Educational Communications and Technology: Issues and Innovations

Brad Hokanson · Gregory Clinton
Andrew A. Tawfik · Amy Grincewicz
Matthew Schmidt *Editors*

Educational Technology Beyond Content

A New Focus for Learning

ASSOCIATION FOR EDUCATIONAL COMMUNICATIONS & TECHNOLOGY

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Educational Communications and Technology: Issues and Innovations

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Editors
Brad Hokanson
Design, Housing, and Apparel
University of Minnesota, College of Design
Saint Paul, MN, USA

Andrew A. Tawfik
Instructional Design & Technology
University of Memphis
Memphis, TN, USA

Matthew Schmidt
University of Florida
Gainesville, FL, USA

Gregory Clinton
Career and Information Studies
University of Georgia
Learning, Design, and Technology
Athens, GA, USA

Amy Grincewicz
Graduate Programs Office
Kent State University
Kent, OH, USA

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The 2018 Summer Research Symposium: An Introduction

What Is a Symposium?

According to the ancient Greeks, who originated the term (Garnsey, 1999), a symposium was a certain kind of drinking party. But somehow along the way, the original root ([πίνειν] pinein/[πόσιον] posion) came to be the basis for modern expressions in the English language such as to suppose, to pose a question, to posit an answer, to make a proposition, and to be influenced by positivism.

In ancient Greece, a symposium was a social vehicle for men to drink wine and share ideas. For those whose good fortunes allowed such leisure activities, it provided a forum for intellectual discourse. Women were not included except as performers or servers. However, as this Greek tradition came to be adapted into Etruscan, and then Roman, lifestyles, one of the clear distinctions of the *convivium* (as the Romans called it) was the inclusion of women and couples as full participants (Garnsey, 1999).

Much later, in Renaissance England, the association between social drinking and intellectual discourse took a notably different turn with the rise of the English coffeehouse, rapidly replacing the beverage of choice, for stimulating conversation, from the alcoholic to the caffeinated. According to Steven Johnson (2010), the new popularity of the coffeehouse among the educated classes was a factor contributing to many of the innovative ideas that arose during that time period.

Actual drinking practices aside, the modern symposium may be metaphorically thought of as a gathering for imbibing knowledge and intellectual stimulation – a drinking party of the mind. Indeed, one recent AECT SRS participant has been quoted to say that the experience is "like drinking from a fire hose." Understood in these terms, even the modern symposium can be said to bring its own kind of free-flowing intoxication.

The AECT Summer Research Symposium experience is structured around a set of ProAction Café sessions (see http://www.artofhosting.org). The sessions provide a specialized, 2-hour interaction time for each of the authors (who are expected to have read each other's drafts before the event). Each segment features a designated subset of the authors, one stationed at each of the round "café" tables. Each of these authors gives a brief verbal description of his or her project to the entire audience, and this is followed by a series of rotating feedback discussions, with periodic movement of small groups around to the different tables, while the authors remain stationary. This sequence is then followed by a brief time when the audience members depart, and the authors are allowed to remain at their tables for a time of individual reflection and note-taking. Via this process, during the course of the symposium, all authors can expect to receive thoughtful feedback from multiple other authors who have read their draft.

The symposium has, over the past four iterations, come to be well regarded as a professional venue. Like the goal of the early symposia, it is a place for sharing and developing ideas; like Johnson's coffee shops, it is stimulating and builds new ideas through conversation and interaction. The Association for Educational Communications and Technology (AECT) has recognized the value of the event, and it is now scheduled on an annual basis, with varying focus topics.

What Does It Mean to Aim Beyond Content?

For most educated adults, our common personal experience as learners, especially in school and college settings, suggests that aiming primarily at "covering the content" is an inadequate way to support meaningful learning. Where application of content toward higher-order thinking has been more of an afterthought, the emphasis has remained on memorization "for the exam" and rapid forgetting afterward.

For purposes of this introduction, we offer a tentative model and several observations for our readers' consideration.

While the relationship between instructional objectives and the noncontent aspects of the human learning experience will always be full of the messy complexities of life, there are at least certain identifiable forces at work that influence the aim of the designer in regard to the role and status of prescribed content.

First, experienced teachers and designers know that formal learning tends to be shallow and decontextualized, and easily forgotten, unless some investment is made toward making the learning experience more memorable. As designers and teachers, we also generally aim to influence learners' attitudes toward the content and toward various other aspects of professional and personal life. Since emotion is recognized as a powerful anchor and trigger for memory, as well as a necessary component of cognition (Damasio, 1999), effective educators inevitably make some kind of bid for emotional or affective engagement on the part of the learner to achieve these aims. And thus, any effective design for learning is also a design aimed, to some extent, at the affective domain.

We can ask, then, as Gray, Parsons, and Toombs (Chap. 4, in this volume) have asked: "What experience do I want the learner to have?" (cf. Boling, Siegel, Smith, & Parrish, 2013). Indeed, this is a reminder that user experience design (UXD) is an emerging design field. According to the authors, UXD competencies can include:

- Visual and interactive representation
- Design philosophy
- Social/research methods
- Technical skills
- Global consciousness
- Leadership and teamwork

Most teachers and instructional designers are not familiar with UXD terminology. But we can conceptualize the spectrum of educators' efforts toward "memorableness" as greater or lesser degrees of intentional user experience design.

Second, in specific contexts, there can be underlying agendas that are foundational to the teaching enterprise. Often, these are political or religious agendas, and they can range from mild, socially accepted forms – relatively close to the social mainstream – to extreme or even nefarious belief systems, aimed at inspiring the kinds of actions espoused by those belief systems. Agendas notwithstanding, the closer these agendas are to the extreme fringe, the more likely participants (those who stick around) will be emotionally engaged and will have memorable experiences. (The existence of extreme agendas in the world points to the need for a means of judging the legitimacy of any curriculum, including its intended content outcomes and those intended outcomes that lie beyond the content. However, a serious exploration of agendas associated with education, from socially accepted to extreme, is beyond the scope of this introduction and, indeed, of this book.)

On the other hand, social norms generally constrain educators away from extremes in regard to how they may pursue memorable experiences for their learners. For example, a near-death experience, related somehow to the content, would be among the most memorable we could devise for learners, but we would not expect mainstream social approval of designs that create near-death experiences.

Another constraint away from creating more memorable experiences for learners is simply time. Designing for more emotional engagement and "memorableness" is a time-consuming proposition, not only because they add more elements of design that need consideration but also because emotional engagement and attitudes are more elusive than content. They are more difficult to measure. And attitudes, in particular, cannot be taught directly in the same sense that we teach content (Dick, Carey, & Carey, 2015). "Sticking to the content," on the other hand, can be viewed as a path of least resistance, as educators are often pressed for time in their work.

We have attempted to capture a simple visualization of these competing forces in Fig. 1. In this figure, content is conceived as central, and proximal to the coverage of content would be the normal or typical UXD level that goes into a lesson plan, that is, one that avoids any obvious causes of discomfort or distraction to the learner. We might call this the "unconscious" or "automatic" level of UXD that is employed by any teacher or designer, which implies a relatively "proximal" level of intended engagement with the affective domain in learners. Beyond this customary level of concern for the experience of learners lies more overt degrees of UXD effort and more "distal" kinds of activities in regard to promoting learners' emotional or affective engagement.

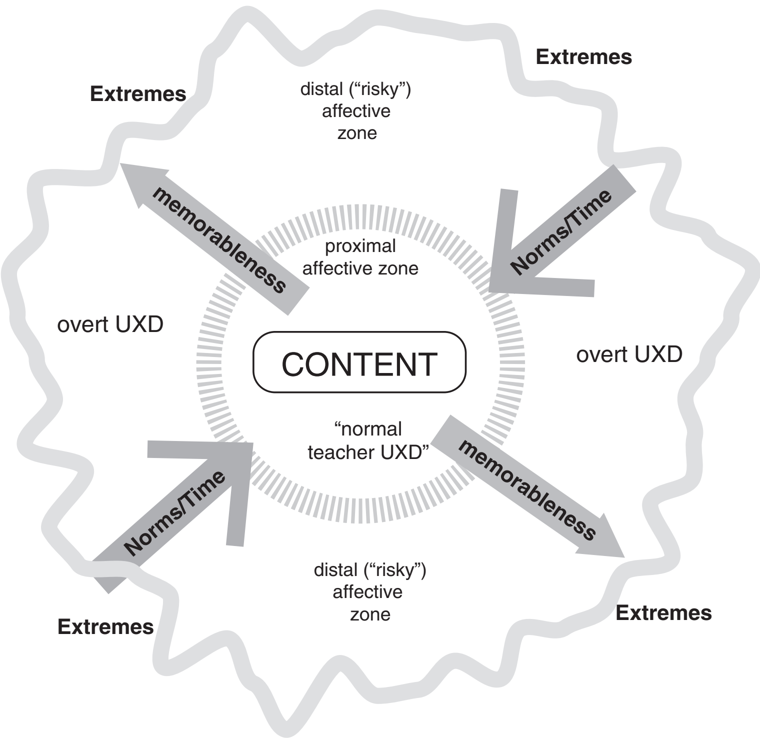

Fig. 1 Competing forces toward, and away from, a primary focus on content

Aside from the competing dynamics identified above, a few brief observations may be useful in regard to aiming beyond content:

First, there is a sense in which some level of aiming beyond content is inescapable. If we try to imagine a design for learning, or an episode of teaching, stripped of all else besides the learning of content, we end up with a proposition so sterile, so devoid of context, as to be impossible in practice. We should therefore be careful not to use "sticking to the content" as a straw-man element in an argument against something that doesn't exist. Rather, with the call for proposals on the theme of "beyond content," we have sought to engage scholars with the broader aims of training and education and to gain new perspectives from their work. In our view, the 2018 Summer Research Symposium and this book have accomplished this in robust fashion.

Second, the general requirement of instructional designers to avoid, in instructional objectives, verbs or verb phrases that signify "internal operations" (e.g., understand, know, be aware of, feel, etc.) takes advantage of one of the strengths of behaviorism: empirical clarity in assessing learning.

However, this clarity brings a danger: designers are liable to forget how much more we value those internal operations over the external behaviors.

We admire those whose actions not only reflect comprehension but also show something we perceive to be "deep understanding" and whatever we perceive to be internal wisdom. Just as a musician must remind herself that the notes on the printed page are not the actual music and that mechanically reproducing what is on the page is also not the music, so we as designers can remind ourselves that the actual learning is ultimately beyond our control and that the real treasures that may arise from our designs lie beyond the prescribed content to be learned.

Finally, if we strongly privilege user experience over intended learning outcomes, we may run the risk of drifting, or being seen to drift, from instructional design into the realm of entertainment. One possible solution to this issue, for instructional designers, could be to consider UXD as worthy to be elevated to the same level as content and skill outcomes but no higher. The importance of teaching beyond the content could thus be acknowledged and given its due but in such a way as to strengthen, and not overturn, the desired knowledge and skills that have occasioned the training in the first place.

What Is in the Chapters of This Book?

The considerable collection of scholarly work gathered together in this book is a testament to the efficacy of the Summer Research Symposium as a vehicle for professional development. There are 24 papers that are the result of the process of submission, review, and participation. Submissions were responses to the call for proposals on the theme of "beyond content."

A rich array of major themes, plus many secondary topics, is presented in these chapters. For this introduction, we attempted an informal inventory of themes and chapters in which they are addressed, as presented in Table 1. (It should be noted that this inventory was created by the senior editors only; it is possible that an individual author may not completely agree with one or more of our characterizations, so we invite readers to investigate the table of contents and the abstracts of individual chapters to confirm, via the authors' own words, the primary intent and scope of each chapter.)

One theme that seems to be a strong constant through almost all the chapters is that of various perspectives or portrayals of design. Design has been an emphasis of our field for decades, but this emphasis has acquired more breadth and depth in recent years. Aside from this near-universal theme, perhaps it is no surprise that many authors chose to use the expression "beyond content" explicitly in their chapters (or used slightly different expressions to convey the same idea), rendering this as the second most widely occurring theme. It is also unsurprising that such areas as metacognition, social development, and creativity would receive wide coverage, since these are aspects of learning that we do not normally associate with merely "covering the content."

Table 1 Themes identified in the chapters of this volume, by chapter number

Perspectives or portrayals of design (1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24)
Beyond content – overtly stated (1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 14, 15, 16, 18, 20, 22, 23, 24)
Metacognition (3, 5, 8, 9, 12, 13, 14, 15, 16, 18, 20, 22, 23, 25)
Social development/social skills (6, 7, 8, 9, 10, 12, 14, 16, 17, 18, 22, 24)
Creative output of individuals (2, 5, 9, 11, 12, 13, 15, 17, 21, 23)
Study of general adult learning (1, 9, 10, 12, 13, 15, 19, 20, 23, 24)
Explicitly affective learning (2, 3, 4, 8, 11, 14, 15, 16, 19, 21)
Learners' learning about design (2, 4, 7, 9, 12, 16, 18, 23, 24)
Learners' professional or personal growth (2, 4, 6, 9, 11, 14, 16, 21, 22)
"Beyond curriculum" – curriculum innovations; content innovations (3, 4, 9, 12, 13, 23, 24)
Study of teaching (7, 15, 17, 18, 20, 22, 24)
Study of adult learning in specific domains (5, 6, 8, 11, 14, 21)
Learners' identity development (2, 4, 7, 9, 12, 18)
Study of general learning of students in K–12 settings (1, 3, 10, 13, 15)
Studying (or promoting) outcomes relating to citizenship (9, 12, 16, 23)
New theoretical perspectives (1, 3, 13, 19)
Role of media in learning (5, 6, 13, 19)
Learners' physical development (18, 20)
Direct focus on content (3, 7)
Life skills (6)

It should be noted that the symposium is a joint effort of editors, reviewers, authors, and those attending. Reviewers for the 2018 Symposium are:

Ilene Dawn Alexander	Colin Gray
Greg Clinton	Jennifer Englund
Marisa E. Exter	Glenda Gunter
Phil Harris	Jason Huett
Karen Kaminski	Robert Kenny
Jason MacDonald	Amie Norden
Jody Nyboer	Andrew A. Tawfik
George Veletsianos	

The symposium has grown with the active support of the board and administration of AECT. Special thanks go to Larry Vernon and Terri Lawson for their work and assistance with operating the event and Phil Harris, AECT Executive Director, who has continued to support, participate, run a boom mike, and guide the symposium.

We very much hope you find the contents of this book to be engaging as well as useful for your scholarly endeavors.

University of Minnesota
Saint Paul, MN, USA
Brad Hokanson

University of Georgia
Athens, GA, USA
Gregory Clinton

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Contents

Chapter 1
Unfinished Business: The Missing Skills

Andrew S. Gibbons

The Fragmentation of Goals

In the dust and smoke of academic warfare, it is easy to lose our orientation. In the unnecessary and unfinished battle between the objectives taxonomies of Bloom and Gagné, it is possible that our vision has been obscured, and we have lost perspective on the original problem, which was to systematically summarize the elements of human performance so that complex learning experiences could be organized and ordered logically. Neither taxonomy ever really reached a final state, and therefore they represent unfinished academic business. What each did accomplish was to use a particular decomposition logic to identify fragments of a larger but seldom acknowledged phenomenon of human behavior, the competent skilled performance. Skill as a type of learning outcome has been overlooked in the dust and smoke raised by the squabble over taxonomic details. This paper makes the case for revisiting the unfinished taxonomy business in search of a unifying view based on a higher organizing principle of human performance: fluid and fluent skill. From this perspective, it is easy to see that the taxonomies are much closer in substance than previously thought and that they can be harmonized.

In the early 1900s, the idea of fragmenting and typing instructional goals took root and grew to dominate the literature and practice of instructional technologists throughout much of the twentieth century. Emphasis on using objectives (Bruner, 1970; Glaser, 1966; Tyler, 1949) spawned rules for writing objectives (Mager, 1962)

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A. S. Gibbons (✉)
Brigham Young University, Provo, UT, USA
e-mail: andy_gibbons@byu.edu

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and the two popular objective typologies of Bloom and Gagne (Bloom & Krathwohl, 1956; Gagné, 1965, 1970, 1977, 1985). Today these taxonomies[1] are taught to new designers as "given" wisdom, and the teacher's opinion about which one is most suitable is often imprinted on the opinions of the designer. This creates a loyalty war that is unnecessary and counterproductive. This paper suggests that we should bend our efforts in the direction the original taxonomists were headed with their work, beyond the restrictions of the taxonomies in their present form, to search for the overarching, unifying theme they were seeking. This paper proposes that finding that theme will unite the apparently disparate taxonomies. I recommend that we can use the concept of skilled performance to accomplish this.

In 1956 Bloom's family of goal typologies for the cognitive, affective, and psychomotor domains was originally motivated by the desire to discriminate levels of behavior for test construction (Bloom & Krathwohl, 1956; Bloom, Krathwohl, & Masia, 1964; Harrow, 1972). At roughly the same time, Gagné was interested in specifying conditions that facilitated different types of learning identified from more basic learning research. The taxonomies of both Bloom and Gagné are appropriately considered works in progress, as evidenced by persistent efforts to expand and elaborate them. In the cases of both the Bloom and the Gagne taxonomies, this would also include integrating affective and psychomotor goal types with the cognitive and intellectual types. Anderson and her team of experts elaborated and expanded the work of Bloom in the cognitive domain (Anderson & Krathwohl, 2001; Krathwohl et al., 2001). Gagné himself created multiple versions of his taxonomy of learning types, continuing to develop the theme after the publication of the fourth and last edition of his *Conditions of Learning* series.

There has been surprisingly little curiosity about why Gagné's followers stopped elaborating his system of learning goals after his death. Gagné himself would doubtless have continued building on the foundation laid. His taxonomic work grew in a pattern that seemed to be reaching toward the most expansive summation of the human learning phenomenon. Similarly, the revision of Bloom's cognitive domain taxonomy by Anderson et al. (2001) and her team is suggestive: We should be curious about what a similar revision of the affective and psychomotor domains would look like and how these domains might be integrated.

Given this historical pattern of taxonomy expansion and elaboration, there is reason to believe that the early taxonomists would disapprove of the inflexible way in which their ideas are treated today. Many designers come away from university and textbook training with the impression that the taxonomies represent a settled issue. New designers are not taught to ask about the absence of current research on instructional objectives, so designers are left to choose a favorite taxonomy, create their own approach, or do without. For practical purposes, most designers apply

[1] It is important to note that although Bloom used the term "taxonomy" in the title of his work, Gagné distanced himself from the term. Despite that, it has stuck anyway: "No particular reason exists to think of these five different learning outcomes as constituting a taxonomy or as having been derived for that reason" (Gagné, 1984, p. 384). Gagné preferred the phrase "useful categories of human performance" instead. This gives evidence to my thesis.

objectives as a tool to communicate with clients, and at some level taxonomies work for this purpose. They provide the designer with a formula and the client with a comforting feeling. Many designers pursue their trade with a “follow the process” mindset, including with respect to objectives. But over time, what began in the minds of the early taxonomists as an exciting exploration of new territory became a trip around the block.

Even these frozen forms might thaw if we were to revisit the original explorations of Bloom and Gagné and pursue their questions with fresh energy. Reopening the taxonomy question could possibly lead to a unification of the two major taxonomies and a reconsideration and revitalization of the theme of high-level instructional goals, how they are created, and their relationship to instructional methods and assessment. Despite the changing landscape of learning theory, designers still must supply a rationale for their designs based on learning goals.

A Way Forward and a Proposal

We might begin with observing how instructional designers tend to use taxonomies today. Many if not most designers find goal taxonomies useful to some degree, and most have a favorite, but these are often adapted and expanded by the designer for the designer’s particular personal use. For example, a designer creating training for emergency medical technicians (EMTs) will normally identify the individual concepts, principles, and procedures that make up the subject matter using some form of task analysis and perhaps the taxonomized learning objective types.

However, most designers also realize that proper assessment of higher-level capabilities following training requires the learner to flexibly perform extended sequences of procedures under real-world conditions, following correct principles and using “good” judgment: The learner must demonstrate some level of *skill*. Often this level of assessment requires specialized practice and assessment environments, such as simulators or realistic drills.

