, learning has been preserved at the university level as liberal arts education. But even that iteration has seen a decline over the past century, according to some researchers (e.g., Breneman, 1990; Baker, Baldwin, & Makker 2012).

Today's commonly accepted definition of learning remains locked to the demonstration of observable phenomena, which skews education decisions made on this basis, leading to policies and procedures that, in fact, may actually limit learning. Recently, however, modern scientific research has begun to give greater credence to cognitivist and related theories than previously was the case.

Cognitivism arose in the 1950s as a psychological theory in direct contrast to behaviorism (Mandler, 2002). Whereas behaviorism identified thinking (learning) as evidenced by externalized behavior, or behavioral change, cognitivism posited that cognition, or thinking, was in itself a behavior within the brain, regardless of external evidence. At the time, this theory failed to achieve wide acceptance within the national narrative of school because only limited evidence could be obtained to verify such activity within the brain.

Recent strides in neuroscience are now changing that. Today's researchers can discern activity within the brain using increasingly sophisticated technologies, such as structural magnetic resonance imaging (sMRI), functional MRI (fMRI), and positron emission tomography (PET). These kinds of noninvasive brain imaging technologies are, according to researcher William R. Crum (2010), "for the first time offering researchers the ability to directly observe the effect of different types of learning on brain structures and function" (p. 37). Consequently, cognitivism may be seen in a new light, perhaps more accurately termed *neuro-cognitivism*, a term we use to recognize the advances in neuroscience now giving new credence to existing cognitivist theory.

Fundamentally, these new technological tools of neuroscience are making it possible to redefine learning by moving the threshold of evidence. It is on this point that the narrative of school turns. Teaching and learning that proceed from a behaviorist viewpoint rely on external evidence, such as test scores, to signal that learning has occurred. Neuroscience, by contrast, moves the threshold of evidence to an earlier point in the learning process, showing that activity—therefore some form of learning, however nonspecific—is occurring in the brain, prior to or absent evidence in terms of external behavioral change.

The new threshold of evidence argues for redefining learning as changes within the learner's brain, rather than merely changes in the learner's behavior. This new definition provides an impetus for responding in new and different ways to perceived or suspected learning and to the accumulation of evidence, both internal and external, of learning. A neuro-cognitive definition of learning, in contrast to a behaviorist definition, requires a concomitant rethinking of all aspects of the school narrative: from structural components, such as traditional grade-level sequencing, to evaluation, which has come to be dominated in the current era by standardized testing.

For the purposes of this paper, we use the following broad neuro-cognitive definition of learning: *Learning is a multidimensional process that creates a changed state in the brain.* Ultimately, we are concerned with the further question: How does this new definition change the narrative of school? And what are the ramifications of this new narrative?

Ideas and Research on Neuro-cognition

Behaviorism, as a movement in psychology and philosophy stemming from the ideas of John Watson, who coined the term, emphasizes external, or visible, behavioral aspects of thought—"evidence" of learning—and largely disregards internal, experiential, and non-visible, or previsible, learning (Watson, 1913). As discussed in the preceding section, behaviorism was well suited to the Industrial Age, or factory model of school. Even so, behaviorism was not universally accepted as an ideal definition of learning.

From a psychological point of view, behaviorism is *descriptive*. Learners (and teachers) exhibit certain behaviors under certain circumstances. Thus it can be fair to say that “many” or “most” kindergarteners, for instance, come to school knowing basic colors, some numbers (perhaps 1–10), and at least a few letters. The shift from psychology to education—thus the shift in the national narrative of school—resulted in policy formulations, in which behaviorism is *prescriptive*. In other words, in order to be considered “ready” for kindergarten, children *must* know basic colors, some numbers, and so forth. The threshold of evidence that a child is ready for kindergarten, in a prescriptive behaviorist sense, is the presence of certain behaviors.