Assessment at this level involves performance organized at a level above what is contained in the Bloom or Gagné taxonomies. In this instance, many designers dealing with complex subject matter areas develop one or more additional objective categories that account for this level of performance. These categories represent a step “beyond content” as the theme of this conference suggests. Perhaps one approach to getting beyond content is to consider the unfinished business—higher-level knowledge that makes skilled performance possible.

Designers use this higher level of goal specification to design performance challenges in the form of practical problems that require integrated application of many of the taxonomized knowledge types by learners in a fluent performance that requires problem-solving, adaptation to unexpected circumstances, improvisation, and self-monitoring and self-correction. This is *skilled* performance. A more robust literature for instructional designers on skill as a form of learning and assessment goal—a goal that integrates the intellectual, the emotional, and the motor aspects of performance, among other things—would help individual designers accept the value added of a coherent doctrine of skill learning, instruction, and assessment that subsumes the value of their taxonomies without destroying them.

There exists outside of the field of instructional technology (IT), a robust literature on the subject of skill training and assessment. What is lacking is the adoption and absorption of this literature by the IT field and its appropriation for the research and development purposes. The topics of skill learning, instruction of skills, and high-level instructional design skills are highly relevant to the practice of instructional technology, but they occupy a proportionally very small segment of the IT literature and design practice. This paper proposes that:

1. The field of instructional technology should pay greater attention to the concept of skilled performance, which includes seamless real-time integration of cognitive skills, motor skills, emotive and conative states, value sets, and ethical principles.
2. The field of instructional technology should place greater emphasis on research on instructional practices that can be used for establishing and maintaining skilled performance, and it should expand the range and quality of literature on the establishment of skills that is available to new designers during their professional preparation.
3. The field of instructional technology should teach design practice as a flexible and judgment-intensive skilled performance—a skill—rather than as processes to be followed.

This program of action will increase the relevance and applicability of instructional technology research and encourage the use of flexible and adaptive instructional design practices.

What Is Skill?

Skill is the fabric of our everyday behavior. It represents *the unfragmented flow of constantly adaptive human behavior*. It incorporates within it all other taxonomized forms of performance and adds the dimensions of judgment, constructive and helpful attitudes, and ethical behaviors. If skill is involved with taxonomies at all, then it should be considered at the apex of all taxonomic structures: the culmination of what taxonomies were leading to in the first place. Skills are never really "mastered." They are acquired and either grow or decay over time. The study of how this occurs and how designers can themselves become skilled practitioners of their own craft is worthy of our concentrated study. In fields where instruction concentrates on skills, the literature normally refers to the creation of "expertise," a connection made by Amirault and Branson (Amirault & Branson, 2006). Gagné and Merrill (1990) were collaborating in this direction in their writing on "enterprise" learning.

The term expertise normally denotes a very high level of skilled competence, but expertise begins with the learning of basic skills, so progress toward expertise is relative to where the performer started. There seems to be no firm dividing line between skill and expertise. In this paper I use the term *skills*, but I will also draw on the literature of *expertise* and *expert performance*. It is possible that Gagné in his continued expansions of his taxonomic system was moving in the same direction as Bruner, who himself was trying to describe a species of human activity typical of the flow of performance in everyday life—skilled performance. Bruner's description proposed that "what is learned is competence, not particular performances" (Bruner, 1970, p. 67). There are in Bruner's description a type of performance and a degree of adaptability and fluidity of performance that the work of the taxonomists points to but does not capture. The learning of this type of performance requires conditions congenial to this type of learning. Instructional technology as a field must embrace a technology of designing for and instructing skilled performance.

Many fields outside of instructional technology have explored the development of skilled performance and expend much of their research and development energies to study the establishment of skills. This includes the fields of reading research and reading instruction, writing and composition skills, business entrepreneurial skills, foreign language skills, sports, industrial/technical skills, and research in cognitive skills. The interests of instructional technology should be connected with and felt in all of these areas, but the progress and findings of these other fields are not a primary theme in the IT literature, despite the fact that the learning of complex skills often involves heavy use of advanced hardware, software, and instructional technologies. Excellent resources describing research on skills and expertise in other fields can be found in *The Nature of Expertise* (Chi, Glaser, & Farr, 1988) and *The Cambridge Handbook of Expertise and Expert Performance* (Ericsson, Charness, Feltovich, and Hoffman, 2006).

Skilled Performance as a Unique Class of Learning

What makes skilled performance sufficiently distinctive that it should be considered a class of learning and instruction by itself, complete with distinctive methods of instruction?

1. Skilled performance consists of the performance of multiple, subordinate, constituent skills in a sequence sculpted by conditions at the moment of performance. The constituent skills that make up a skill are themselves skills that must be learned before they can be combined into longer segments of competent performance. It is interesting to note that Gagné attached the term "skill" to some of his categories.
2. Because it is constituted and executed contingent upon circumstances surrounding the performance, skilled performance is adaptive. Performance plans change to adapt to changing conditions in the performance environment moment by moment.

3. Because skilled performances are composed at the moment of performing, a particular kind of performance, such as returning a ping pong ball or dancing a tango, is performed differently from occasion to occasion, even if only in minute details. The performance of skill involves constant monitoring by the performer of the conditions surrounding performance and of the ongoing quality of the performance itself. Information gained from monitoring conditions is used by the performer to adjust the performance in real time.
4. Skilled performance is learned through repeated practice that includes knowledge of the quality of the performance (feedback) provided either during or following performance. The first performance of a skill normally involves unfamiliar actions, mental calculations, emotions, and values on the learner's part that are unfamiliar, so initial performances may be halting and error-prone. As these disparate elements of an acceptable performance become integrated in the learner's mind, performance can become more fluid.
5. As a performer observes his or her own performance of a skill, it often leads to new learning that can be used for the improvement of future performances. New methods of performance can be invented by a performer spontaneously, leading to increased skill, efficiency, or effectiveness. Skills can also be discovered serendipitously through accidental or unplanned experiences and even through mistakes that produce unexpected outcomes.
6. Excellence in skilled performance involves the exercise of judgment and agency, based on self-observations or feedback over a large number of performances.
7. It may be necessary in some cases for a performer to concentrate practice temporarily on a subordinate component skill in isolation, under less than real-world conditions in order to improve performance that otherwise hinders the performance of a complete skill.
8. Skill is often learned in the presence of a coach or mentor, who provides feedback on performance details the performer cannot observe. A coach may also suggest improvements, which the performer may choose to adopt or not. Attaining the highest levels of mastery or artistry always requires external assistance.
9. Skilled performance has cognitive, physical, and attitudinal or emotional components, as well as conative and ethical dimensions. Competent performance requires that *all* of these factors be present at an acceptable level. Assessment of skilled performance must therefore take into account and judge *all* of these factors. Instruction in skilled performance must provide for the integration of these concerns with practice during learning, rather than dealing with them as separate topics.
10. Skilled performance may take place at barely acceptable levels, or it may advance to levels of mastery or even artistry. Higher levels of attainment require using disciplined training methods over a long period of time. Acquisition of a skill is a process of constant learning that often requires scaffolding that fades over time.

11. Confidence is an essential part of skilled performance. Lack of confidence can lead to errors. Continued failure experiences can lead to demoralization, which the performer can turn inwardly into a negative self-judgment. Likewise, a sufficient number of success experiences, as perceived by the performer, can increase confidence and encourage pursuit of further levels of skill. Some scaffolding actions on the part of the instructors contribute to calming fears and raising confidence.
12. There is an element of introspection before and after skilled performance that even a highly skilled learner can use to improve future performance through anticipation, mental rehearsal, self-assessment, and self-correction.
13. Skilled performances become automated to the extent that more than one skill can be performed contemporaneously and under conditions of divided attention. In this way, separate skills such as walking can be interleaved with other skills such as chewing gum. Skill performance can also become habitual to the extent that performance is initiated without conscious awareness.
14. Learners can become aware of their own learning processes to the extent that they can manage their own learning by selecting and pursuing their own new skills.

These characteristics of skilled performance taken together set skilled performance in a class by itself, related to, but apart from the performances found in the standard taxonomies. Many of the taxonomized learning types of both Bloom and Gagné are fragments of higher-level skills. It is important to note that both taxonomies consider themselves at least partially cumulative and hierarchical. Many of the taxonomized behaviors can be learned in isolation and still not be very useful by themselves in everyday settings. Skilled performance provides the context that makes taxonomized behaviors useful in everyday activity.

Revisiting the Taxonomies

The distinctive quality of skilled performance learning is found in the transition points between the completion of one lower-level, constituent performance and the selection of the next. This, of course, is a gross oversimplification, and skill performance is clearly more complex than stopping one activity and deciding to take up another. However, there is a kind of learning that *enables the learner to select and integrate sequences of performances in an adaptive manner*. This is a description of skilled performance as a unique class of instructional goal, and the Bloom and Gagné taxonomies are both compatible with this definition.

David Krathwohl (2002), while describing the revision of the original Bloom taxonomy, explained that one of the purposes of the original taxonomy was as a "means for determining the congruence of instructional objectives, activities, and assessments in a unit, course, or curriculum…" (Krathwohl, p. 212). Just as the taxonomy categories can serve as a touchstone for comparing equivalences of individual objectives, this paper speculates that they could also be used as a touchstone for building links with the goal categories of other taxonomic systems.

A move in that direction may already have been taken in the revision of the Bloom taxonomy, in which Krathwohl participated. The original version of Bloom's categories represented generalized, content-agnostic skills, unlike Gagné's, which represented content-specific skills (e.g., associations, S-R chains, concepts, rules, and principles, depending on the version of his taxonomy). Gagné's taxonomies were formed asking the question, "What is learned?" His multiple answers to the question over time showed that he was trying to derive categories from the best available research knowledge. At the same time, his categories became centered on types of learned entity. He persisted in describing the *association* because it was, he felt, a basic learned structure. He identified rules and procedures because he felt there were some learned entities of that type.

The Anderson et al. (2001) revision of Bloom's cognitive taxonomy involved the creation of a matrix that crosses each generalized mental process with specific content categories very much like Gagné's. Krathwohl (2002) described this as giving the verb (the behavior) a noun phrase (the type of knowledge acted upon by the generalized performance types), as was already implicit in the original taxonomy. The two taxonomies that designers previously saw as being so different moved closer to each other with this revision of Bloom. Similarly, David Merrill (1994), in an attempt to elaborate on Gagné's categories, used this same approach when he formed a matrix of instructional goal types by crossing the content types (fact, concept, procedure, and principle) with the mental process types (find, use, remember generality, and remember instance) (see pp. 111–120). Over a period of years, Merrill's taxonomy underwent multiple changes as well.

Conclusion

This paper began with a discussion of the unfinished business of the learning taxonomists, noting that many designers consider the differences between the Bloom and Gagné taxonomies so great that they feel they must choose one or the other or else blend the two and make creative additions of their own. It is highly likely that an analysis more detailed than can be accomplished in this paper would substantiate the claim that the taxonomies are in fact highly compatible in their revised forms and that both are compatible with and can supply primitives for integration within the super-category of skilled performance. This view deserves more elaboration, but it represents a question of much importance to the field.

Instructional technology should pay greater attention to the concept of skilled performance, and the proposition that research on skill learning should become an important research topic in IT follows naturally. My third proposition, that design activity *should be taught within IT as a skilled performance rather than a procedure*, would represent a major step forward. What is needed is a better description of design skill. Much recent IT literature has targeted that goal (see Gibbons, 2014).

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Chapter 2
Aha, I'm a Designer?! Becoming Empowered Designers Through Course Experiences

Lisa C. Yamagata-Lynch, Hsin-Hui Chang, Takuya Hayakawa, Jason Michael Mastrogiovanni, Lisa A. Shipley, Cody Miller, and Terrica M. Durbin

We introduce our work as a collaborative team of faculty and graduate students researching the outcomes of a design thinking course taught in a nontraditional instructional design program. This work is an example of how adults do not know when they are engaging in design in their personal and professional lives. We present how doctoral students from a variety of professional backgrounds including K-12 and higher education, nursing, graphic design, and corporate training discovered what it means to be a designer in their respective fields.

This chapter presents a summary of literature that concerns design in instructional design and technology. The review suggests that design is a forgotten discipline in K-16 Western formal education, despite the fact that designing is an aspect of being human. Many people engage in design unwittingly in their daily lives without identifying themselves as "designers." Examples of accidental designs encompass personal and professional settings, such as cooking and family vacation planning as well as curriculum design in K-12 and higher education settings. The review also summarizes contemporary understanding of design thinking, conceptualized as a complex problem-solving activity. We will present how the review informed the context of the study, data collection methods, and analysis. The implications of the findings are discussed in the conclusion.

L. C. Yamagata-Lynch (✉) · H.-H. Chang · T. Hayakawa · L. A. Shipley · C. Miller · T. M. Durbin
University of Tennessee, Knoxville, TN, USA
e-mail: LisaYL@utk.edu

J. M. Mastrogiovanni
Texas A & M University, College Station, United States

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Evolving Relations Between Theory and Practice

Quest for Design Truths in Instructional Design

The field of instructional design and technology has been shaped and influenced by an emphasis on scientific research methods to legitimize findings in human interaction research (Ohlsson, 2010). This practice has ranked scientific truths of higher importance than truths discovered in design precedents from practical experiences (Boling, 2010). The value that is put on theories and models in instructional design and technology demonstrates the tendency for presenting scientific truths as the content that instructional designers must learn. This has resulted in a field laden with theories based on what is believed to be true and models that represent those truths. Many design models in the field of instructional design and technology (IDT) were developed when systems theory was popular in the 1950s and 1960s (Edmonds, Branch, & Mukherjee, 1994; Gibbons, Boling, & Smith, 2014). They were initially created as a teaching tool rather than as a tool for defining design (Dick, 1996). These design models were often focused on solving problems (Smith & Boling, 2009) and expressed as a set of procedures (Branch & Kopcha, 2014).

By overvaluing design models, instructional design education programs have encouraged students to passively follow step-by-step processes. This is an obstacle to students developing an empowered designer identity (Tracey, Hutchinson, & Grzebyk, 2014). To overcome this obstacle, Tracey and Boling (2014) introduced how an active agent designer identity can be conceptualized. According to them, designers are sophisticated problem-solvers who work with uncertainties while acting as a human instrument, as well as a change agent in different contexts. Designers engage in reflective practice while relying on past experiences and judgments to find innovative solutions to problems they encounter (Tracey et al., 2014). In this study, an empowered designer is someone who recognizes themselves as a designer and is able to engage in design as an active agent with a purpose.

Consequences of Focusing on the Truth About Design

The quest to ensure scientific rigor in design research has made findings from those works irrelevant to practice and provided little guidance to designers on how to advance the field (Hanington, 2010). An overemphasis on theories and models has left no room for designers to learn from trial-and-error, which may be relevant to their future design activities (Gropper, 2015). In many situations, designers do not follow process models that were taught in formal educational settings (Boling & Smith, 2012; Fortney & Yamagata-Lynch, 2013). For example, Klein (1991) and Young, Reiser, and Dick (1998) found that teachers do not follow instructional design models while engaging in their daily instructional design and planning. Design models have thus become the default definition of design in our field, but do not sufficiently address the complexities that instructional designers encounter every day (Bichelmeyer, Boling, & Gibbons, 2006). Many practitioners find design models to be difficult to apply to their specific situations (Tessmer & Wedman, 1995). As a result, they have discounted theories and models they learned in their formal training because they are often unable to translate them into practice (Yanchar, South, Williams, Allen, & Wilson, 2010).

Instead of devoting a significant amount of time on the content of how design can be represented, designers need time to learn about designerly ways of knowing (Cross, 2006). The historical context of design education, in IDT, has created a gap between what instructional designers know and do and how designers identify themselves (Boling & Smith, 2012; Rowland, 1993). Furthermore, the content taught in formal instructional design education, dominated by process-oriented models, may be negatively impacting how professionals develop design expertise (Jonassen, 2011).

Understanding Design from Design Thinking

Design thinking, which has gained popular ground in efforts to understand design, is practice-based and recognizes design problems as ill-defined and ill-structured (Cross, 2011). In contrast to scientific problems, design problems have been described as wicked and grounded in practical situations (Rittel & Webber, 1973). Rittel and Webber further explain that design problems often involve multiple individual interests with contradictions and resource constraints that lead to challenges for maintaining equity within a large social system.

Cross (2006) explains that design is often omitted from formal education because the Western language and culture lack the ability to understand it in words. Designers do not share design knowledge regularly through language in written form because it is not their professional mode of communication (Lawson, 2004). According to Lawson, designers value actions more than recording ideas for the purpose of externalizing design knowledge. However, while analyzing design-related conversations between an experienced architect and an apprentice, Schön (1983) explains that design involves a metalanguage, which he calls *language about design* (p. 81). Nelson and Stolterman (2012) state that human beings are hard-wired to engage in some relationship with design. We engage in design because everything surrounding us is a product of design (Cross, 2006). In other words, whether individuals are aware or not, they are constantly being introduced to design, acting based on design, and engaging in design themselves.

Design can be described as a reflective conversation that professionals engage during problem-solving in practice (Schön, 1983). In this reflective conversation, designers reflect on complex constructs in their practice (Thorpe, 2004). Schön explains that in its broadest sense, design is about making things. Lawson and Dorst (2009) describe design as a free flow of ideas and creativity to make something new while exploring satisfactory solutions. Rowland (1993) shared his definition of design as:

> Design is carried out in numerous fields and will vary depending on the designer and on the type of thing that is designed. Designing requires a balance of reason and intuition, an impetus to act, and an ability to reflect on actions taken. (p. 80)

Rowland summarizes that becoming a designer involves individuals finding a balance between technical skills and creativity and rational and intuitive thought processes.

Design as a Problem-Solving Activity

Design involves engaging in multidimensional problem-solving with the unknown where not all goals and constraints related to the problem are discovered (Dorst, 2011; Jonassen, 2011). Jonassen (2011) explains that design involves problem-solving through model building activities with an infinite number of solutions that can be explored within the culturally accepted context. He continues that this type of problem-solving is different from scientific problem-solving where the goal is to hone into the best solution that can be generalized to multiple situations. Farrell and Hooker (2013) stated that there are far fewer research efforts put into examining what design is and what designers do in comparison with understanding the works of scientists.

The iterative path to a final solution may contain both successes and failures (Dorst, 2011). Cross (2006) explains that while experiencing initial failures, designers often find themselves in a place where they break through from being stuck. They find themselves encountering a creative leap, whether it is small or significant. He further explains that in this process, designers "need to learn the self-confidence to define, redefine, and change the problem-as-given in the light of the solution that emerged from their minds and hands" (p. 7).

Methods

Data Context

The design thinking course was offered in an interdisciplinary doctoral degree program. In this program, instructional design was one of three areas of emphasis along with educational psychology and cultural studies. Instructional design courses were part of the program core requirements. Many students entered without a designer identity because of the interdisciplinary nature of the program. Students in the program, in many cases, learned about design for the first time through the required coursework.

This IRB-approved study took place in one of the required courses in the program. In the design thinking course, students explored both theoretical and empirical works about design in various fields, design research methods, and the sociocultural implications of design. The course was implemented as a 15-week, one-semester, on-campus offering. The class involved assigned readings, discussions, in-class design activities, as well as student presentations of researched topics and designed products. In-class research presentation activities included students presenting various data collection methods for examining and understanding design in action. Product presentations included activities such as developing a prototype for physically redesigning a classroom as a student-centered interactive learning space. Students drafted their design with a tool of their choice, including paper and pencil sketches, electronic sketches, and origami 3D models. After each term concluded and the instructor posted final grades, students were solicited to participate in this study.

The course was offered in 2013, 2015, and 2016. Students were required to examine their role as a designer by completing a design reflection journal throughout the semester, as well as a design philosophy paper at the end of the semester. Additionally, students were required to write a design case and present on nontraditional research methods to examine design. The data of this study included student design reflection journals (see Appendix A for design reflection journal topics) and student design philosophy papers (see Appendix B for design philosophy paper guide).

Data Collection and Analysis

Data collection was performed by the faculty researcher starting in 2013. Each year the course was offered, the faculty researcher had a third party collect informed consent from students enrolled in the course after grades were submitted and students completed their instructor evaluations. Over the 3-year duration, a total of 18 students volunteered to participate in the study by signing the human subjects informed consent form. Graduate student authors of this chapter were all enrolled in the course in one of the years offered and were participants of the study.

Data analysis began in 2017 when graduate students became involved in a collaborative research team. At this time, we discussed how authorship would be determined and created an agreement that was approved by all involved. We followed naturalistic inquiry methods (Lincoln & Guba, 1985) for our qualitative methodology to focus our attention on emergent themes related to how participants of this study gradually identified themselves as designers. We were not interested in identifying how participant experiences fit a preconceptualized design model. The data analysis process began with each author acclimating to the data while identifying initial codes following the constant comparative method (Charmaz, 2014; Corbin & Strauss, 2015). A set of agreed-upon codes and definitions to each code were identified. Initial coding was done individually in NVivo, a qualitative data analysis software. During research team meetings, assigned pairs came to a consensus on the coding.

After coding was completed, we began our analysis by running reports for codes that were used most frequently. The reports consisted of the coded raw data, which then sub-teams were assigned to examine for overarching findings. These efforts were recorded and shared in an electronic notebook hosted on Evernote. During our research team meetings, each sub-team presented their findings, and the entire team reached a consensus on the identified findings.

Trustworthiness

To ensure methodological rigor, we involved multiple researchers, relied on multiple sources of data, and contextualized our work within the existing literature (Denzin, 1989; Tracy, 2010). All authors were involved in the coding, analysis, meaning making of the data to findings, and continual analysis of our work in the process of writing this chapter. The data analysis workflow of our team consisted of (a) reaching a consensus on steps to take as a team, (b) sub-teams engaging in data analysis, (c) sub-teams presenting findings to the research team, (d) research team coming to consensus on the analysis and findings, and (e) research team finding relevance of our work in the context of existing literature. This led to a continual state of renegotiation of what we learned while we collectively made meaning of the data.

Findings

The findings from this study showed that students in an interdisciplinary instructional design program, who did not initially identify themselves as designers, experienced three distinct phases on their way to becoming an empowered designer. These phases included the following: (a) I am not a designer, (b) design is everywhere, and (c) I am a designer. While we found that students progressed through these phases via different pathways, all students ultimately arrived at the conclusion that they are designers. In this section, we will discuss representative participant experiences.

I Am Not a Designer

In the early entries of the design research journals across all cohorts, participants shared that they did not refer to themselves as a designer. Participants also shared that this belief originated from their work in non-design-related settings. They did not perceive that design took a role in their daily practice. In some cases, there were participants who showed bewilderment or resentment early in the semester during class sessions. They explained that they could not understand why a course about design was required. In their journals, many posed questions about the relevance of design to their work because formal training for their profession did not include design.

At this early stage in the course, participants discussed the definition of design through personal examples. Ashley, who was a former K-12 educator and web designer for a nonprofit organization, commented, "When I was a web designer, I tended to see design in a very literal way: Design was the active process of creating something" (Design Reflection Journal Entry 1, 2013). When asked what design meant to them in their first assigned journal entry, many participants shared that it was something related to personal preferences, such as home decor and for "creative types." In many cases, participants' definition of design led them to believe that they interacted with design as a consumer and never thought of themselves as designers. Tracy, formally trained in nursing, stated, "My basic assumption [prior to this course] was that design was something other people were involved with, and that my interaction with design was limited to using objects designed by other people" (Design Reflection Journal Entry 1, 2016).

Participants shared that becoming a designer was unreachable and unattainable because they were not formally trained as a designer. They specifically associated design to what they perceived as creative activities, and because they did not see themselves possessing creative talent, they did not imagine that they were designers. For example, both Ashley and Jennifer from the 2013 cohort had formal training as classroom teachers and shared in their journals that when they began the course they believed that design was for people in professions such as architecture, graphic design, and art in general.

In addition to individuals who believed they did not qualify as a designer, there were a smaller number of participants who began their course experience with formal training as designers in creative fields. For example, Emily, who enrolled in the 2015 course, shared that she was trained as a graphic designer and "design played a significant role in my life so far" (Design Reflection Journal Entry 1, 2015). Interestingly, Emily continued to share that until this course, she had applied design specifically to her work as a graphic designer and not in other areas of her life.

Design Is Everywhere

As course activities progressed, participants began recognizing design in their everyday lives. Ava from the 2015 cohort, who has a background in academic coaching for university athletes, shared in her journal that, "The more I learn about design, such as what constitutes being a designer, and what constitutes design as a whole, the more I realize that I am engaged in designing on a day-to-day basis" (Design Reflection Journal Entry 1, 2015). Susan, who was a city planner and a

K-12 classroom teacher, commented, "I realized that design is all around us and it is not something that we are always conscious of" (Design Reflection Journal Entry 5, 2015).

Many participants started to see how design took a role in both their personal and professional lives every day and everywhere. Participants shared during class and in their writing that they were now aware of the necessity to reflect and acknowledge how they engage in design. Susan described how she had been engaging in design in the past without realizing:

> …I have designed as a teacher…I've designed lesson plans and PowerPoint lectures (going crazy with the "clip art.") When I was teaching high school, I had to arrange and fit 32 student desks, a teacher's desk, a filing cabinet, a computer table, and a technology cart "comfortably" in a classroom. I use quotes because under those circumstances, as long as I wasn't blocking the exit, I think I did pretty well. (Design Reflection Journal Entry 1, 2015).

I Am a Designer

As participants recognized that design took a role in their personal and professional lives, they also started to see themselves as designers. Cheryl, who was formally trained as a classroom teacher and was a practicing English as a Second Language (ESL) teacher, described her process of this recognition as follows:

> I had an "ahah" moment during the first class. Our discussion revolved around the current curriculum used in my position and I had commented that before this new curriculum had been purchased, I was essentially on my own to create my lessons…There it was; I was a designer. I had been creating curriculum for my special group of ESL students who did not fit the typical mold of a student you would find in a regular classroom. (Design Reflection Journal Entry 1, 2013)

At various points within the course, participants from all three cohorts claimed their role of designer as they reflected upon their new understanding of design and their own day-to-day actions. As expressed in comments shared above, all participants commented in their class discussions and written work that they saw themselves in a new light engaging in design.

When reflecting on why she did not see herself as a designer prior to the course, Tracy, from the 2015 cohort, shared in her journal that previously she had built "artificial boundaries" around the concept of design as her professional education had not included design. This comment was also shared by participants who claimed a design background. Emily from the 2013 cohort explained that she had purposefully limited design to take a role in her professional life, but by being part of the course she came to understand that she needs to examine design and its role in her personal life. Many participants shared comments similar to Tracy and Emily that the boundaries they had built around design had been preventing them from purposefully engaging in design in both their personal and professional lives. At the end of the course, participants shared a new sense of commitment and a sense of empowerment in claiming their identity as a designer.

Where Are They Now?

As we wrote this chapter, student authors reflected on design activities after they became aware that they were designers. They identified that once they started to see themselves as empowered designers in their various professional contexts, they were willing and able to take multiple approaches to a problem. Some participants applied and secured new jobs that allowed them to serve as designers in their respective fields, such as a curriculum designer. They also found new opportunities to challenge the status quo in their everyday professional context. They shared that they became unafraid of discovering what had been unknown before, and they were willing to work through necessary processes for developing ideas into products, rather than settle with having a lot of good ideas that often led to no action. These reflections show that participants came to understand design as a multidimensional problem-solving activity with the unknown (Dorst, 2011; Jonassen, 2011). Participants discovered that design is an act of making things (Schön, 1983) and became unafraid to engage in the making. This is demonstrated in the following post-course experiences shared below by the authors of this paper.

Lisa S., the fifth author, shared that she was involved in a project to redesign an existing face-to-face graduate-level course in statistics for an online format. She partnered with statistics faculty and took on the role of the instructional designer working with a content expert. She shared while reflecting that "acknowledging myself as a designer gave power to my ideas and thoughts on how best to achieve the learning objectives set by the faculty" (Research Memo, August 2018). During the course redesign process, Lisa was able to see her role in the project clearly as a designer, which then made her responsibilities in the project evident and helped her communicate her contributions to her partner faculty. As partners, Lisa and the faculty went through several iterations of the course design, and after several discussions with one another, they identified an appropriate design for the course and developed it.

Cody, the sixth author, shared an experience related to developing an outdoor classroom at the community college where she works. For several semesters, she had taken her students outdoors for class when the weather was nice. After acknowledging that she herself was a designer, she decided to apply for a small grant for building an outdoor classroom on campus. Soon after her decision, she found other faculty members who were willing to collaborate on the grant. As the team worked on the grant, what started as a small idea with a modest budget turned into a larger project involving architects, extensive grant writing, classroom designers, and several upper-level administrators from the community college. The college president and the foundation director eventually became interested in the project and started a community campaign to raise money for the outdoor classroom. Cody shared that she was confident to move forward with the project even when it scaled up significantly because she gained the confidence to be a designer and learned the skills to implement her ideas from design to a product in the design thinking class. She also shared that as a designer, "the course inspired me to pursue professional goals and ideas that I had not previously felt possible to achieve" (Research Memo, September 2018).

Implications

What We Learned

The findings from this study suggest that prior to taking the course about design thinking, the graduate students did not know that they were engaging in design every day. Participants associated this difficulty with the lack of opportunities in their formal education to learn about design. However, once participants started to see how design took a role in both their personal and professional lives, they were able to overcome self-imposed boundaries that reserved design as a talent only for people in few professional fields. By tearing down the walls participants had created around design, they gained confidence to become empowered designers.

Participants were able to embrace an active role as designers rather than passively following step-by-step processes (Tracey et al., 2014). They gained a designerly way of knowing as well as the capacity to engage in iterative processes involved in design projects (Cross, 2006). This made it possible for participants to find new ways of understanding the world and gain new perspectives in problem-solving. Participants also became comfortable claiming the role of a sophisticated problem-solver (Tracey & Boling, 2014) and became able to clearly communicate their ideas to non-designer project collaborators.

In the initial peer-review process of this chapter, there were several reviewers who questioned whether the participants in this study were realizing, becoming, or evolving into designers. Upon further analysis and discussion of our data, we now believe that participants became designers once they realized that design is everywhere and they had been engaging in design unwittingly. When participants realized how they were involved in design every day, they became empowered designers who took initiative in future design projects. The realization about their designer status was a necessary part of participants becoming designers. This enabled them to challenge themselves, embracing new opportunities and continuing to evolve as empowered designers with purpose and agency.

Future Design Education Reflections

It is important to provide experiences that help students understand design in a manner that is relevant to both theory and practice (Yanchar et al., 2010). These experiences cannot solely focus on introducing students to theoretical content represented through instructional design models (Gropper, 2015) because designers do not engage in design the way they were taught (Boling & Smith, 2012; Fortney & Yamagata-Lynch, 2013; Klein, 1991; Young et al., 1998). Future instructional design programs thus need to make room in their curriculum to move beyond prescribed and predetermined content, theories, and models to provide opportunities for students to develop their language about design (Schön, 1983). Students should also be encouraged to see themselves as designers and gain the confidence that will provide opportunities for them to see design problems as designers (Cross, 2006).

In conclusion, we believe that instructional design programs should focus on recognizing, nurturing, and empowering student habits and beliefs related to being a designer. When students see themselves as designers, they become intentional about engaging in it. From our experience, when students claim their designer identity, they become bold, innovative, and confident in generating solutions to evolving ill-defined problems.

Appendix A: Design Reflection Journal Topics

Overview

This page will identify the journal entry topics. If you are a participant of LEES 650 Design Thinking and Theory class during fall 2016, please follow the agreed deadlines and post your journal entry as a blog post. Then participate in the peer commenting portion of the journal activity following the agreed deadlines in the course syllabus.

Journal Deadlines and Instructions

Reflective Journal Entry 1

Deadlines: Your entry is due 9/14, and your comments to others are due 9/16.
Topic: How would you define design based on your past experiences, on what you have read for class thus far, and on insights from class discussions? To the extent that you are able to provide a definition that is currently satisfactory to you and as much as you see necessary, articulate elements in your definition such as assumptions, themes, and subthemes relevant for building your argument. Remember that this journal activity is a work in progress throughout the semester, so if there are elements you have a hunch about and want to make a note of in this entry but cannot articulate well, that is fine. Once you have identified a definition that is currently satisfactory to you, examine the definition you just wrote and determine how your definition has been influenced by what has been introduced to you throughout

your life as the nature of science. Then discuss what role design has had in your education thus far, and what role you see it continues to have in your doctoral education.

Reflective Journal Entry 2

Deadlines: Your entry is due 9/28, and your comments to others are due 9/30.
Topic: Thus far through course readings, discussions, and activities, we have examined the nature of design. Through these examinations and sharing of ideas, several of you have stated or voiced that you may be engaging in design more often than you thought through work and through everyday activities. For this reflective journal entry, think of a design activity from work or everyday life that you engaged in the last month. You can share an activity that involved individual or a team design situation. Provide a brief description of the activity. Then reflect on why the activity you described was design. Then discuss what skills you needed to be an active participant of the activity and how you came about acquiring those skills. Then discuss if you were to teach/train somebody to become able to engage in the same activity you did, how and what would you teach them. Use references to readings and discussion we have had related to this class when appropriate.

Reflective Journal Entry 3

Deadlines: Your entry is due 10/12, and your comments to others are due 10/14.
Topic: The focus of our class topic for the next couple of weeks will be on reflective practice. While we engage in discussion of this topic, you as a designer need to identify what are critical reflection questions that need to be addressed when sharing reflective narratives about design experiences. When writing a narrative about a past design situation, you need to provide a "thick description" that give you and the reader an opportunity to (re)experience the situation. In this reflective journal entry, define what reflective practice means to you. Refer to selected readings from class when appropriate, and/or introduce works of authors you have encountered in the past that take a vital role in your definition of reflective practice. When you share your definition, in order to contextualize your discussion, include a short narrative about a time in your career that reflection took a role in your development. Then choose three Reflective Journal Entries from Entry 2, and identify additional questions for your peers to address in their entries so that you will be able to better understand the design situation through their reflections and learn from his/her design expertise. Narrow down to a maximum of three questions. Finally, provide reasons to why you would like your peers to address the questions you identified.

Reflective Journal Entry 4

Deadlines: Your entry is due 10/26, and your comments to others are due 10/18. *Topic*: Explore projects included at http://www.ideo.com/ (for commercial projects) and http://www.ideo.org/ (for humanitarian projects) to find one project that you will focus on discussing in this reflection. You will have to dig into the information included at the websites pretty deep and find narratives, pictures, and any other documentation about a project to become familiar with it. There may be some projects with more sources of information than others, so keep that in mind while you are exploring projects. To prepare for this reflection, engage in a thorough study of your favorite project. Then to practice your design storytelling skills, based on all the information that is available, prepare a narrative in your own words. After you write your design story, reflect on the following: (a) how did you decide which elements of the design to include in your story, (b) why did you think that others would be interested in your story, (c) what elements of the design story drew your attention to this story, (d) how did you maintain rigor when writing the story, and (e) after writing the story, did you think that it was a worthwhile story to share and why? Note: if you are interested, you can read a *New York Times* article about IDEO at http://www.nytimes.com/2010/10/10/automobiles/10FACE.html?n=Top%2fReference%2fTimes%20Topics%2fSubjects%2fD%2f and another article about humanitarian design that mentions IDEO.org at http://www.nytimes.com/2012/10/07/opinion/sunday/dignifying-design.html?pagewanted=all.

Reflective Journal Entry 5

Deadline: Your entry is due 11/9, and your comments to others are due 11/11. *Topic*: Share at most a three-page double-spaced portion of your Design Philosophy Paper.

Appendix B: LEES 650 Design Philosophy Paper Guide

The goal of this assignment is for you to explore how you define design within your field, how you see yourself as a design practitioner, how you see yourself as a design researcher, and how you identify your various views about yourself and design will affect your future work. Writing this paper will require you to reflect on your past experiences as a design practitioner and researcher. It will also require that you reflect on readings you have completed for this class, experiences you gain from this class, and discussions with other participants in class both face-to-face and online.

This assignment is an opportunity for you to explore, reflect, identify sources, and engage in a professional conversation about your design philosophy.

Your paper should include the following sections:

1. *Title page.*
2. *Introduction*: provide a clear overview, purpose, and plan for your paper. In this introduction, state what types of discussions the reader can expect from your paper.
3. *Definition/approach to design within your field of practice and research*: provide a discussion about your design definition/approach within your field of practice and research. Your discussions can include how your definition/approach has evolved. Refer to relevant readings, discussions with other participants, and personal experiences that help clarify your arguments to the reader.
4. *Reflections on future practice*: provide a reflection on how your definition/approach to design will affect your participation in future design practice. Include discussions on design projects you want to be involved, what role as a designer you want to take in future projects, how you intend to work with other designers, what specific design activities you envision you would be engaging in, and what type of relationship you want to cultivate with clients/target audience.
5. *Reflections on future research*: provide a reflection on how your definition/approach to design will affect your participation in future design research. When discussing about design research, include discussions on likely research settings you will position yourself and how you are likely to engage in data collection and analysis.
6. *Concluding remarks*: provide a conclusion that explains what you intended to accomplish in this paper, your assessment of how you accomplished them, and the impact on your future work.
7. *References and if necessary appendices*

Your paper should be between 2500 and 3500 words double-spaced using 1-inch margins 12-point Times New Roman font excluding title page, references, and appendices following APA style guide sixth edition. If you exceed the required word count, your work will not be read past that point. On the title page, please include the exact word count of your document excluding the title page, reference, and appendices.

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Chapter 3
What *Should* Be the Content for Student Learning?

Theodore W. Frick

Introduction: What Is? vs. What Should Be?

Instead of conceiving subject matter as acquiring knowledge within extant disciplines, I argue that educational content *should* be considered with respect to student mental structures that are expected to result from teaching and learning activities. This stands in stark contrast to "covering the content" presented in printed textbooks and other media, which is too often the case in schools today.

It is a mistake to justify "what should be" on the basis of "what is." To do so would be to commit what philosophers call the "naturalistic fallacy" (Stanford Encyclopedia of Philosophy, 2004). Just because something exists does not mean it is good. For example, murder of human beings still occurs. Murder exists, but that does not mean we *should* do it or allow murders to continue. As another example, in American schools, student achievement has been measured by standardized tests in recent decades, and those tests, in turn, tend to drive what content is taught in K-12 education. But that does not mean that we *should* assess student learning achievement by such tests. Just because something exists does not mean it *should* exist.

Scientific and praxiological inquiry are *empirical* matters. For example, we know scientifically that a very large amount of energy is released when mass is destroyed. And some engineers praxiologically know how to make atomic bombs of great destructive power. But that does not imply that we *should* make and use atomic bombs.

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T. W. Frick (✉)
Department of Instructional Systems Technology, Indiana University Bloomington, Bloomington, IN, USA
e-mail: frick@indiana.edu

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"What should we do?" is a philosophical question. It is not an empirical question about what is or what works. Empirical data are not required to answer a philosophical question. Philosophy is concerned with matters of value, with matters of what is worthwhile. "What is intrinsically worthwhile?" is not an empirical question. Empirical data are irrelevant.

If we are going to determine worthwhileness, we must have justifiable criteria for making such judgments. Reasoned argument is paramount for such justification. Rationality is required.

Reasoned argument for criteria should not be based on what is but rather on what ought to be. Reasoned argument for justifying criteria should not rely solely on empirical evidence, for to do so would be to commit the naturalistic fallacy.

The ultimate criteria for making such judgments must be based on initial principles that are justified by means other than empirical evidence. As an example, the Greek philosopher, Plato (360 B.C.E), put forth the fundamental principles of *truth*, *goodness*, and *beauty*.

Another well-known philosopher, Immanuel Kant, reasoned that justice should be determined by the *categorical imperative*: "Act as though the maxim of your action were to become, through your will, a universal law of nature" (1785, p. 24). In other words, it is right for one person to do this action, only if it also should become a universal law for everyone to do so. For example, one should treat others with respect, because everyone ought to do so. On the other hand, murder of human beings cannot be justified, when judged rationally by the categorical imperative.

Elizabeth Steiner, an authoritative educational philosopher, further argued for these primary criteria: "The justification of the principles of universality (*impartiality*), autonomy (*liberty*), and humanity (*rational benevolence*) resides in the intuition of rationality as the essential characteristic of humanness" (Steiner, 2009, section 13.5, italics added). Simply put, to be truly free, we must become *rational*. The primary goal of education should be to guide students to become rational and therefore free (Steiner, 1981).