Cognitivism offered a counter narrative. As outlined above, cognitivism gained recognition beginning in the 1950s (Mandler, 2002). However, what it lacked was evidence—behavioral evidence, that is, the “observable” being the gold standard for research-based credibility at that time. At the mid-twentieth century, there was little research that could provide scientists, educators, theorists, and education policy makers with visible evidence of cognition, or thinking. Cognitivism focused on mental processes: perception, thought, problem-solving, and so on. In other words, these are the tools and processes that enable learning. For cognitivists, the evidence was in the internal, in the thinking processes themselves; however, because these processes were largely invisible, cognitivism was relegated to the status of an interesting theory but not one that could be operationalized.

Before behaviorism became dominant, there were other theories of learning that bore similarities to cognitivism. Such theories stretch back to ancient times, from early twentieth-century introspectionism (Watson, 1913) to Plato and Socrates in Ancient Greece, who posited that physical events (i.e., behaviors) are “shadows” of their perfect, ideal, metaphysical, or theoretical, and thus non-visible, forms (Plato, 360 BCE). González (2013) suggests, with regard to Plato’s ideas:

The scientific method requires quantifiable evidence. Philosophical truth, more often than not, requires time to flush out fallacious premises.... Truth, Plato tells us, is objective and serves as the ground of human reality. (PAGE NUMBER – Online Essay)

González continues, “Education, in the Platonic sense, cannot exist to merely catalogue the objects, those particulars that populate the sensual world of appearance (*phainomena*). Instead, education seeks to understand the essence of the timeless, universal principles that rule over human existence” (PAGE NUMBER – Online Essay). These “timeless principles” are metaphysical—interior or mental “behaviors,” rather than the exterior, observable behaviors—or “particulars” of the “sensual world of appearance.”

In the early 1970s, another movement in educational psychology and philosophy arose that attempted to extend the essential ideas of cognitivism and its various precursors. It was termed *reconceptualism*, and its primary proponent was curriculum theorist William Pinar. Pinar used the term *currere* (the infinitive form of curriculum) to shift the focus of curriculum theory toward self-reflection as a means of shaping teaching and learning. According to Pinar (2004):

The method of *currere* reconceptualized curriculum from course objectives to complicated conversation with oneself (as a “private” intellectual), an ongoing project of

self-understanding in which one becomes mobilized for engaged pedagogical action—as a private-and-public intellectual—with others in the social reconstruction of the public sphere. (p. 37)

Pinar's emphasis was on educators as curriculum developers and deliverers. It is a small step rather than a large leap to apply his ideas to learners as well.

Pinar would suggest that teachers' self-reflection on their own experiences and education provides a lens through which to view their role as educators, rather than rely on prescriptive notions of curriculum. This view, incidentally, gives rise to personal narrative, a more particularized sense than the national narrative that is our main concern. What is taught, how, and when become lived experiences that shape this personal narrative. According to Pinar (1975), "They must not subordinate the lived present to their abstract 'selves'" (p. 11). In similar manner, taking this idea a few steps further, we would suggest that by moving the threshold of evidence in accordance with a neuro-cognitive definition—that learning is a multidimensional process that creates a changed state in the brain—teaching (thus curriculum) should be guided not by a behaviorist prescription but, rather, by a judgment about each learner. That is, as educators we might better teach by adapting instruction to where the learner is, instead of presuming where the learner should be in terms of knowledge and skills development. Increasingly, neuroscience is providing internal (brain-based) evidence to guide teaching and learning.

This notion of proceeding from a neuro-cognitive definition of learning, incidentally, harkens to John Dewey's admonition in his 1916 classic, *Education and Democracy*:

Were all instructors to realize that the quality of mental process, not the production of correct answers, is the measure of educative growth something hardly less than a revolution in teaching would be worked. (2008/1916, p. 183)

Learning as a manifestation of individualism was intended to counter the Industrial Age narrative that learning is purely instrumental—that is, learning is training for future work. The sentiment is still heard in today's often-repeated phrase: "college and career readiness." The narrative shift from an industrial future to an individual future continues to be a radical and largely unrealized change in what it means to learn.