In summary, justification of criteria for determining educational content must be through reasoned argument from initial principles—i.e., through rationality—not from empirical fact. What is does not justify what ought to be.

What Exists: Content as Cognitive Subject Matter Divorced from Emotion and Intention

The great American philosopher of education, John Dewey (1916), discussed the typical conception of content as subject matter:

> In the traditional schemes of education, subject matter means so much material to be studied. Various branches of study represent so many independent branches, each having its principles of arrangement complete within itself. History is one such group of facts; algebra another; geography another; and so on till we have run through the entire curriculum. (p. 134)

Not much has changed in the century that has passed. For example, in the USA, the Common Core State Standards have been widely promoted and adopted. According to their promotional website, these Core Standards have been adopted by 41 US states, as of January, 2020: http://www.corestandards.org/standards-in-your-state/.

Readers should note that the Common Core State Standards largely address *cognitive* outcomes in mathematics and English language arts in grades K-12. *Conative* and *affective* goals appear to be missing from the Common Core State Standards, nor are these important goals assessed by standardized tests. This is particularly salient in light of findings about prevalent student feelings about school. For example, the majority of US high school students are bored every day in school. Yazzie-Mintz (2007) summarizes results from a survey of 81,499 students in 110 high schools across 26 US states. Approximately two out of three students said that they were bored in class every day. When asked why they were bored, the top reasons were that learning materials were uninteresting, irrelevant, and not challenging enough. Yazzie-Mintz cited one student who stated, “Our school needs to be more challenging. Students fall asleep because the classes aren’t really that interesting.” Another said, “School is easy. But too boring. Harder work or more is not the answer though. More interesting work would be nice” (p. 10). Students who considered dropping out of school indicated that the main reasons are dislike of their school and teachers. Sixty percent further said, “I didn’t see the value in the work I am asked to do” (Yazzie-Mintz, 2007, p. 5). For those who stay in school, the primary reason they do so is to get their high school diploma, so that they can go on to college.

The lack of integration of cognitive, conative, and affective outcomes does not bode well in terms of student learning. Greenspan and Benderly (1997) have noted that since the ancient Greek philosophers, the cognitive aspect of mind has often been viewed as developing separately from emotion. They argue that this view has blinded us to the role of emotion in how we organize what we have learned: “In fact, emotions, not cognitive stimulation, serve as the mind’s primary architect” (p. 1). They identify the importance of emotion during human experience: “… each sensation … also gives rise to an affect or emotion…. It is this dual coding of experience that is the key to understanding how emotions organize intellectual capacities …” (p. 18). Greenspan and Shanker (2004) provide further evidence of how emotion is central to how we organize our thinking.

There is a biological basis for formation of mental structures (i.e., learning) as they are encoded through neural connections in the nervous system (Kandel, 1989, 2001; Squire & Kandel, 1999). Kandel (1989), a Nobel-prize-winning neuroscientist, concludes from empirical evidence that:

> Learning produces changes in neuronal architecture (p. 103)…. Whereas short-term memory does not require the synthesis of new proteins … the consolidation of long-term memory … does require new protein synthesis (p. 109)…. Our evidence suggests that learning produces enduring changes in the structure and function of synapses... (p. 121)

Kandel recommends further study on the “… the *power of experience* in modifying brain function by altering synaptic strength…” (p. 123, italics added). Subsequent research in neuroscience has further supported Kandel's earlier claims (Bertolero & Bassett, 2019; Eagleman, 2015).

If emotion is indeed the architect of mental structures, as mounting evidence appears to support (Eagleman, 2015; Greenspan & Shanker, 2004), then it follows that many students are likely to be developing ill-formed mental schema for the subject matter they are expected to learn in school—mental structures which are weakened or disconnected from existing mental structures due to feelings of meaninglessness, irrelevance, boredom, and even disdain with respect to the content of their education (Frick, 2018). Ideally, students should instead be developing mental structures that are strengthened through authentic life experience and positive emotion. If so, then those positive feelings and the authenticity of purposeful learning activities will facilitate organization of mental structures that constitute long-term memory.

Students could attain the Common Core Standards while remaining unenthusiastic toward learning itself and fail to be inspired and to persevere in discovering lifetime pursuits. That is, students could perform well on standardized achievement tests, but not be able to answer the important question: What should I do with my life?

What Should Be: How Do We Guide Students to Be Rational?

If we value the criteria of *impartiality*, *liberty*, and *benevolence* (cf., Steiner, 1981, 2009), then the content of education should focus on the development of student *rationality*. Being rational is facilitated by the integration of cognition, emotion, and intention through activity that is grounded. Cognition refers to thinking, emotion to feeling, and intention to trying. Activity that is grounded means that student experience of objects of learning is direct—that is, firsthand experience. For example, looking at a drawing of a dog is secondhand and indirect, not grounded in the sense of actually interacting with a dog—e.g., actually seeing it, hearing it bark, petting it, smelling it, playing with it, getting licked by it, etc.

As an example of non-integration, we could reason cognitively that every person should be treated with respect—based on Kant's (1785) categorical imperative. However, if in actuality we also feel hatred and fear toward others whose skin color is different, and we exclude them from our community, then we would be irrational. Our cognition would be dissociated with our feelings and our actions. We would in fact be racists. We would be irrational. We would believe and say that everyone should be treated with respect, but our feelings and actions would contradict our cognition.

What is needed is totally integrated education (TIE). TIE is intended to help students form mental structures which integrate cognition, intention, and emotion through grounded real-world experiences. Figs. 3.1, 3.2, 3.3, and 3.4 represent cognitive, conative, and affective levels to be integrated when designing content for student learning.

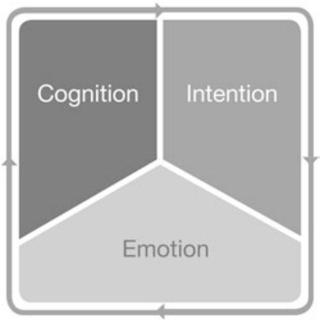

Fig. 3.1 Schema for desired connections among student's cognition (thinking), intention (willing), and emotion (feeling) during a learning activity (graphic by Colin Gray). (Reprinted with permission from Frick, 2018)

Fig. 3.2 Three basic kinds of cognition (drawings by Elizabeth Boling). (Reprinted with permission from Frick, 2018)

Note that in Fig. 3.5, 18 components of "knowing how" and "knowing that one" are missing, disconnected from each other and from "knowing that." Furthermore, *within* "knowing that," six components of student intention and emotion are missing from this mental structure (with respect to an object of knowing), which are represented by unshaded areas with dashed borders. The only two present and connected components in Fig. 3.5 are instantial and relational "knowing that" with respect to an object of knowing (e.g., a dog). Criterial "knowing that" is absent and hence disconnected. This kind of ungrounded and dissociated learning can occur when signs used in communication are used in isolation from their corresponding real-world objects and purposeful activity. The resulting mental structures are weakly connected, lacking wholeness and integration.

Figures 3.3, 3.4, and 3.5 are grossly oversimplified representations of mental structures in the human nervous system, which is extremely complex. Even fMRI movies of firing synapses in highly complex neural circuits in real time are very rough approximations to the complexity of *active* connectivity. fMRI movies do not indicate the biochemical *potentials* of trillions of connections among billions of nerve cells that are not firing at any given time (cf. Kandel, 1989, 2001; Eagleman, 2015). According to Greenspan and Shanker (2004), strength of feeling (emotion) during a human activity affects the strength of the biochemical *potential* of each connection (the enduring structure). The actual firing of a connection in real time is

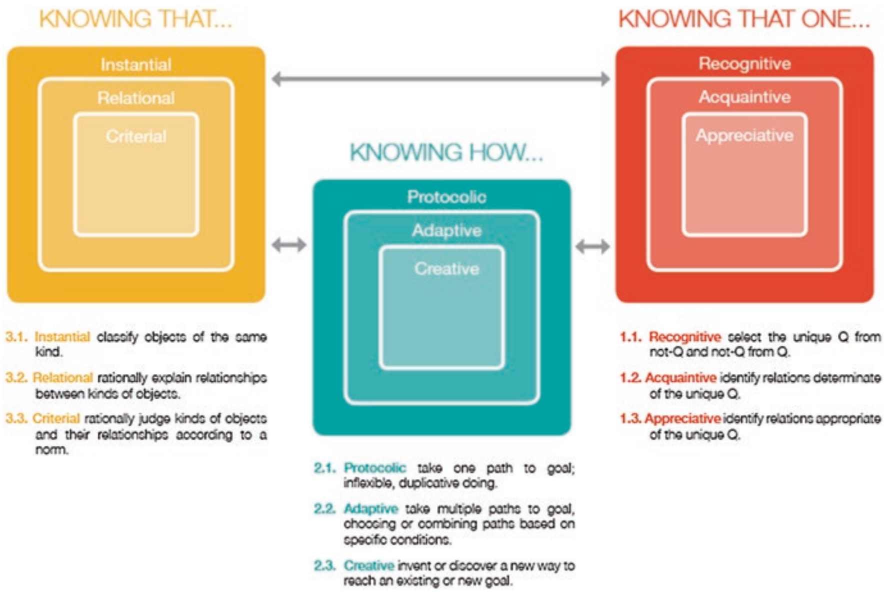

Fig. 3.3 Illustration of integration of 9 kinds of cognition. The shading of areas indicates presence of components, and the nesting of areas represents subset relationships (connectivity). The double-headed gray arrows represent connections among the 3 basic kinds of knowing, which are respectively color coded. Graphic by Colin Gray and Theodore Frick. (Reprinted with permission from Frick, 2018)

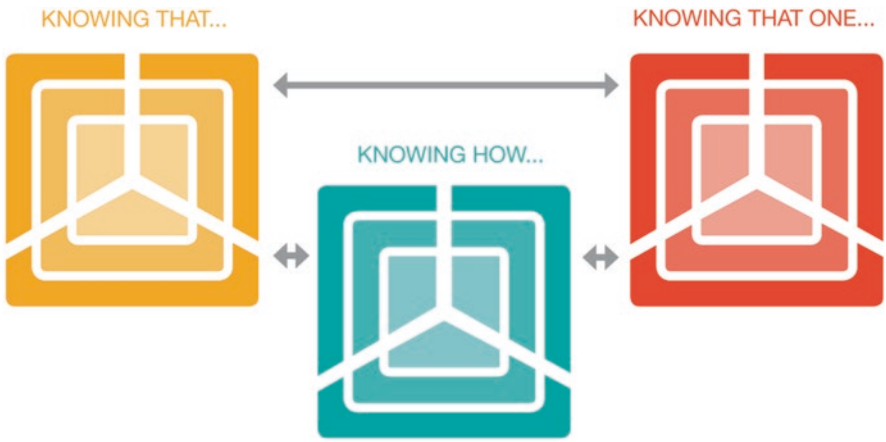

Fig. 3.4 Illustration of a totally integrated mental structure, where cognition, intention, and emotion are completely connected with respect to an object of knowing (e.g., a dog). Figs 3.1, 3.2, and 3.3 are in essence combined visually. Graphic by Colin Gray and Theodore Frick. (Reprinted with permission from Frick, 2018)

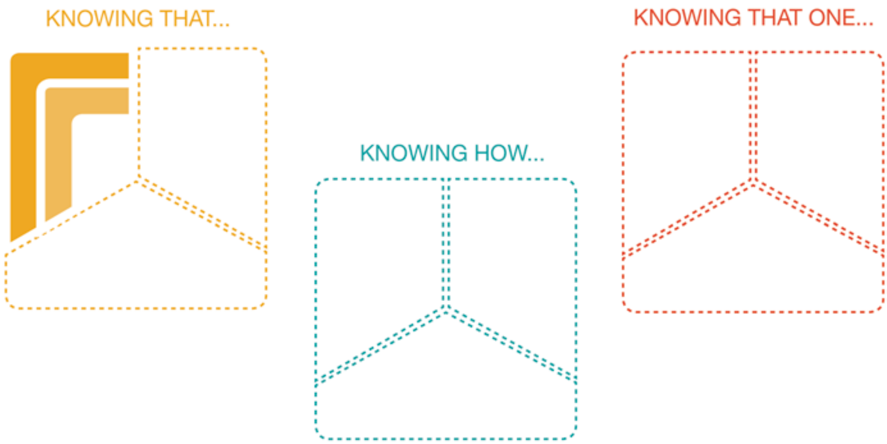

Fig. 3.5 Illustration of a weak and highly disconnected mental structure. Components are mostly missing and disconnected with respect to a given object of knowing (e.g., a dog). Unshaded areas with dashed borders indicate those components are missing. Moreover, the three basic kinds of knowing are disconnected, represented by *lack* of gray arrows. Compare with Fig. 3.4. (Graphic by Colin Gray, reprinted with permission from Frick, 2018)

part of the thinking process (Eagleman, 2015). Connected intentionality appears to be associated with neurotransmitter activity and structural receptors in a part of the brain that is associated with motivation (cf., Lustig, 2017). Note that TIE is an *educational* theory (Frick, 2018), but it nonetheless appears to be consistent with emerging research in neuroscience and how people learn, and neuroscience is a relatively young field (Eagleman, 2015; Lustig, 2017; National Academies of Sciences, Engineering, and Medicine, 2018).

Note further in Fig. 3.2 that three fundamental types of cognition are identified: (1) "knowing that," (2) "knowing how," and (3) "knowing that one" (Brown, 1970; Estep, 2003, 2006; Frick, 1997; Geach, 1964; Maccia, 1973, 1987, 1988; Ryle, 1959; Scheffler, 1965). Clearly, these three classifications of cognition are *not exclusive* in the sense that two or more of them can occur at the same time within an individual. For example, in Fig. 3.2, the person knows Rover as an instance of the dog classification ("knowing that"), a way to give Rover a bath ("knowing how"), and this particular unique dog, Rover ("knowing that one").

In Fig. 3.3, kinds of knowing are further explicated, based on Maccia's pedagogical epistemology, Estep's (2003, 2006) evidential arguments about natural intelligence, and Frick's (1997) discussion of issues in artificial intelligence. Nine kinds of knowing are outlined below as goals for worthwhile education—i.e., cognitive structures that students *ought to* develop:

1. "Knowing that": what are indicators of *belief*—is it warranted by disciplined inquiry, i.e., is it *true* belief?

   1.1. *Instantial*: Classify objects of the same kind.
   1.2. *Relational*: Rationally explain relationships between kinds of objects.

1.3. *Criterial*: Rationally judge kinds of objects and their relations according to a norm.

2. "Knowing how": what are indicators of *performance*—is it effective and ethical?

    2.1. *Protocolic*: Take one path to goal; inflexible, duplicative doing.
    2.2. *Adaptive*: Take alternative paths to goal, choosing or combining paths based on specific conditions.
    2.3. *Creative*: Innovate or invent a new way to reach an existing or new goal.

3. "Knowing that one": what are indicators of *opinion*—is it right?

    3.1. *Recognitive*: Select the unique *Q* from not-*Q* and not-*Q* from *Q* (where *Q* is the object of knowing).
    3.2. *Acquaintive*: Identify relations determinate of the unique *Q*.
    3.3. *Appreciative*: Identify relations appropriate of the unique *Q*.

Norms for evaluating these kinds of knowing are indicated by the questions following each of the three major types. In worthwhile education, when students develop mental structures for "knowing that," their beliefs must be *warranted by disciplined inquiry*. In other words, students should come to hold *true* beliefs. For "knowing how," student conduct must be both *effective* and *ethical*. For "knowing that one," *right opinion* is essential. Clearly, some learned beliefs are unwarranted, some actions are unethical, and some opinions are not right.

Unfortunately, students can develop mental structures for false beliefs, bad actions, and wrong opinions. One can, for example, believe that the Earth is the center of the universe; however, Galileo and Copernicus long ago provided empirical evidence that this belief is false. It is not supported by facts. One can hold the false belief that plain water freezes at 100 degrees centigrade. Such belief is clearly at odds with empirical evidence. One can learn how to deceive others, by making emotional appeals to their fears and prejudices. Such conduct is unethical.

Note that within each type of knowing, each higher level requires the lower level. Criterial knowing requires relational knowing, and relational knowing requires instantial knowing. Creative "know how" requires adaptive "know how" that, in turn, requires protocolic "know how." Appreciation requires acquaintance, and acquaintance requires recognition. In other words, within each classification of knowing, the categories are progressively inclusive.

Maccia's typology for cognitive structures is further used here as parallels for classifying conative and affective structures:

Universals A universal is a "form or essence" that is not limited by time and space (Steiner, 1988, p. 5). For example, "justice" is a universal. A student can learn to seek justice as a goal. This would be a conative structure, that student could also develop affective mental structures for good feelings about justice and bad feelings about injustice.

Means to ends There are “means to ends,” i.e., ways of doing. For example, the Macintosh operating system is a means to launch apps, print documents, do text messaging, etc. One might want to use the Mac OS, time and time again. This would be a conative mental structure. One might also have good feelings toward use of the Mac OS. Hence, there may be conative and affective structures for means to ends.

Uniques Conative structures can have unique objects, just as cognitive thoughts and means to ends. For example, a person can want a particular thing, such as MacBook computer, or to be friends with a unique person such as David Merrill, the author of *First Principles of Instruction* (2013). Similarly, one can have feelings toward that MacBook or David Merrill.

Finally, note that in Fig. 3.4, total integration of cognition, emotion, and conation is illustrated. For example, cognitive understanding of “truth” as a universal is an example of “knowing that.” Justifying the value of truth as a norm and applying truth as a criterion in judging assertions is an example of *criterial* “knowing that.” Seeking of truth is conative, and feeling strongly resolute about truth is affective. To “know how” to determine truth is cognitive—i.e., how to do disciplined inquiry to create knowledge. To intend to find the truth about a matter is conative. And the satisfaction of establishing truth is affective. To “know that one” truth is cognitive—e.g., to know that former US President Thomas Jefferson owned slaves at his residence at Monticello is acquaintive “knowing that one.” To feel revulsion about this particular fact about Jefferson is affective, even though he is well-known and appreciated for being instrumental in writing the US Declaration of Independence.

Next, I further illustrate TIE through several extant cases in education.

Examples of Totally Integrated Education (TIE)

Frick (2018) described two extant cases which illustrate TIE. Three more cases are described here: the Unionville Elementary School EARTH curriculum; State University of New York (SUNY) Cobleskill Fisheries, Wildlife and Environmental Sciences program; and SUNY Cobleskill Biotechnology program.

Unionville Elementary School Curriculum

The Unionville Elementary School in Bloomington, Indiana, USA, has developed a unique curriculum they identify by the acronym EARTH: Environment, Art, Resources, Technology and Health. Howell (2018) notes:

> You can see it when you stop by the school: Trays full of seedlings sprouting on classroom windowsills. Potatoes growing roots in cups of water. Large shelves bearing gardening tools and seed packets near the back door. Teachers and students holding class outside, on the

> hill, by the garden boxes, under the sheltered "learning lab" on the playground and in the miniature amphitheater with wooden benches by the pond. Students planting flowers and vegetables, or watching and sketching the trees, writing their observations in science notebooks. (paragraph 2)

Howell further writes:

> In many ways, the curriculum harnesses things Unionville has been doing for years. They compost and recycle in the school cafeteria, use the outdoor spaces often and go for hikes on Unionville's 18 acres. The fishing club catches fish in the school's pond from a little dock built for class purposes. They use different kinds of art, including quilting, to visually represent what they're learning. The school teaches digital citizenship and coding, as well as healthy living and good lifestyle choices.
>
> EARTH puts a renewed focus on those elements, increases the number of science experiences and puts an outdoor, environmental twist on it all. (paragraphs 7–8)

Howell quotes the Unionville principal, Lily Albright, who said, "It's about appreciating and understanding what's going on right here in our own backyard, and applying that as we think about the world and our place in the world" (Howell, 2018, paragraph 9).

The EARTH curriculum is clearly intended to help guide Unionville elementary students to connect "knowing that," "knowing how," and "knowing that one" (see Figs. 3.1, 3.2, 3.3 and 3.4). It illustrates a practical implementation of TIE in this particular context.

SUNY Cobleskill Fisheries, Wildlife and Environmental Sciences Program

Hands-on learning is central for students in the Fisheries, Wildlife and Environmental Sciences program at the State University of New York, in Cobleskill, NY, USA. The program utilizes its own cold-water fish hatchery tanks (Fig. 3.6). One classroom includes aquariums with live fish as well as some taxidermized species on the walls (Fig. 3.7). Advanced undergraduate students spend time in the outdoors doing scientific research and subsequently present their findings at professional conferences (Fig. 3.8).

Feldman (2018) quotes department chair, Mark Cornwell, who says:

> As students progress in the program, moving up level to level, the mix of their activities changes… For example, those at the beginning of their study are taught in four-hour blocks of time. The first hour is classroom instruction covering theory and practice; the remaining three hours are spent in the water, where students are suddenly surrounded by what they were just taught about in class. It's a terrific way to teach and learn. (p. 7)

Feldman (2018) further describes this unique program:

> As they continue in the program, students collect and interpret data, delve deeply into the biology of the species with which they work, even become conversant about the laws and regulations that affect the present and future of specific habitats and of the environment in general. (p. 7)

Fig. 3.6 Department chair, Mark Cornwell, explains that large fish tanks on campus are used for breeding purposes. Students learn how such hatcheries are managed, engage in raising fish, and then release them into the wild in upstate New York. (Photo by T. Frick)

Fig. 3.7 A classroom at SUNY Cobleskill includes both live and mounted species of fish. (Photo by T. Frick)

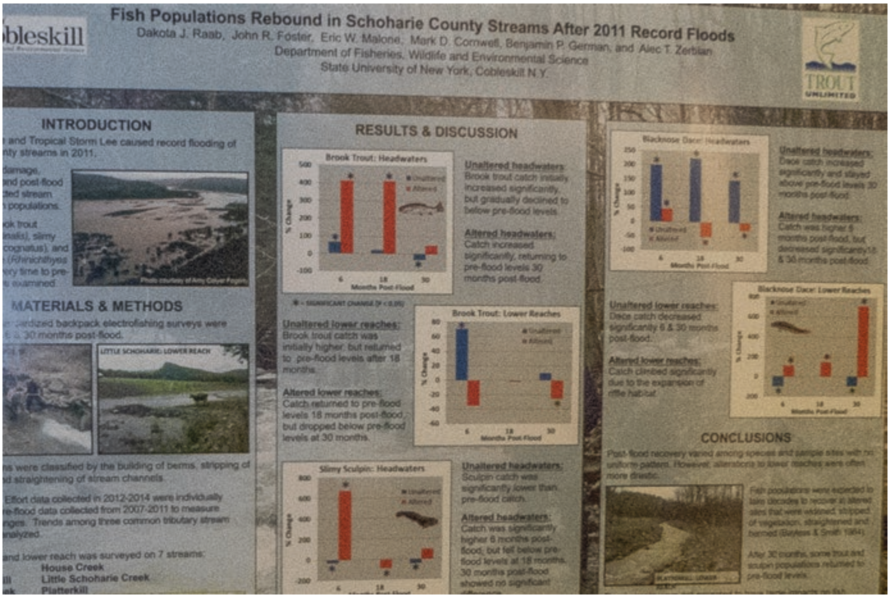

Fig. 3.8 Posters such as this one are presented by undergraduate students at professional research conferences. (Photo by T. Frick)

Cornwell is further quoted: "Ultimately, our goal is to produce graduates who are both extremely knowledgeable about the real-world species and systems they study and the relevant public policy issues that arise in our field" (Feldman, 2018, p. 7).

It is clear that students in this undergraduate degree program at SUNY Cobleskill are provided with learning activities and contexts to help them connect "knowing that," "knowing how," and "knowing that one." Parts of the real world are brought to the campus learning environment, and students also go out into the real world as they continue learning. This is an excellent example of totally integrated education (TIE), as illustrated in Fig. 3.4. Contrast these SUNY learning environments with typical barren classrooms where students read textbooks, perhaps watch some videos, sit at desks discussing ideas during class, and subsequently take paper-and-pencil tests on what they have learned (schematized in Fig. 3.5).

SUNY Cobleskill Biotechnology Program

Undergraduate students from the SUNY Biotechnology program are actively recruited by graduate schools and corporations. Feldman (2018) describes the intensive, hands-on program, where juniors and seniors "do valuable leading-edge research in such areas as developing disease and drought-resistant crops for agricultural enhancement" (p. 8).

Student research involves genetics, and some of them are invited to present at professional conferences. Students not only must understand genetic theory (relational "knowing that") but engage in creative "knowing how" (Fig. 3.4) as they develop new strains of plants. Student learning appears to be purposeful (conative) and satisfying (affective). Feldman quotes biotechnology professor, Peiyu Zeng:

> Our program definitely makes its mark among other researchers working in our field… For instance, SUNY Cobleskill is one of only a handful of academic institutions that have been able to create a strain of soybeans capable of withstanding highly adverse growing conditions. It is wonderful for students to know that the work they do here will have a real impact—and real visibility—in the world outside our labs. (p. 8)

The SUNY Biotechnology program is a further example of totally integrated education in higher education. TIE is a theory that can be actualized in practice. As defined in educology, *content* is conceived as "objects and signs of objects selected for student learning" (Educology, 2018, http://educology.indiana.edu/content.html). As C. S. Peirce (1932) noted:

> The Sign can only represent the Object and tell about it. It cannot furnish acquaintance with or recognition of that Object; for that is what is meant … namely, *that with which it presupposes an acquaintance in order to convey some further information concerning it* (2:231, italics added).

Context is defined in educology as "the system environment for teaching and learning that includes content" (http://educology.indiana.edu/context.html). Clearly, teachers at Unionville Elementary School and at SUNY Cobleskill utilize content and contexts beyond the confines of classroom walls and signs (words and pictures) contained in books and other media. These students are provided with opportunities to experience particular, unique objects in their immediate learning environments with which respective signs are directly associated ("knowing that one"). These learning activities can help students to connect cognition with emotion and intention (Figs. 3.1, 3.2, 3.3, and 3.4). Through hands-on learning activities, they can form holistic, integrated mental structures that are grounded in real-world experiences.

Summary and Conclusion

Content as typically conceived is the subject matter of education, often contained in textbooks, movies, posters, and more recently within software apps run by computers, tablets, and smartphones. This chapter has, hopefully, dispelled this limited conception of content. My arguments for a much broader conception of content are largely based on those made by Dewey, Steiner, and Maccia (see the Educology Website: http://educology.indiana.edu/). I have further alluded to *conative* and *affective* schemata for student learning as Steiner (1988) described. Conative and affective mental structures are also important parts of content for student learning. Totally integrated education aims to help students connect cognitive, conative, and affective structures through learning activities that support holistic integration of these structures (Figs. 3.1, 3.2, 3.3, and 3.4). The Unionville Elementary School was used as an exemplary case, as well as two undergraduate programs in the sciences at SUNY Cobleskill.

If we pursue totally integrated education (TIE), *student learning will be grounded*. Grounding of knowing, feeling, and intending is vitally important. Students who are grounded are less easily deceived and misled by others who are ignorant, prejudiced, or intentionally lie or distort truth. Students who can think critically become responsible participants in a democratic society. Critical thinkers will not allow deceitful leaders, tyrants, shysters, or ignorant people to control us and tell us what to believe, feel, or do. The principles of *impartiality*, *liberty*, and *benevolence* justify the need for the development of student *rationality* as the primary aim of education (Steiner, 1981, 2009).

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Chapter 4
Building a Holistic Design Identity Through Integrated Studio Education

Colin M. Gray, Paul Parsons, and Austin L. Toombs

Introduction

Design is a unique way of knowing that has been called the “first tradition” of human endeavor (Nelson & Stolterman, 2012). While design competencies are often categorized by the form or type of designed outcome (cf., Buchanan, 1995), contemporary approaches to design education view outcomes as increasingly situated, dynamic, and experiential. This expansion has led to the need for a more holistic approach to developing students’ “designerly ways of knowing” (Cross, 2007) in ways that prepare them for the realities of current design practice, while also building a foundation for the present and future broadening of design practice. In this chapter, we explicitly link students’ acquisition and performance of designerly ways of knowing with the development and integration of a *design identity* (Gray, 2014b; Liu & Hinds, 2012; Tracey & Hutchinson, 2016), whereby they are able to produce intentional change in the world through the lens of professional design activity.

Design education frequently takes place within a studio learning environment. The studio pedagogy, as one of many “signature” pedagogies in higher education (Shulman, 2005), is focused on types of learning that are germane to the practice of design. Some of these features include project-focused curricula, critique as a formative and summative method of socialization and assessment, and an intentional bridging of learning activities with their eventual utility in practice (Cennamo, 2016; Brandt, Cennamo, Douglas, Vernon, McGrath, & Reimer, 2013). We have built upon this traditional notion of studio, which has existed in some form for over two centuries, to address the rapid changes in design outcomes and the required competencies of practitioners. While the centerpiece of studio has conceptual

C. M. Gray (✉) · P. Parsons · A. L. Toombs
Purdue University, West Lafayette, IN, USA
e-mail: gray42@purdue.edu

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similarity to modern instructional practices often labeled as "active learning" or "inquiry-based" learning, we attempt to reposition the nature of studio pedagogy practices while also seeking to maintain resonance with the signature form of studio recognized in art and design disciplines.

In this chapter, we chronicle a portion of the development of a novel undergraduate program in user experience (UX) design at a large, US research-intensive university. We focus our attention on the ways in which the program and course design facilitate students' development of a holistic and future-oriented identity as design practitioners: a design identity. In particular, we explore the development of an *integrated design studio* that is experience-focused rather than content-focused, relying on a spiral model of skill attainment that inculcates values such as productive failure, iteration, leadership, and reflection. Rather than focusing primarily on content (e.g., topics and methods), an experience-focused curriculum prioritizes ideas, attitudes, and values in a way that is coherent with students' everyday lives and future identities (Beane, 1995). From this perspective, a significant portion of instructional energy is aimed at developing the personal, emotional, value-driven aspects of design work that are necessary for meaningful, deep learning (Caine & Caine, 1997; Erickson, 2002). While there are strands of instructional design literature that have indicated the potential interplay of tasks, topics, and learned routines (e.g., Van Merriënboer & Kirschner, 2007), our overarching curricular philosophy was to design curricula that produced primarily emotional and attitudinal outcomes through experiences that we wanted for students to have (Boling, Siegel, Smith, & Parrish, 2013).

Building a Design Identity Through the Hidden Curriculum

In previous work, researchers have addressed the developing identity of design students and the relationship and trajectory of this identity with future practice—a forward-looking attitude toward professional practice and design activity that we refer to as one's *design identity* (Brandt et al., 2013; Gray, 2014b; Liu & Hinds, 2012; Tracey & Hutchinson, 2016, 2018). While student development is often framed through the lens of academia, the forward- and future-looking trajectory of students as *proto-professionals* (Gray, 2014a) has previously been shown to be useful in modeling identity formation processes in design as inherently being oriented toward practice. Brandt et al. (2013) have described this liminal space as the "studio bridge," where students learn academic ways of knowing while also having access to constructive and authentic design tasks that help them to develop their abilities. Tracey and Hutchinson (2016, 2018) have previously identified reflection as particularly valuable in calling learner and instructor attention to this development process, increasing awareness of the role of the developing designer herself in producing a lasting change in identity.

Within this liminal space occupied by the academic design studio, we particularly value the role of the *hidden curriculum*—which we define as the learning outcomes that are learned without being explicitly taught. The concept of a hidden curriculum comes from the critical pedagogy literature (e.g., Freire, 1970/2000; Martin, 1976) and refers to aspects of socialization that may not be openly intended yet influence and shape learners and learning behaviors. Scholars have argued for decades that the hidden curriculum can be described—thus laying bare the unintended and often negative aspects of learning taking place in learning environments. But we argue, in agreement with Martin (1976), that knowledge of the hidden curriculum can lead to the development of new practices and structures that subvert or change this curriculum. We take on this pragmatic yet activist stance toward our own program, seeing the hidden curriculum as not solely negative but also generative to instructional design interventions. In doing so, we attend not only to the *designed curriculum* (i.e., what is intended by us as program designers) but also the *lived experience*—what is *actually* felt and experienced by students in terms of both learning and socialization.

In our previous work, we have identified reflection as one important mechanism for revealing students' identity development as designers and the disjunctures that often form among students' perceptions of their learning environment, their beliefs as designers, and their involvement in design activity (Gray, 2014b). By foregrounding the hidden curriculum and the role of these learned behaviors on identity formation, we seek to use this implicit learning as "material" with which to inform and direct the creation of learning experiences. This learner-centric view of the aesthetic learning experience (Gray, 2015) inverts the instructional design process in some important ways, valuing the role of *experience* over that of content or specific measurable gains in objective or objective-like knowledge. Thus, we position agency and student control within the learning experience to be constitutive of the students' developing design identity and, within this development process, the hidden curriculum to be the most fundamental mechanism through which the instructor can design and shape students' view of disciplinary "content" and the tacit knowledge that binds this content together.

In what follows, we will demonstrate how we build on this approach of foregrounding and designing with the hidden curriculum as it links to our students' identities as designers. We will outline the mechanisms we have used in creating our integrated studio to build these designerly identities, focusing on design leadership, learning through productive failures, and developing a sense of design expertise by trusting one's tacit knowledge.

Method

We use a single case study approach (Yin, 2009) to document the program and course design, exploring how the interactions among various elements of the learning system encourage students to take on a design identity and continuously practice that identity in a holistic way. To document our instructional design approach and learning outcomes, we rely upon a variety of data sources: (1) artifacts from our design process, such as whiteboard sketches, project briefs, and other planning materials; (2) student-created artifacts, such as written reflections, project deliverables, and course evaluations; and (3) dialogue among three program faculty that have been responsible for creating the integrated studio. In triangulating these data sources, we seek to expose both the objective knowledge that our final instructional design represents, as well as the tacit and professional judgments that have led us to make these decisions.

Program Goals and Institutional Context

Our initial goals for this undergraduate program were situated within common educational patterns in UX and the relatively new disciplinary status of UX (Lallemand, Gronier,& Koenig, 2015; Vorvoreanu, Gray, Parsons, & Rasche, 2017). Historically, practitioners have either learned on-the-job or have received graduate training in human-computer interaction (HCI), information science, or related disciplines. Because there were virtually no other undergraduate programs in UX design, we knew that our students would likely have to compete with graduate students for internships and jobs. Thus, our goal for the program was to have students build holistic abilities in UX design, not leaning too heavily toward user interface design (with links to graphic design and the tradition of art and design schools) or usability (with links to human-computer interaction, information science, and human factors). We also wanted to ensure students' ability to enter a rapidly changing discipline where long-term technical skills are unstable and the core competencies needed for success are still emerging and contested (e.g., Kou & Gray, 2018).

At the institutional level, substantial incentives were being provided to encourage the development of transformational educational programs at the time of this program's creation. While some characteristics of these programs included features common to "active learning" more broadly in higher education, other features situated the focus at the program level, including instructional innovations such as vertical and horizontal integration across courses and cohorts, in-context learning, and the provision of real-world or authentic learning experiences ("Answering the Call", n.d.). The UX design major was the first to be developed with these criteria in mind, with substantial institutional support for breaking down barriers between courses and challenging traditional notions of course delivery. Thus, while studio as an educational approach is under threat in other segments of higher education (e.g., Boling et al., 2013), we were able to receive broad support for rethinking course and program delivery in a residential context.

Creating the Integrated Studio

Working within these institutional and disciplinary constraints and opportunities, we constructed what we refer to as the *integrated studio*. The integrated studio encourages students to build competence across multiple strands of content in a reflexive, spiraling way, integrating knowledge(s) from multiple disciplinary traditions and perspectives. Because of the diversity of UX as a discipline and its numerous intellectual cousins (e.g., Faiola, 2007), teaching in a content-focused way is increasingly infeasible or otherwise undesirable. Instead, we crafted a cascading series of integrated studios (also known informally as "learning studios") (Vorvoreanu et al., 2017) spanning five semesters of students' undergraduate experience that are themed, broadening, and deepening students' understanding of design and UX in each semester (Fig. 4.1). Each studio includes primary threads of user research, prototyping, and evaluation/testing, with supporting threads of design philosophy, HCI/technology history, psychology, values and ethics, and collaboration/teamwork/leadership. All strands are present in every semester, and students' competence is built and extended progressively throughout the studio sequence. Students are also simultaneously enrolled in a cross-cohort studio consisting entirely of industry-sponsored projects each semester, providing a coherent experience that continuously informs their skill development and identity formation as a designer.

In this framing of curricular experiences, we thus move beyond the course as a container for content and rather view learning in the constructivist tradition as a constant movement toward competence and mastery. In the process, we broke with instructional design orthodoxy by choosing not to "chunk" or scaffold content but rather to sequence what Parrish (channeling Dewey) describes as the *aesthetic learning experience* in all of its complexity (Boling et al., 2013; Gray, 2015; Parrish, 2009). The framing of learning as being inherently experiential in nature leads to a different means of designing and structuring learning experiences. Using Parrish (2009) as a guide, an instructional designer might begin their process by consider-

Fig. 4.1 Overview of the integrated studio sequence

ing: *What experience do I want the learner to have?* This is dramatically different in focus from traditional approaches which place generative value on how to assess learning (cf., Backwards Design) or what learning objectives should frame the learning experience. This experience-centered approach was first suggested by the creator of the first curriculum map for this new major, which was then realized as a course experience by the first author. The particular approach to designing the *aesthetic experience* was inspired by two things: (1) the first author's ethnography of an HCI program, particularly focusing on the students' lived experience of the program that moved beyond the designed course experience (Gray, 2014a) and (2) a focus on hedonic (e.g., Diefenbach, Kolb, & Hassenzahl, 2014) and experiential (McCarthy & Wright, 2004) language to describe aspects of user experience in the HCI literature, resonant with Parrish's translation of Dewey in an educational context (Parrish, 2009).

Using this aesthetic framing of the learning experience, we identified the main threads of content and disciplinary competence that our program needed to include (Table 4.1). This process included multiple rounds of Post-It generation, sorting, and pruning in relation to existing UX/HCI texts. What resulted were two sets of strands—one oriented toward competence in UX particularly and one oriented toward a transdisciplinary situating of UX/HCI practice in a liberal education tradition.

In the undergraduate major that has resulted from these efforts, we leverage the student experience as a pedagogical "laboratory," where we can integrate best practices from critical pedagogy, instructional design, and design education. These experiences that we have designed and studied exemplify the instructional design value of documenting the hidden curriculum and using it to inform all pedagogical decisions on a course and program level. We have begun to validate that our students have achieved these intended outcomes, using a combination of data sources including regular reflections, assessments of student work, and workshops to engage students in cocreating the future learning experience. In addition, we have socialized the curriculum as a *learning experience*, rather than as a set of courses, involving students in core parts of the program such as mentoring, professional practices, and contact with industry partners. In our current research, we are studying ways in which this pedagogy can also meaningfully connect knowledge from academia/research and practice, constructing an effective "studio bridge" (Brandt et al., 2013)

Table 4.1 UX and transdisciplinary competencies embedded in the integrated studio

UX competency	Transdisciplinary competency
Visual and interactive representation	Psychology
Design philosophy	Anthropology and sociology
Social/research methods	Philosophy
Technical skills	Ethics
Global consciousness	Technology and HCI history
Leadership and teamwork	Art and design history

that allows students to learn and practice their role as future professionals throughout the program.

The integrated studio that has resulted from these efforts supports several higher-level competencies that exist “above content.” In the following sections, we describe several of these higher-level competencies that emerged as design goals and elements of the “hidden curriculum” in the design of the undergraduate program and, in particular, the integrated studio learning environment.