It is time, indeed it is well past time, for a Digital Age revolution in teaching à la Dewey, which can be achieved by moving the threshold of evidence using neuroscientific advances as guides.

Visser and Visser (2001) take a somewhat different tack from Dewey and Pinar, although a compatible definitional approach, suggesting that learning should be "undefined"—meaning that learning should be redefined in broader terms. They suggest that:

research currently underway...makes it possible to get a better insight into the meaning of learning from the perspective of those who learn, rather than the point of view of those who design or facilitate learning. (p. 1)

The research to which Visser and Visser allude involves “learning stories,” in which an “emphasis on the role of curiosity and challenge as conditions present in people’s most meaningful learning experiences speaks directly to the design of learning environments and instructional materials” (p. 7). They also point to the importance of “constructive and conscious involvement in someone else’s learning” and the “presence of a role model or emotionally significant support” (p. 7). These characteristics echo Pinar’s focus on self-reflection, plus observation, which are variants of a cognitive definition of learning, rather than a behavioral one.

Fundamentally, Visser and Visser arrive at this perspective in recognition of the world of the Digital Age:

The conditions that prevail in today’s world mark a fundamental change with those that characterized the state of the planet a mere couple of decades ago. This calls for new visions of learning and the re-examination of the conditions that promote and facilitate it. (2000, p. 1)

Digital Age technology—particularly neuroscience—should be shaping a new era in education, a long-overdue transition from the factory school narrative to something else. The characteristics of this something else will be driven by the new definition of learning that we have proposed as seen through neuroscientific discoveries that are emerging with unimagined speed and complexity.

For example, merging innovative instruction with brain science, Carnegie Mellon researchers (Reder, Liu, Keinath & Popov, 2015) have been able to offer evidence of a phenomenon that educators have long known intuitively: that learners learn more effectively and more easily when new knowledge is mediated through existing knowledge. These researchers examined memory related to recall of Chinese characters and paired English words. Although the findings have specific implications for second language learning, they can be generalized to learning in almost any subject.

Direct examination of the brain in learning also is giving insights into phenomena of knowledge acquisition that are not visible. In other words, neuroscience is making it possible to move the threshold of evidence of learning back from the visible, behavioral position to one closer to the source: the brain in action. For example, researchers (Jaberzadeh, Bastani, Zoghi, Morgan, & Fitzgerald, 2015) at Monash University in Melbourne, Australia, discovered that noninvasive brain stimulation enhanced brain “excitability,” which could improve physical performance in healthy individuals, such as athletes and musicians. In a summary article for *Neuroscience News* (2015), Shapour Jaberzadeh, one of the researchers, commented:

This treatment, which we called transcranial pulsed current stimulation (tPCS) is a non-constant form of stimulation with “on” and “off” periods—or pulsing—between the two electrodes... We discovered that this new treatment produced larger changes in the brain and that the interval between pulses also had an effect. The shorter the interval between pulses the larger the excitability effect in the brain... When we learn a task during movement training (for example playing the piano), gradually our performance gets better. This improvement coincides with enhancement of the brain excitability. Compared to tDCS

(transcranial direct current simulation), our novel technique can play an important role in enhancement of the brain excitability, which may help recipients learn new tasks faster.

Animal studies have long preceded studies in human subjects. But they can be no less revealing. In another recent study, for example, researchers (Cichon & Gan, 2015) at New York University School of Medicine used calcium imaging of neurons in the motor cortex of mice to explore how the brain stores new information (an aspect of learning) without disrupting previously acquired memories (i.e., prior knowledge). According to these researchers, their findings show that “dendritic-branch-specific generation of Ca^{2+} spikes is crucial for establishing long-lasting synaptic plasticity, thereby facilitating information storage associated with different learning experiences” (p. 1). In humans, according to lead researcher Joseph Cichon, their discoveries could have implications for explaining underlying neural circuit problems that occur in disorders such as autism and schizophrenia.