Design Leadership

Nelson and Stolterman (2012) focus on the role of the designer as leader—an individual that is in service to the design situation and has a set of ethical obligations. We have positioned this learning outcome as formative to the development of students’ design identity, bringing together strands of social psychology, organizational management, ethics and values, and design philosophy. These outcomes are cemented through multiple program mechanisms:

- *Teamwork and collaboration*: Throughout a five-semester sequence of studios, students work in teams to solve a range of “wicked” problems. Taking on problems that are, by their very definition, impossible to solve requires students to take on a leadership role and learn how to navigate conversations with their peers where there is no “right” answer.
- *Vertical integration*: Each semester, students are enrolled in a cohort-specific studio (Learning Studio; the integrated studios described in this text) and a studio where all cohorts are present (Experience Studio). In the Experience Studio environment, students work in cross-cohort teams on industry-sponsored projects. This experience fosters awareness of industry norms and the need to advocate for design and the “voice of the user” and facilitates peer mentorship among the students of varying levels.
- *Design as avocation*: Throughout the studio sequence, students are taught to view design as a way of being, rather than simply a method for solving problems or something that only has professional application. This view of design as avocation allows students to see their everyday actions—even something as simple as the positioning of a handle on a door (cf., “Norman doors”)—as being always already permeated by designed experience and design possibility. Being a designer is positioned as an active negotiator and shaper of social change, with a substantial and weighty responsibility that is inherently value-laden.

Our program is designed to expand students’ agency, giving them opportunities for peer mentorship, leadership in teams, and reflection on their role as designers and humans throughout the program. As students advance through the program, they gradually take on more leadership and mentoring responsibilities, through direct peer-mentoring roles and also as design-team leaders. Students’ increasing leadership expectations are supported through integration of design ethics as both an explicit topic of study and implicit substrate for team project work.

Productive Failure

Failure is widely acknowledged to be a critical element of professional success (Petroski, 2006); however, encouraging failure in the classroom can impose significant demands on both students and instructors. We not only advocate for failure, but we also place it at the center of our instructional and evaluative approach through some of the following mechanisms:

- *Failing with a safety net*: Student grade allocations are balanced to allow for significant failure on group design projects, with around 50% of the final grade allocated to individual work which is nontrivial, but also not difficult to score highly on (e.g., portfolios, reflection, reading annotations, participation). The remaining design projects are assessed through a mastery grading process, whereby students are evaluated not as freshmen or sophomores but as early professionals. Pragmatically, this means that students typically receive failing grades on their first projects in the program. Students are told that their final grade will be based not on their component grades but rather on their willingness to take risks and show a trajectory of development over time. Through this set of experiences, students slowly learn to value feedback more than grades. We have spent substantial time and effort on this aspect of socialization, recognizing that trust and strong identity as a designer can help to mitigate the fear that may come from a poor grade. Peer and faculty mentoring, alongside discussions about the purpose of feedback and the inadequacy of grades, are critical in learning complex performances such as design.
- *Centrality of formative critique*: While students do receive point value scores on their projects, the focus is on formative critique throughout the project lifecycle and open-ended feedback on their final project materials that is not grade-oriented. This focus means that the vast amount of feedback that students receive is not assessment-oriented in a summative sense but rather allows students access to multiple types of rich and subjective feedback, some of which is conflicting and potentially generative. Students regularly participate in desk, group, and peer critiques, and the final projects are evaluated by multiple graders with comments on Post-It notes. This grading model allows for multiple sources of feedback on numerous aspects of each project, including communication, organization, utilization of various required methods, argumentation, risk-taking, and demonstration of professional judgment throughout the process.
- *Acculturation through peer mentorship*: Throughout this process of experiencing failure, students' access to peer support is crucial. Because all students of varying levels interact together in Experience Studio, their sharing of these "failure moments" allows for bonding to occur and for more senior students to assure

junior students that their failure will not be a permanent state. Additionally, select senior students serve as peer graders for the lower-level studios, thus allowing the formative feedback to scale, and for students to continue to develop an awareness of their own abilities and design identity.

In our program, we intentionally build failure into the student experience across all levels of the curriculum, providing pedagogical, emotional, and reflective supports for them to reorient their notions of academic success, the value of formative feedback, and the role of design process in relation to design outcomes. We encourage students' development of community and mentorship relationships, which both prepares them for the failure they will experience and provides additional provision of peer critique and emotional support as they build resilience in their initial semesters in the program.

Design Expertise and Tacit Knowledge

One of the most important features of heightened design expertise is the increasingly tacit nature of design judgments, whereby experts are often unaware of the component judgments that result in large creative leaps (Cross, 2007; Lawson & Dorst, 2009). This gradual backgrounding of judgment makes it difficult to directly access or assess, requiring attention at the assessment, project, and experiential levels. We use some of the following mechanisms to encourage the development of design expertise:

- *Reflection as a way-of-being*: Students engage in various forms of reflection throughout the program, where the ultimate goal is for reflection to become a habitual means for students to understand themselves and their role as designers. Weekly written reflections in a shared Slack workspace[1] serve as the nexus of community-building and externalization of design identity, and this space is further supported by classroom reflections in aural and sketch form (cf., Gray, 2014b). Slack is a multi-platform team communication tool that allows participants to interact through public and private channels, as well as through direct messages, on many mobile and desktop devices. Through these reflection activities, students become more aware of their actions and rationale in informing their design judgments, as well as the larger role of designers in producing responsible change.
- *Rubric-free feedback*: Because our ultimate goal is for students to be able to understand and shape their tacit design judgments rather than to simply pass tests, we focus on providing rich formative feedback that meets the student where they are, rather than using rigid rubrics with predefined criteria and levels of performance. While we have overarching learning outcomes in mind, student

[1] https://www.slack.com/

feedback is not governed by a rubric with defined categories of feedback and achievement. Rather, students are provided with adaptive and situated feedback from a range of perspectives, including technical writing, visual communication, organizational communication, design process(es), advocacy for user-centered design, presentation of research and analysis methods, and rationale for designed outcomes. This approach often results in dozens of Post-It notes on the final document and many desk and group critiques in the formative design stages. While we do consider a range of potential assessment criteria within each assignment, these criteria are not applied directly or exclusively to student work. Rather, we attempt to perceive each assignment in a holistic way, providing feedback on areas that appear most salient to that specific assignment for that particular student or student team.

- *Sustaining the learning community*: One of the most important drivers of the development of design expertise is the attitude of lifelong learning. Students quickly learn about the volatile nature of UX practice, which impacts their selection of tools and methods, their understanding of the role of UX designers in industry, and their positioning of the present and future of design as a driver of our society. While we encourage this forward-looking and continuous form of learning in our studios, such as by not teaching specific pieces of software in our program, students also play a central role through a UX-focused student organization and the sharing of internship experiences.

In our program, we carefully build students' metacognitive skills, particularly through monitoring and reflection exercises. These skills are regularly practiced through critique sessions, using a multimodal critique approach (Gray, 2019) and weekly reflections on a shared Slack channel. In addition, students are expected to explicate their design process and related design decisions in their project documentation, which also encourages self-reflection and enables the provision of substantial formative feedback. Throughout the sequence of studios, we progressively disclose a portion of our "hidden" learning goals as a means of furthering students' reflection, allowing them to assess their progress and their metacognitive development.

Implications and Future Work

Throughout the design and implementation of the integrated studio, we have questioned the role of courses in relation to the overall program design. When considering aspects of the hidden curriculum as design material, how or *should* "content-free" elements of the lived curriculum—that is, the curriculum that is actually experienced by students—intersect with content or disciplinary knowledge? What might it means to explicitly design the hidden curriculum through these sorts of outcomes as we have attempted to do in our program, and how should these explicitly designed elements subsequently be "hidden" again, thereby giving these elements legitimacy? As Martin (1976) noted, there is always a hidden curriculum in play; even once a hidden curriculum is described and intentionally altered, a new, largely hidden, form of socialization is created. We have chosen to alter the common hidden curriculum of higher education in specific ways to shape students' development as designers and have allowed certain elements of this redesign to remain hidden to students or to be progressively disclosed as they move through the curriculum.

We believe there is an important tension between the implementation of an explicit curriculum and maintaining some sense of narrative thread that makes the overall direction or trajectory of learning visible (cf., Boling et al., 2013) while also leaving aspects of that trajectory hidden or undetermined. Future work should include investigation into instructional design practices that rely more heavily on the narrative and aesthetic aspects of learning, potentially repositioning conventional ID wisdom away from issues such as scaffolding, fading, and chunking. In rethinking the role of content in instructional design practice, we seek to not just organize or sequence content but rather actively build upon and adapt existing signature pedagogies on a program level, respecting and leveraging the epistemological foundations and hidden curriculum of the disciplinary traditions we rely upon.

Conclusion

In this chapter, we have provided early research insights from our work in designing and studying an innovative undergraduate program in UX design. We propose that taking a critical perspective toward instructional design and the construction of a "living curriculum" (Churchill, Bowser, & Preece, 2016) encourages the rich externalization and discussion of values and learner experience, both from an educational standpoint and in how a pedagogy can prepare learners for future professional practice. While uncovering and foregrounding the norms and *hidden curriculum* in the classroom environment are vitally important, so too is an understanding of how learners construct patterns of self-learning with their peers and the attention to how an increase in design expertise inevitably involves the development of values in relation to the learner professional design identity.

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Chapter 5
Language Learning Beyond Content: An Exploratory Study of Higher-Order Thinking and Digital Literacy via Digital Book Trailers in an ESL Reading Classroom

Shizhong Zhang and Ying Xiong

Today's students must be prepared to thrive in a continuously evolving technological environment, international students being no exception. An increasing number of international students come to English-speaking countries to improve their English skills and gain a different educational experience. In such a scenario, English as a Second Language (ESL) teachers are among the first group of educators to help international students, especially those who are unfamiliar with current educational technology, to utilize technology for learning. In this paper, we, as ESL educators, introduced one such technology, known as the digital book trailer (DBT), to an ESL reading classroom.

DBT has emerged as a new vehicle that combines storytelling and digital video technology with a pre-project reading task (Gunter, 2012). The origin of DBT can be traced back to the tradition of storytelling. Human beings are essentially "storytelling and story-listening beings" (Moon, 2010, vii). Throughout history, storytelling has been a means of sharing knowledge, wisdom, and values. Educators could promote reading and literacy development by upholding the storytelling tradition with the aid of digital video technology, that is, digital storytelling (DST). In a DST, a creator narrates a personal story with the help of videos, images, and video editing

S. Zhang (✉)
Foreign Languages College, Guangxi University, Nanning, China

College of Community Innovation and Education, University of Central Florida, Orlando, FL, USA
e-mail: shizhong.zhang@knights.ucf.edu

Y. Xiong
Foreign Languages Department, Jiangxi Science and Technology Normal University, Nanchang, China

College of Community Innovation and Education, University of Central Florida, Orlando, FL, USA

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software (Godwin-Jones, 2012). DBT adds a reading component to digital storytelling. Because of this add-on, DBT, to some extent, extends the DST process by giving readers a purpose to read: to create book trailers (Gunter, 2012).

DBT can be an effective instructional tool for teachers. The process of creating digital stories requires students to be able to locate relevant information, organize time and resources, utilize technological tools, make decisions, solve problems, and evaluate the stories produced (Robin, 2008). It is also an interdisciplinary practice that involves reading, writing, drama, and technology (Castañeda, 2013). Therefore, DBT lends itself well to learning opportunities beyond content.

This paper explores how DBT could be implemented in the specific context of the second language (L2) classroom to promote learning beyond content. Specifically, the authors were interested in the role of DBT in promoting higher-order thinking and digital literacy skills while providing opportunities for L2 literacy development. In doing so, the authors explain the rationale behind using DBT in L2 classrooms, followed by delineating a practical case of systematically implementing DBT in an 8-week intensive English as a Second Language reading course for adult learners.

DBT in Second Language Classrooms: The Rationale

DBT has not yet found its place in the field of second language acquisition (SLA). In fact, the authors were not able to identify a single empirical study using DBT in L2 classroom. Nevertheless, existing literature in SLA as well as literacy studies has witnessed a rising adoption of storytelling pedagogy, video technology, and the combination of both. Literature on storytelling pedagogy, Digital Booktalk®, and DST suggests that DBT could be instrumental in L2 reading instruction and learning.

To start with, DBT relies on a narrative or storytelling approach to promote literacy learning. The story structure facilitates learners' comprehension of events and actions (Haven, 2007). In a story setting, learners are placed in a contextualized environment which aids information comprehension (Bruner, 1990). Moreover, because stories organize information in a pattern that allows for learners' recognition and outcome prediction (Mandel, 1984), they make learning more engaging. Finally, when learners are taught the elements that make up a story or narrative, they are more likely to retain it (Kintsch & Keenan, 1973; Kintsch & Van Dijk, 1978). In short, stories can be utilized in an educational setting since they serve as an effective knowledge-sharing tool and help learners retain knowledge (Gunter, Kenny, & Junkin, 2018).

Furthermore, DBT has been used by researchers in literacy studies to promote reading motivation, among whom Gunter and Kenny have been the leading researchers. Gunter and Kenny (2012) noted that students in the digital age are generally more attracted to multimedia materials and shun traditional paper-based readings.

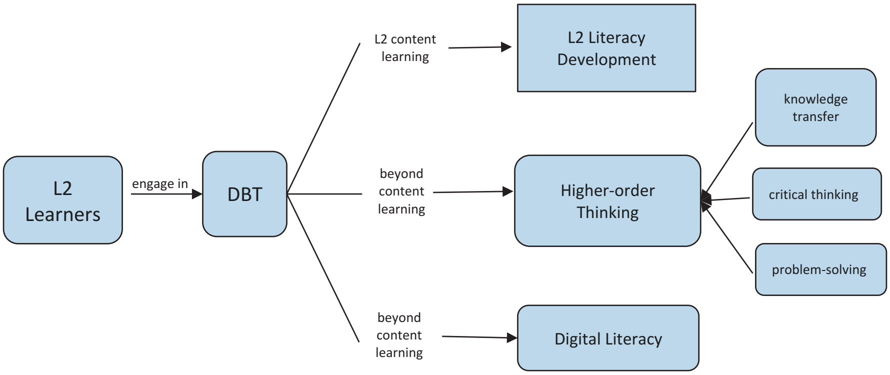

Fig. 5.1 Learning opportunities provided by DBT in L2 classrooms

Based on this observation, their series of field-tested research in K-12 settings (Gunter, 2012; Gunter & Kenny, 2008; Gunter & Kenny, 2012; Gunter & Gunter, 2015; Kenny, 2007; Kenny, 2008; Kenny & Gunter, 2006) has shown that DBT, referred to as Digital Booktalk® in their studies, can be instrumental in shaping learners' awareness of narrative structures and promoting reading motivation (Gunter, 2012). In addition, their research highlighted that DBT could function as an educational tool to transform individuals from passive media consumers to active content producers. As L2 reading classrooms share similarities with general reading classrooms, DBT practice can be equally beneficial for L2 readers.

In SLA literature, even though DBT studies cannot be found, researchers did show that DST can be a helpful tool for L2 learners. Hafner and Miller (2011) used DST with 59 college students enrolled in English for Science and Technology courses. The result indicated that students displayed high degrees of autonomy when participating in a meaningful twenty-first-century task which involves outside an audience. Yang and Wu (2012) utilized DST for 110 tenth-grade ESL students in Taiwan and found that DST participants improved English proficiency, critical thinking, and learning motivation. Castañeda (2013) integrated DST into Spanish language teaching in 12th grade and reported that DST provided students L2 practicing opportunities in writing and speaking and functioned as an authentic task. The study by Liu, Tai, and Liu (2018) showed that DST promoted language learning by enhancing oral reading fluency and extrinsic motivation among sixth-grade ESL students.

Drawing on literature relating to the instructional practices that informed DBT, the authors argue that DBT appears to be a promising tool to enhance L2 reading instruction and learning. In addition to the general benefits of using DBT in language teaching, the authors further propose potential beyond-content learning opportunities enabled by DBT in the following three areas: L2 literacy development, higher-order thinking, and digital literacy development (see Fig. 5.1).

DBT and L2 Literacy Development

Developing literacy skills in an L2 can be a challenging task. L2 readers and writers face a number of barriers posed by vocabulary, grammar, and stylistic and cultural differences (Nassaji, 2011). In addition, L2 literacy skills need to be developed in an integrated manner. Reading input itself does not necessarily translate into language acquisition; to internalize the language input, learners need to be pushed to produce output to improve their language fluency and confidence in L2 use (Swain, 2005). These L2-specific difficulties, adding to the general decline of interest in reading physical texts among the younger generation (Gunter, 2012), project bigger challenges for L2 literacy instruction.

DBT as an instructional technology can address these difficulties in promoting L2 literacy for the following reasons. DBT motivates L2 readers to read and write by setting a specific goal to achieve: producing a digital story. In addition, DBT could serve as an alternative assessment tool to encourage students to articulate their understanding. Finally, DBT could potentially bridge the divide between paper-based instruction and digital device usage. This paper does not focus on the role of DBT in actual L2 literacy development; nevertheless, potential language learning opportunities provided by DBT should be noted.

DBT and Higher-Order Thinking Skills

DBT as a learning activity has the potential to promote L2 students' higher-order thinking (HOT). The project adopted Brookhart's (2010) principles and guidance in understanding and assessing HOT because this specific approach takes into consideration the various HOT taxonomies that emerged over the years (e.g., Airasian, Cruikshank, Mayer, Pintrich, Raths, and Wittrock, 2001; Barahal, 2008; Nitko & Brookhart, 2007) while still considering classroom assessment needs.

Brookhart (2010) identified HOT in three dimensions: HOT as transfer, HOT as critical thinking, and HOT as problem-solving. Transfer means students are engaged in "meaningful learning" and "making sense of what they have learned" (Airasian et al., 2001, p. 63). Critical thinking means "reflexive and reasonable thinking that is focused on what to believe or do" (Ennis, 1985, p. 45). Problem-solving can be broadly defined as actively employing strategies to reach a goal (Brookhart, 2010).

DBT projects extend the conventional L2 reading instruction and increase learners' contact with the content so that learners could engage in more cognitively demanding activities beyond simply remembering and understanding content. L2 reading instructors could potentially promote HOT by guiding students to transfer what they learn from an L2 text, exercise their critical thinking, and solve technical and procedural problems to create digital artifacts.

DBT and Digital Literacy

The European Information Society defined digital literacy as "the awareness, attitude and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyze and synthesize digital resources, construct new knowledge, create media expressions, and communicate with others in the context of specific life situations, in order to enable constructive social action; and to reflect upon this process" (Martin, 2006, p. 135). Similarly, the International Society for Technology in Education (International Society for Technology in Education, 2016) released its standards for students and calls on educators to empower learners to actively utilize technology and become knowledge constructors and creative communicators. DBT projects could answer these calls by providing authentic tasks for students to use digital tools in classroom settings and express their knowledge in a digital format through video creation.

In summary, the rationale for using DBT as an instructional strategy in L2 classrooms lies in its potential to provide L2 learners with promising learning opportunities by engaging them in deep creativity and learning while expressing their most authentic selves. We do not presently know how DBT can be properly implemented in L2 classrooms to maximize learning opportunities. This chapter offers a concrete example of how a DBT project was designed and implemented in an adult ESL reading classroom to address the abovementioned goals.

Implementing DBT in an ESL Reading Class

Project Description

In this DBT project, adult ESL students were asked to create and present a 2- to 3-minute digital book trailer based on an English novel they read during an 8-week ESL reading class in the spring semester of 2018. The DBT project accounted for 20% of the course grade and was a compulsory assignment that students had to complete individually.

Each student went through a process of (1) choosing an English book appropriate for their English proficiency level, (2) reading it while following a recommended reading schedule, (3) submitting checkpoint assignments, (4) attending multiple face-to-face DBT training workshops, (5) composing the DBT, and (6) presenting their DBT to the whole class.

Instructional Context

The course The DBT project was implemented within a reading course titled "English Through Stories" at a university-based English language institute (ELI) in the southeastern United States. This particular ELI offers an English curriculum catering to eight levels of English learners based on their English proficiency. These levels are specified as beginner (Levels 1 and 2), intermediate (Levels 3 and 4), upper intermediate (Levels 5 and 6), and advanced (Levels 7 and 8) in the Common European Framework of Reference for Languages (Council of Europe, 2018). Each level of curriculum lasts for 8 weeks (7 weeks of instruction and 1 week for the final exam), during which students take four core courses (i.e., communication skills, grammar, reading, and writing) and one elective class.

"English Through Stories" is an elective language course designed for students who are at the upper intermediate to advanced English proficiency levels. The class meets for 50 minutes per day, 4 days a week (Mondays to Thursdays) for 8 weeks. The goal of the course is to help students practice and improve reading skills while learning to read for pleasure through fiction. Specifically, the course objectives include (a) familiarizing students with important literary elements and their functions within fiction texts, (b) improving students' ability to infer meaning from unstated material, (c) developing students' ability to apply background knowledge to their interpretations of texts, and (d) improving students' overall enjoyment of reading in general and reading fiction in particular.

The course was determined to be a good fit for implementing DBT because the potential learning opportunities provided by DBT align with the course objectives. An additional advantage of choosing this course to implement DBT is that, due to its status as an elective course, the course structure is flexible enough to allow new projects to be introduced and changes to be made. Most importantly, both DBT and the course "English Through Stories" focus on storytelling as a central element. "Any intervention that utilizes story as its basis needs to include instruction on the elements of story making" (Kenny, 2007, p. 186). The regular instruction of course on basic elements of stories [e.g., time and place, cause and effect, a central character, a teller, and a listener (Branigan, 1992)] lays the foundation for students to grasp the storytelling aspect of DBT.

The instructor Because the DBT project needed to be integrated into the existing curriculum and become a significant part of the course, the authors invited the course instructor to participate actively in the instructional design stage of DBT. For instance, the authors and instructor collaborated closely in terms of making necessary adjustments to the course syllabus and lesson plans, as well as developing DBT project materials (see implementation procedures). The instructor has never included digital video elements in the "English Through Stories" class before but has received teacher training in instructional technology and holds a positive attitude toward the DBT project.

During the 8-week implementation period, the authors served as guest lecturers, volunteers, and observers in the classroom. Outside the classroom, the authors and the instructor held frequent meetings reflecting on and discussing students' progress in completing the DBT project.

The students Seventeen students self-selected to be in this elective course, yet among them only nine students attended the class regularly. The authors and instruc-

Table 5.1 Demographics of the students

Age	First language (*n*)	Gender (*n*)	English level (*n*)
18–25	Arabic (6) Chinese (1) Japanese (1) Turkish (1)	Male (6) Female (3)	Upper intermediate (3) Advanced (6)

tor speculated that the low level of attendance was due to the course's nature as an elective course. Some students may have perceived it as less important when compared with the core courses and therefore had poor attendance.

As a result, the student data the authors were able to collect were from the nine regular class attendees. Table 5.1 presents the demographic information of the nine students including their age, first language, gender, and English proficiency. As can be seen, most students are young adults (ages range from 18 to 25). They speak different first languages, and Arabic speakers accounted for the majority.

In addition, the authors and the instructor made several key assumptions about the students when designing the instructional procedures of the DBT project. These included the following: (a) students may have a mixed level of motivation to attend class, read the assigned book, and complete the necessary steps of the DBT project; (b) students may have a mixed level of familiarity with digital technology; (c) students may have varied L2 reading abilities.

Book Selection

The starting point of the DBT project is storybook selection. Students were given choices as to which novels they would like to read and for which they would create a DBT. Physical copies of books from the *Oxford Bookworms Series*, a collection of American and European literature adapted for English learners and struggling readers, were provided in class for students to preview and choose. The books are in seven accessible levels, from beginner to advanced, and the students were suggested to choose a book depending on their interest and English proficiency levels. Examples of students' book selections include *The Scarlet Letter*, *Treasure Island*, *Great Expectations*, and *Pride and Prejudice*. Students selected the books in Week 3 of the course (see Fig. 5.2).

Implementation Procedures

The authors and the course instructor codesigned the procedures and elements of the DBT project, taking into consideration (a) best practices suggested by prior DBT research, especially the pedagogy of Digital Booktalk® developed by Kenny

Week	Class Time Allotted	DBT Activities	Assignments
3	1 class (50 minutes)	**Introducing digital book trailer Project** (the following information was provided to students: project description, checkpoint assignments, project timeline, reading schedule, book project rubric) **Choose books**	Checkpoint Assignment #1: Audio Reading Journal
4	1 class (50 minutes)	**Workshop #1**: Scriptwriting, Storyboarding, and Video Editing Software WeVideo	Checkpoint Assignment #2: Audio Reading Journal
5	1 class (50 minutes)	**Workshop #2**: Scriptwriting and Storyboarding Editing	Checkpoint Assignment #3: Storyboarding Worksheet
6	1 class (50 minutes)	**Workshop #3**: Video Editing	DBT Projects Due
7	1 class (50 minutes)	**Presenting** completed DBT projects and class voting on projects	

Note: We did not introduce the DBT project until the third week of the semester because students were still being registered into the course during week 1, and week 2 was Spring Break. Also, the DBT project ended in Week 7, as Week 8 is the final exam week at ELI.

Fig. 5.2 Timeline of the DBT implementation

and Gunter (Gunter, 2012; Gunter & Kenny, 2008; Gunter & Kenny, 2012; Gunter & Gunter, 2015; Kenny, 2007; Kenny, 2008; Kenny & Gunter, 2006), (b) the instructional context that the project was to be implemented in, and (c) the goal of exploring the role of DBT in promoting higher-order thinking and digital literacy development. Figure 5.2 presents the timeline of the DBT implementation.

The project design has been informed by Digital Booktalk® and Lambert's (2013) recommended steps of storytelling: (1) students learned the narrative constructs while reading English stories; (2) recall reading experiences; (3) retrieve memorable moments; (4) choose appropriate images and sounds; (5) record narrations; (6) storyboard; and (7) assemble, share, and critique digital stories. From Week 3 to Week 7, a total of five 50-minute face-to-face classes were devoted to the project: one class for introducing the DBT project, three for providing DBT instructions and workshops, and one for DBT presentation and viewing.

To set the students up for success, we also added the following noteworthy aspects to the DBT project design: at the beginning of Week 3, students were provided with a DBT information packet (e.g., project description, timeline, suggested reading schedule, and DBT grading rubric) and the opportunity to view sample DBTs, so that they could develop a clear vision of a pathway to producing their own DBT video as well as an understanding of the benefits of undertaking such a project.

In addition, every Monday, we provided support to students through in-class training and workshops, with weekly checkpoint assignments after class, aiming to monitor students' progress and provide them with formative assessments and feedback. This design allowed students to read, reflect, and create outside the classroom throughout the rest of the week with the information gained in class. The first workshop focused on mapping out each step required to create a DBT from scriptwriting to storyboarding to video editing. The second workshop was a working session in which the authors and the instructor helped students revise and edit drafts of their scripts and storyboards. The third workshop focused just on the video editing. Students were taken to a computer lab where they created their DBTs with on-site assistance from the authors and the course instructor.

Finally, the evaluation of the DBT was based on how well students did in completing (a) the three checkpoint assignments (i.e., audio reading journal, scriptwriting, and storyboarding worksheet) and (b) the actual DBT video. The assignments were worth 20 points, whereas the actual DBT was worth the remaining 80 points. Altogether, the two components of the DBT project added up to 100 points and constituted 20% of the total course grade. This way, our grading system gave students credit for putting effort into the process of creating the DBT, rather than solely relying on their final DBT product. All assessments were done by the course instructor based on a standardized rubric. During the DBT presentation, students could vote for their peers and provide feedback as a viewer but were not allowed to grade each other's work.

Results of Implementation

Throughout the DBT implementation, the authors obtained student assignments and video submissions, observed students' in-class participation, and collected student feedback through informal focus group interviews. The key results regarding students' beyond-content learning are as follows:

Student completion rate Out of the 17 students who registered for the class, 9 students (52.9%) attended classes regularly and completed the training and workshop sessions. However, only five students (29.4%) successfully completed the DBT project on time and presented their DBT videos in class. The other four students indicated that they did not finish the DBT project because they did not finish reading the books.

The low attendance and completion rate was undesirable, especially considering that the authors and the course instructor had already scaffolded the project through in-class workshops and checkpoint assignments as well as constantly encouraged and monitored the students to make progress with the project. Again, the authors and instructor speculated that the course's nature as an elective course might be one of the reasons why some students did not come to class and complete the project. In addition, students could still pass the class without completing the project because the project was only worth 20% of the total grade. The students who did complete the projects seemed to be those who were more motivated and had more familiarity with digital technology. However, more stringent investigation will have to be done before we can propose answers with more certainty. On the positive side, students who did not complete their DBTs on time but attended the DBT presentation session were energized by their peers' productions and expressed willingness to finish their DBT videos.

Evidence of higher-order thinking skills Immediately after the DBT presentation session, an informal focus group interview was conducted with three students (one female from China and two males from Saudi Arabia) who successfully completed the DBT project. The authors interviewed the students to determine whether the DBT project indeed promoted their higher-order thinking (HOT) skills. The students' responses were audio-recorded and transcribed.

According to the data, there was evidence from the focus group interview that students used all three types of HOT (as transfer, as problem-solving, and as critical thinking). Firstly, one student noted that after completing the DBT project, he thought of using WeVideo, the video editing tool, to "produce some dramatic scene, maybe an action movie or something," which shows evidence for HOT as transfer.

Secondly, students also exhibited HOT as problem-solving. Students expressed difficulties in recording the voice-over in a satisfactory manner, especially regarding mispronunciation, lack of emotion in their own speech, and dealing with the mismatch between their voice and the background music chosen. To solve these problems, one student repeated recordings to capture her best pronunciations and intonations. This took up to "3 hours just on recording," and one sentence was "recorded ten times." Producing the best voice-over requires learning how to effectively use multiple recording devices.

Lastly, students shared that they had to exercise HOT as critical thinking. The students had to make decisions about what major plot points to include to achieve the goal of introducing a novel in a 2- to 3-minute video without revealing the ending of the story and convincing the audience to read the book. The task lent itself well to developing a critical thinker. Indeed, students shared that they "have never done a task like this," in which they had to "read, but not only read." Students had to "think very hard and deeply to make the book trailer interesting." Also, one student noted the benefit from watching other students' videos, especially to compare peers' work with their own and thereby learn what they did incorrectly.

Evidence of digital literacy development The authors further analyzed the focus group interview data as well as conducted DBT video analysis (see Table 5.2) on the five student-produced DBTs to determine if students had opportunities to develop digital literacy skills.

It is evident that students used (1) PowerPoint software for storyboarding; (2) search engines and websites to locate royalty-free images and video and audio materials; (3) smartphones or computers to record narration and create original video clips; and (4) iMovie or WeVideo to create and edit the DBT. These digital

Table 5.2 Evidence of digital literacy in student-created DBT videos (n = 5)

Student	Recording narration	Using pictures	Using sound effects	Using visual effects	Integrating readily available video clips	Shooting original video clips	Giving credits
A	x	x	x	x	x	x	x
B	x	x	x		x		
C	x	x	x	x	x	x	
D	x	x	x	x	x		
E	x	x			x	x	

literacy skills, according to the interview data, were developed through participating in the DBT project. One student recalled that "at the beginning, I was afraid of making videos. But when I started working on the project, and after that final workshop, my confidence was stronger."

In summary, the results illustrated above shed light on the learning opportunities afforded by applying DBT to an L2 classroom with adult English learners. Even though the completion rate of our DBT project was low, the students who successfully participated in all components of the DBT project harvested both language-related content learning and beyond-content learning. Specifically, in 5 weeks, the successful students were able to (a) finish reading an English novel appropriate to their English proficiency level; (b) engage in unfamiliar tasks such as recording an audio reading journal, scriptwriting, storyboarding, and video editing; (c) improve digital literacy skills; (d) use higher-order thinking skills to internalize their reading; (e) independently produce a 2- to 3-minute DBT; and (f) share their work in a formal academic setting.

The DBT project offered students a learning experience which can rarely be found in a regular language classroom. More importantly, students who learned how to successfully produce a DBT once in our class are likely able, should they choose to do so, to extend such acquired learning to other video storytelling projects for future personal and academic purposes.

Conclusion

The purpose of this paper is to demonstrate how DBT can be applied to L2 classrooms to promote higher-order thinking and digital literacy skills in an L2, in addition to the conventional objective of L2 literacy development.

The paper offers a detailed rationale regarding the educational opportunities provided by DBT in L2 classrooms. The paper also provides pedagogical insights by delineating a practical case of systematic DBT implementation in an 8-week intensive L2 reading course for adult learners. The findings suggest that there was evidence that DBT in an L2 reading course could provide opportunities to practice higher-order thinking skills and foster digital literacy. Our results corroborated with

Ng's (2012) findings that digital natives can be taught how to use new technologies to create meaningful artifacts.

This study is not without limitations. Due to the nature of the course and the research setting, we were not able to select the most representative group of ESL students. Furthermore, the 8-week course setup placed a limited time frame for DBT project implementation. Even though the design of the DBT project provided ongoing support and necessary training and monitoring to encourage students to finish their DBT video, only 5 out of 17 students were able to complete on time, thereby further limiting our data analysis. Future studies could examine a different student population or operate with a longer time frame (e.g., 12 weeks or 16 weeks) to see if students will perform differently. Obviously greater participation among students within the program is also paramount for valid and reliable information to be obtained.

As one West African "griot" (troubadour-historian) related to a western scholar, "stories are more than entertainment; they are vehicles for learning" (Thornburg, 2013, VII). The digital age requires more practices and research that harness the potential digital book trailers can provide. The authors believe in the potential of learning associated with conducting DBT in L2 classrooms, so learners can process information and build skills in an L2 for future challenges.

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Chapter 6
Promoting Acquisition and Generalization of Skills for Individuals Severely Impacted by Autism Using Immersive Technologies

Matthew Schmidt, Noah Glaser, Carla Schmidt, Dennis Beck, Heath Palmer, and Mark Lim

Introduction

This chapter presents the theoretical and conceptual grounding for a suite of prototype immersive technology supports designed for individuals with autism spectrum disorder (ASD) who are transitioning from secondary education into adulthood. Entitled Virtuoso (a play on the words "virtual" and "social"), this project is an immersive technology-based intervention for individuals with ASD who are enrolled in the *Impact Innovation* adult day program at the University of Cincinnati (UC). Individuals in the *Impact Innovation* program have the designation of "associates." The general focus of Virtuoso is to promote the acquisition and generalization of adaptive skills in safe, completely controllable virtual reality environments. In its current form, Virtuoso provides virtual training on the use of public transportation. This suite of immersive technology prototypes includes a three-dimensional collaborative virtual learning environment (3D CVLE) designed to support the acquisition and generalization of adaptive skills related to use of the UC shuttle system.

M. Schmidt (✉) · C. Schmidt
University of Florida, Gainesville, FL, USA
e-mail: matthew.schmidt@coe.ufl.edu

N. Glaser · H. Palmer · M. Lim
University of Cincinnati, Cincinnati, OH, USA

D. Beck
University of Arkansas, Fayetteville, AR, USA

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Impact Innovation *Program*

Impact Innovation is an adult day program for individuals with significant communication and behavioral challenges associated with ASD. Over 20 adults participate in *Impact Innovation* year-round. Participants follow a uniquely designed daily schedule with the assistance of a peer mentor. Participants take part in a variety of vocational internships in a number of domains as part of an employment exploration process. Healthy lifestyles are encouraged through a variety of activities, including exposure to the Health Matters curriculum (Marks, Sisirak, Heller, & Wagner, 2010), as well as several adaptive skills, including daily life skills training, hygiene interventions, and time at the UC recreation center. Finally, as a means to foster a high quality of life, the *Impact Innovation* program encourages lifelong learning based on participant's individual interests. In alignment with the theme of this edited volume, "Beyond Content," the adaptive skills taught in the *Impact Innovation* program extend beyond content delivery, retention, and recall; they involve real-life skills such as personal hygiene, putting on clothing, circumventing risk, handling food safely, complying with work and school regulations, money management, housework, and learning to make friends, as well as more complex behaviors that include navigating a workplace, practicing social skills, and taking personal responsibility. These skills are indispensable to effectively navigate through the demands of everyday life. One part of the *Impact Innovation* program is Virtuoso, a suite of immersive learning technologies that focus on learning to use public transportation, an activity that involves a synthesis of several subordinate tasks that can be used in many different situations and combinations.

Virtuoso: The Technology Arm of Impact Innovation

Virtuoso is a subset of the *Impact Innovation* program at the University of Cincinnati. Virtuoso serves the *Impact Innovation* program by providing technological interventions and training for *Impact* associates. It is a suite of prototype immersive technology supports designed for adults with ASD who are transitioning from secondary education into adulthood. The focus of this chapter is the public transportation training module that combines curriculum, technology, and applied behavior analysis techniques to promote the overarching goal of helping *Impact* associates become more independent users of public transportation. Virtuoso's overarching learning objective is for learners to be able to use the UC shuttle. The adaptive skills learned in the public transportation training involve four discrete tasks: (1) plotting a map to a shuttle stop, (2) navigating to a shuttle stop, (3) using the UC campus shuttle app to find the correct shuttle, and (4) getting onto the correct shuttle. *Impact* associates complete four stages of curriculum to complete the public transportation training prototype. The first two stages focus on acquisition of the skill and the second two stages on generalization of the skill. First, associates review a social narrative presented on an iPad. Second, associates engage in computer-based video instruction using an Android-based spherical video-based virtual reality (SVVR) app. SVVR uses omnidirectional cameras or a collection of cameras to create a 360-degree video-based environment in which the user is positioned in the center. SVVR utilizes interactive videos in which the user can dynamically change the view in any direction by moving their head. Some SVVR environments incorporate interactivity such as hotspots and branching scenarios. Third, associates practice the skill in a multiuser 3D CVLE. Fourth and finally, associates perform the skill in the real world. Each stage of the curriculum can be repeated as many times as needed. This provides a way to learn about and virtually practice using the public transportation that is safe and predictable. In the following sections, a detailed description of how associates engage in the four discrete tasks within the Virtuoso 3D CVLE is provided.

Background and Context

ASD affects 1 in 68 people in the United States (Centers for Disease Control, 2014). Individuals with ASD require supports because they struggle in varying degrees with a triad of impairments commonly associated with the disorder (Wing, 1988). These impairments typically manifest across (1) social, (2) communicative, and (3) behavioral domains (American Psychiatric Association, 2013). Challenges across these domains lead to deficits in adaptive skills, that is, practical, everyday skills needed to function and meet the demands of one's environment, including the skills necessary to effectively and independently take care of oneself and to interact with other people. Hence, individuals with ASD can benefit from adaptive skill supports during their transition from secondary education to adulthood. Before transitioning and while enrolled in the US public education system, they typically receive multiple supports. The individualized education program (IEP) plays a central role in preparing for the transition from secondary education to adulthood. At the age of 16, the IEP process is required to include services to help plan for this transition (Individuals with Disabilities Education Improvement Act, 2004). However, the legal entitlements mandated by the IEP end at the age of 21. This absence can lead to significant obstacles for young adults related to employment (Wei, Wagner, Hudson, Yu, & Shattuck, 2015). The majority of these individuals are unemployed or underemployed after completing their secondary education (Taylor & Seltzer, 2011). To promote more positive outcomes, continued supports are needed (Friedman, Warfield, & Parish, 2013).

Three-Dimensional Virtual Learning Environments for Individuals with ASD

Information and communications technologies (ICT) have the potential to address some of the challenges associated with providing continuing supports after completing postsecondary education. ICT for individuals with ASD is an area that has received substantial interest in literature (Goodwin, 2008; Odom et al., 2015), demonstrating strong potential as an intervention modality for treating the impairments associated with ASD (Grynszpan, Weiss, Perez-Diaz, & Gal, 2014). Using information and communications technologies as a means to provide continuing supports for individuals transitioning into adult life potentially could address some of the challenges associated with providing continuing supports after completing postsecondary education. There is no question that ICT has had a profound impact across all areas of modern life. It is therefore not surprising that using ICT for providing interventions for individuals with ASD is an area that has received substantial interest from both researchers and practitioners (Goodwin, 2008; Odom et al., 2015). ICT has demonstrated strong potential as an intervention modality for treating the impairments associated with ASD (Grynszpan et al., 2014). Further, the use of ICT-based interventions is supported by a wealth of evidence-based research across a variety of domains, including learning, behavior modification, etc. (Parsons, 2016; Knight, McKissick, & Saunders, 2013). Computers in general and ICT specifically are considered to hold particular promise for individuals with ASD due to these individuals' affinity to the systematic and predictable nature of computers, as well as computers' ability to provide individualized positive reinforcement (Constantin, Johnson, Smith, Lengyel, & Brosnan, 2017). Virtuoso utilizes a variety of technologies to provide continued supports for transitioning adults with ASD, including a multiuser 3D CVLE.