While animal studies are important, real strides in understanding brain function in learning are also being made in human studies that involve noninvasive investigative techniques. For example, researchers (Glezer, Kim, Rule, Jiang, & Riesenhuber, 2015) at the Georgetown University Medical Center in Washington, DC, studied how individuals learn new words, a key factor in learning writ large. Taking their cue from prior studies that have given evidence that reading “engages the left ventral occipitotemporal cortex” (p. 4965), the researchers investigated new word acquisition by studying 25 native English speakers, ages 18–35, using fMRI-RA (functional magnetic resonance imaging-rapid adaptation). Their findings offer several important observations that may influence teaching and learning:

It has been proposed that the VWFA (the visual word formation area in the brain) develops with reading acquisition as a result of the “recycling” of visual cortex, resulting in neurons dedicated to orthographic processing... Our study supports the theory that the role of the VWFA in reading is that of an orthographic lexicon in which during word learning, neurons come to be selective for the “objects” of reading, that is, whole words, enabling the rapid recognition of familiar words. These findings have interesting implications for reading remediation in individuals with phonologic processing impairments because they suggest the possibility that these individuals might benefit from visual word learning strategies to circumvent the phonologic difficulties and directly train holistic visual word representations in the VWFA (p. 4971).

For readers who remember the vigorous debates in reading instruction over phonics approaches versus whole language approaches, especially during the 1980s and 1990s, this study provides one way to consider how neuroscience can move the threshold of evidence from behavioral observations to fundamental observations of phenomena occurring within the brain, that is, previsible behaviors.

Evidence is rapidly accumulating that will support a transformation from the narrative of school based on behaviorist definitions of learning to a narrative that identifies teaching and learning based on some form of neuro-cognitive definition of learning.

Conclusion

The purpose of this work has been to explore—and to encourage others to explore—a new neuro-cognitive definition of learning and how our national narrative of school might be reshaped accordingly. We posited that this definition could be stated as follows: *Learning is a multidimensional process that creates a changed state in the brain.* We suggest that this definition of learning could potentially affect education of many kinds. While we focused primarily on public education, particularly in the United States, much of the discussion was applicable to other Western or Westernized nations.

We are mindful that this neuro-cognitive definition has long roots, stretching deeply into the soil of learning at least to the historical depth of Ancient Greece. The “neuro” element recognizes today’s Digital Age capacities for examining actions within the brain that we call learning and that, if considered holistically, would lead educators and policy makers to a fundamental reconceptualization of schools and schooling.

What we envision as this reconceptualization of education from a neuro-cognitive definition of learning will not be achieved overnight, nor do we have a crystal ball with which to predict exactly the shape a new narrative of school might take. After all, Albert Einstein propounded his theory of general relativity in 1915, which among other things predicted the existence of gravitational waves, but the phenomenon was not observed until late 2015 and reported in early 2016 by a team of scientists that heard and recorded the sound of two black holes colliding a billion light-years away (Overbye, 2016).

In this work we likewise stand on the shoulders of education philosophers, scholars, and researchers—such as Plato, Dewey, Pinar, and many, many others—who envisioned schooling focused on learners and how they acquire knowledge and understandings that create internal transformations, our “changed state in the brain,” that are not necessarily immediately manifested in externally observable behavioral changes. We invite readers to ponder the ideas expressed in this work and to consider further how teaching and learning might be reconceptualized for the Digital Age, thereby framing a new narrative of school, rather than perpetuating the outmoded Industrial Age narrative.

Authors’ Note: This article is adapted from a lengthier work titled “Redefining Learning: A Neuro-Cognitive Approach,” which explores some of the ramifications of moving toward a new definition of learning.

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Erratum to: It Is a Two-Way Street: Using Storytelling and Narration as a Formalized Method to Promote Partnership Between the Instructors and ID Team in Higher Education Context



Yi Jin, Nadia Jaramillo Cherrez, Autumn N. Cartagena, and Wei Wang

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