Three-dimensional virtual learning environments (3D VLE) are a family of immersive technologies that include virtual reality, video games, and virtual worlds. 3D VLE can be manipulated at a deep level, thus providing researchers with a high level of experimental control (Strickland, 1997). Likewise, they can provide realistic contexts within which skills can be practiced safely and without physical danger (Strickland, 1997; Standen & Brown, 2005) and promote new insights into collaborative learning using computational methods such as data mining (Schmidt & Laffey, 2012). The majority of 3D VLE interventions have focused on single-user applications (Rutten et al., 2003; Trepagnier, Olsen, Boteler, & Bell, 2011). However, researchers slowly have begun to incorporate multiuser, collaborative activities into their interventions (e.g., Jarrold et al., 2013; Lorenzo, Pomares, & Lledó, 2013; Moore, Cheng, McGrath, & Powell, 2005). 3D CVLE technologies may convey concepts, meanings, and a symbolic measure of representing real-world activities through photographic realism as well as embodiment as avatars that promote socio-communicative activity (Wang, Laffey, Xing, Ma, & Stichter, 2016; Wallace, Parsons, & Bailey, 2017). The ability to control input stimuli, visual fidelity, and interactivity within 3D CVLE systems at a remarkably refined level allows designers and researchers to create interventions that are uniquely attuned to the particular needs of learners with ASD.

Technology Interventions for Using Public Transportation

Transportation is central to promoting the goals of the *Impact Innovation* program. Transportation is provided to *Impact* program associates via the UC shuttle system. Shuttle training is included in *Impact Innovation's* training repertoire because the ability to use public transportation such as the UC shuttle bus can increase independence through access to employment, medical care, community, etc. However, transportation is among the most cited barriers across a variety of settings for individuals with disabilities (Allen & Mor, 1997; Carmien et al., 2005). Davies and his colleagues (2010) maintain:

> Public transit systems (e.g., fixed route public buses) provide the most commonly used or available transportation option and provide, probably, the best option for those living in urban areas for independent, timely, integrated, inexpensive, and relatively unrestricted mobility for people with intellectual and developmental disabilities. However, transit buses also present a unique set of barriers due to route complexity, transfer requirements, unfamiliar destinations, schedule complexity, and other cognitively loaded requirements needed for successful transit system navigation. (p. 455)

An example of a public transportation intervention using immersive technology for adolescents with ASD is provided in Parsons, Leonard, and Mitchell's (2006) description of a technology-based training that focused on social skills specifically targeting the skill of finding a place to sit in two contexts: a virtual cafe and a virtual bus. The virtual cafe context utilized a 3D VLE for delivery of the intervention, and the bus context utilized computer-based video instruction. Two participants underwent the training, during which the level of complexity was increased after each successful completion of the corresponding training scenario. Researchers found some evidence of skills generalization in terms of participants self-reporting potential ability to relate the training to situations in the real world. These researchers suggest that generalization of skills learned in a virtual world is an area for future research.

Use Case Example: Virtuoso 3D CVLE

Participants with ASD engage in the 3D CVLE portion of Virtuoso by logging into the High-Fidelity virtual reality toolkit to connect to a privately hosted domain. Learners use avatars as representations of themselves to interact with others and the environment and speak using microphone-equipped headsets. High fidelity is an open-source, multiuser application for constructing and implementing immersive environments. These environments are both social and interactive, meaning they

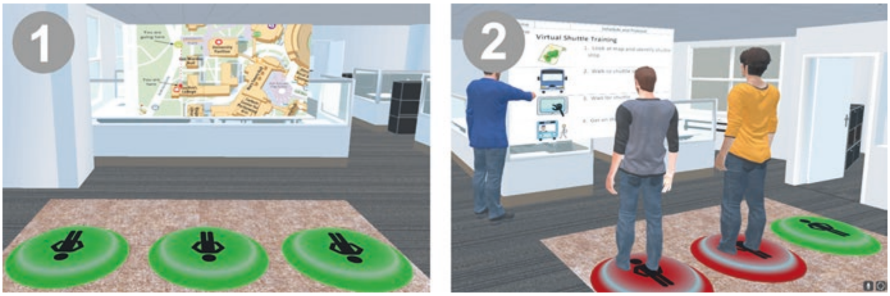

Fig. 6.1 View of 3D CVLE personal pods providing a visual cue indicating where to stand while receiving instruction (1); pods turning red when occupied provide a visual cue to stop avatar movement (2)

allow for real-time creation, reorganization, and alteration of 3D assets (https://highfidelity.com/).

Activities involving the four discrete tasks in the public transportation training are led by an online guide (similar to a coach). The virtual space is structured to allow the practice of the skills needed to catch a ride on the UC shuttle. Learners explore and complete their training tasks within a virtual replica of the University of Cincinnati.

As a fictional use case of how a user might experience this intervention, we present Jonah, an *Impact Innovation* associate, who has returned to the *Impact Innovation* office, where his staff member, Shana, reminds him that he will be using Virtuoso for shuttle training. Jonah has used the 3D CVLE in the past and is familiar how to use it. As Jonah dons a head-mounted display (HMD), his display is mirrored onto a desktop computer so Shana is able to observe his progress. She sees that Jonah is now standing inside of the *Impact* office and that there is another avatar standing in the office with him. That avatar is an online guide that is being controlled by a real person: Carla. Carla introduces herself and directs Jonah's attention to a series of personal pods positioned on the floor in the office suite. Jonah is instructed to go stand on one and to look at the nearby image of their daily schedule. He moves his avatar onto a personal pod, which changes color to red after he enters it. Carla asks Jonah to read the schedule and state what today's task will be (Fig. 6.1).

Jonah reads the schedule, and Carla provides specific positive praise: "Great job, Jonah. I really like how you were able to correctly identify your next task." She then directs Jonah to look at the campus map (Fig. 6.2).

Jonah turns his avatar to view the map, where he sees a path from the *Impact* office to the shuttle stop indicated with a red dotted line. Carla asks Jonah if he can tell her where they will be walking to catch the shuttle bus today and what cues from the map might help him answer the question. Jonah audibly references the dotted lines and the bus stop that is highlighted on the map. Carla confirms that what Jonah has said is correct and provides specific positive praise. Carla then prompts Jonah to exit the *Impact* office suite. Jonah walks through a door and arrives on the UC

Fig. 6.2 View of an online guide gesturing to the map in the virtual *Impact* office; two associates stand on their personal pods as they receive instruction

campus. Carla joins him on campus and asks if he needs a break. Jonah does not, so they continue through the tasks. Personal pods are situated throughout the environment to serve as visual reminders of where Jonah should stand to receive verbal instruction from Carla. Navigational components such as dotted lines and signs are present to act as scaffolding that can be faded as Jonah becomes more familiar with the intervention (Fig. 6.3).

Carla and Jonah walk to the shuttle stop. Jonah follows the path, using signs as cues of where to go. Once at the shuttle stop, they review the shuttle schedule using a shared virtual display and then wait on a bench until the shuttle arrives. Carla asks Jonah to confirm if it is the correct bus. Jonah confirms and Carla provides specific positive praise. She then prompts Jonah to board the shuttle. As Jonah and Carla board the shuttle, they are greeted with a digital achievement that expresses congratulations for completing the session (Fig. 6.4).

Fig. 6.3 Navigational tools used throughout the 3D CVLE including personal pods and navigation aids such as clearly demarcated pathways and signage

Fig. 6.4 Jonah boards the shuttle (1) and is then presented with a digital achievement (2)

Design Considerations: Applying Heuristics for Generalization

Technology-mediated interventions can influence participants' acquisition of adaptive skills and behaviors, but generalization of skills to novel contexts presents a challenge. Stokes and Osnes (2016) define generalization as observable changes in behavior in settings different from the training environment and "across stimuli, responses, and time" (p. 721). Stokes and Baer (1977) identified nine techniques designed to promote generalization, which were later categorized into three broad principles (Stokes & Osnes, 2016), including taking advantage of natural communities of reinforcement, training diversely, and incorporating functional mediators. This section considers how those heuristics are embodied across Virtuoso's UC shuttle system training prototype.

Take Advantage of Natural Communities of Reinforcement The first principle, taking advantage of natural communities of reinforcement, refers to using elements of the natural environment that already function to maintain the target behavior (Stokes & Baer, 1977). Natural communities of reinforcement are aspects of the natural environment that serve to increase or decrease behavior. In order for someone to benefit from the reinforcing aspects of the natural environment, teaching of a skill or behavior is needed. In the public transportation training prototype, Virtuoso

Fig. 6.5 Impact associates learn to use the UC shuttle app in a shared web browser (1) and to navigate to the shuttle stop using a UC map (2)

teaches the skill by first introducing it using a social narrative and then representing those skills through video modeling. It is also the case that sometimes participants are not aware of how fully to take advantage of the reinforcing aspects of a naturally occurring situation. For example, an *Impact* associate might not be aware of how to find a shuttle stop or how to check the shuttle schedule. To account for this problem, Virtuoso teaches associates to use the UC map to find a bus stop and to check the UC shuttle app as part of their training (Fig. 6.5).

Train Diversely The second principle, train diversely, refers to maintaining the minimal level of training control possible while still producing behavior change (Stokes & Osnes, 2016). If training is too controlled and focused, then effects are likewise very focused. Hence, the likelihood of generalization is diminished for skills and behaviors that are learned this way. Correspondingly, the focus and outcomes of training should be broader, and training should be more diverse. Training diversely means that a variety of different training conditions such as setting, trainer, etc. should be used. Virtuoso provides diversity across settings by intentionally varying locations and methods of representation. For example, training takes place in the *Impact* offices, on the UC campus, at the shuttle stop, etc. and is represented across a continuum of technologies. Further, using multiple exemplars of skills in teaching, modeling, practice, and exerting looser control over the situations that are intended to elicit target behaviors can promote generalization. Virtuoso employs a variety of exemplars to provide diversity and presents these exemplars across a variety of contexts. For example, when engaging in structured practice in the 3D CVLE, the tasks are practiced with a variety of people and across different contexts, causing them to become less uniform and therefore less predictable. Varying the circumstances of the training scenario makes the situations less predictable.

Incorporate Functional Mediators The third principle, incorporate functional mediators, refers to taking advantage of relevant discriminative stimuli in the training environment that can be transferred to other environments to promote generalizations (Stokes & Osnes, 1986, 2016). The technologies employed in Virtuoso are examples of a functional mediator. That is, the previously described four-tiered scaffolding strategy of first completing a social narrative, then reviewing video models, then practicing in the 3D CVLE, and finally practicing in the real world serves to mediate the generalization of skills from the training context to the real world. To this end, Virtuoso parallel constructs salient physical, social, and self-mediated physical stimuli found in the real world across all technology scaffolds. According to Stokes and Osnes (2016), salient physical stimuli "may be a physical object that is present in both the training and the generalization setting, or at least very similar items are present in both settings" (p. 727). Salient social stimuli can be "the characteristics of a person, such as a certain gesture, or the presence of the person" (p. 728). Salient self-mediated physical stimuli might be "the use of a notebook that specifies how to perform in a certain setting" (p. 728). Virtuoso embodies these principles across technology scaffolds. For example, social narratives employ real-world photographs of *Impact* staff members, physical settings, and job aids (e.g., annotated maps, schedules). In the 3D CVLE, the *Impact* offices and the UC campus have been modeled after their real-world counterparts with a high degree of photographic fidelity and also provide the same stimuli as provided in other scaffolds. As an embodiment of Stokes and Baer's (1977) heuristics to promote generalization, Virtuoso's public transportation training prototype seeks to promote the acquisition and generalization of associated skills.

Discussion and Conclusion

The purpose of this paper was to describe the theoretical and conceptual influences and supports for Virtuoso, an immersive 3D learning intervention for young adults with ASD that adopts a multidimensional approach for acquiring adaptive skills in a safe environment that can be manipulated so as to reduce input stimuli and adapt to learner needs. A description of ASD and its impact on individuals' ability to transition from a secondary education environment to adulthood was provided, with an emphasis on the skills necessary to do so. Scholarly backgrounds on the use of ICTs as interventions for this population, the *Impact Innovation* program, and the target skill area for Virtuoso were all provided. Finally, heuristics that provide insight into how to promote skills generalizations and how specific skills generalization heuristics map onto the topography of Virtuoso were considered

While the current state of Virtuoso and its implementation is clear, its future is not. How will Virtuoso leverage the promise of immersive technologies for data mining and customization against the very real problems of user-generated environments and privacy? Immersive environments are challenging to implement in practice due to expense and skill required for customization, their inability to scale to multiple geographic locations, and their impacts on privacy issues. Unfortunately, immersive environments are not customizable without spending much money and effort. Privacy and control over personal data is another increasing concern for all technology users (World Economic Forum, 2017). Current features of immersive environments enable data to be collected from eye movements, facial expressions, and haptic data, as well as from more traditional means of data mining (i.e., automated collection of trace data). Drawing from this, we posit that the personal data at risk in immersive environments is even more invasive and personal than the data that is currently available on the Internet, making concerns about user privacy a far more serious issue. Forty-seven percent of people in six nations have stopped or avoided using a technology-based service because of inadequate user controls over personal data (World Economic Forum, 2017). This statistic is of concern because it may mean that individuals with ASD and their caregivers could be pushed from the long-term adoption of immersive technologies due to these privacy issues. This result would be unfortunate due to the incredible potential of these technologies to increase quality of life for individuals with ASD. For Virtuoso, this trend highlights a need for continuous and rigorous attention to Institutional Review Board criteria and a commitment to store data in secure, offline locations. It also means that *Impact Innovations* program at UC, as well as other future programs that Virtuoso partners with, maintains similar, highly secure data storage facilities.

Another concern regarding the future of Virtuoso is the issue of generalization or the ability to transfer learning from the immersive environment to the physical world. Much already has been said about how Virtuoso was designed through the application of design heuristics for generalization (Stokes & Osnes, 2016), with a focus on taking advantage of natural communities of reinforcement, training diversely, and incorporating functional mediators. While we have designed Virtuoso to promote generalization, the following modifications represent our immediate future plans to enhance our application of design heuristics related to diverse training and the use of functional mediators.

Training diversely refers to maintaining the minimal level of training control possible while still producing behavior change (Stokes & Osnes, 2016). One way to enhance this design heuristic in the future would be to allow for users to have more control over their decision-making. Currently, the online guide mediates all decision-making related to adhering to the schedule and completing associated tasks. These decision-making tasks could be incorporated into the Virtuoso software such that action might pause and participants be presented with a set of decisions. For example, participants might be asked what they should do next and then select from a constrained list of possibilities (e.g., "check app," "go back to the office"). The scene could then branch to demonstrate the outcome of that decision, positive or negative. For instance, if participants choose to go back to the office, they might encounter a frustrated director who instructs them to refer back to their schedule and get back to the shuttle stop. If participants choose to check the app, they might receive reinforcement, such as a point or a star.

Incorporating functional mediators involves taking advantage of relevant discriminative stimuli in the training environment that can be transferred to other environments so as to promote generalization (Stokes & Osnes, 1986, 2016). Future iterations of Virtuoso might integrate what is known as a “shamanic” interface that uses cultural gestural metaphors and semantics for augmented reality interaction (Morgado et al., 2015). This method would leverage the rich range of meanings and interpretations associated with cultural gestures, traditions, folklore, and rituals and use them in the immersive environment. This would allow participants opportunities to explore, understand, and communicate complex, systemic ideas and concepts in contexts that are culturally familiar to them. A shamanic interface that incorporates cultural semantics could amplify the relevance of stimuli for participants and thereby could act as a means to better promote generalization. At an immediate level, this approach holds the potential for enabling increased awareness of what is at stake in designing appropriate interventions for individuals with ASD and consequently sheds light on the challenge of enhancing understanding and improving participation in public life and citizenship. This idea also raises questions of human-computer interaction (HCI), particularly related to the wide range meanings and modes of expression which exist in various cultures and societies that can be utilized in a user interface (as opposed to ignoring them and imposing reductivist or prescribed command methods).

The work of *Virtuoso* is highly relevant to other related fields interested in the generalization of adaptive skills and behaviors with adult populations. SVVR technologies have not received substantial attention in research literature, although they are low cost and relatively easy to use and develop training content for. Also, the methods and processes used in the *Virtuoso* project could be helpful to others interested in designing training content for generalization. Finally, other disability areas could benefit from similar interventions, particularly those areas in which executive functioning deficits are a concern (e.g., Down syndrome, traumatic brain injury, cognitive impairment, etc.). As our approach matures, we have also begun to focus on the social validity of our approach. For example, we are considering ways to bring the methods, processes, technologies, and training content developed by Virtuoso to practitioners in a way that is accessible, relevant, and easy to use. This approach could lead to effective immersive interventions that are widely available, thereby approaching the longstanding issue of virtual reality holding great promise for individuals with ASD, but not yet meeting that promise (Parsons, 2016).

As stated previously, while the current state of Virtuoso and its immediate future are clear, longer-term directions remain ephemeral. How can Virtuoso best leverage the promise of immersive technologies for individuals with ASD so as to enhance current design heuristics and optimize learning generalization? How can Virtuoso provide an accessible, relevant, and easy-to-use end product, so that practitioners can easily create similar training content? These questions guide our ongoing inquiry, which continues in the hopes of better support, inclusion, and participation of adults with ASD in everyday life.

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Chapter 7
The Design Discourse of the Advanced Beginner

Katherine L. Bevins and Craig D. Howard

Purpose

The purpose of this chapter is to examine the design discourse of students in a studio setting. We do this to better understand the design learning process as it was experienced by a certain set of early instructional designers. We studied a group of learners involved in a studio course created to design a language learning game as a vehicle for teaching diverse subjects (Howard, Staples, Dubreil, & Yamagata-Lynch, 2016). The pedagogical intervention was very hands-on and provided a unique venue to analyze the discourse of design in its moment of application. Learners had moved past the stage of learning where the content is the focus (French language) to one where they grappled with how that content could be taught via the game. With this opportunity, we sought to find the many forms of knowledge that comprise designerly ways of knowing (Cross, 1982) that emerge in these learners' complex interactions. Other scholars have found that knowledge is complex (Jonassen, 2000; Cross, 2011; Boling & Gray, 2018). Boling and Gray (2018) found that "design learning is a complex performance involving multiple forms of knowledge" (Boling & Gray, 2018, p. 262). We set out to find those authentic performances as they emerged in the discourse surrounding the designing of the game.

Identifying the discursive elements of these early designers could lend insight into what forms of design knowledge the advanced beginner (Dorst, 2015) actually employs in their language in use. We sought to capture the discursive behaviors that embody design knowledge. Gibbons and Rogers (2008) identify the discourse of design as design languages. Design languages are "centered in tools, processes, technologies, theories, or best practices of a domain" (Gibbons & Rogers, 2008, p. 23). Dorst (2015) explains that the advanced beginner level of design expertise is

K. L. Bevins (✉) · C. D. Howard
The University of Tennessee, Knoxville, TN, USA
e-mail: knelso13@utk.edu

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the level where a designer begins to acquire a language of design. We read these languages of design as *design discourses* because they carry the markers, as identified by scholars of language, of *discourses* (Gee, 2011; Krippendorff, 2006). Discourse goes beyond the exchange of simple information and instead creates meanings, identities, and group cohesion (Gee, 2011). Discourses are naturally formed in all groups and are comprised of routines that go beyond grammar and syntax and instead are marked by specific meanings of lexical items, shared understandings, identities, and even gestures used to negotiate meaning within the group (Gee, 2011).

Design discourse has been studied previously in multiple contexts, including *designerly talk*, which is the externalization of design expertise, design ability, and designerly ways of knowing in informal, non-design settings (Gray & Howard, 2014). The term *designerly talk* was originally used to describe the discussions about design in a community of practice of learners. However, the term *designerly talk* could be interpreted as happening in two different ways: critical talk about design in a non-designing context, i.e., on a social network site such as in the Gray and Howard (2014) study, and as design discourse, the enactment of design identity through talk, that we examine here. This second type of *designerly talk* might be found in any context where one uses discourse to create identity or negotiate a specific type of meaning unique to the communities of practice surrounding design. Gray and Howard (2014) framed their *designerly talk* as a community of practice of learners situated in a nonacademic context, i.e., Facebook. However, we searched for discourse that suggested an entry into that community of practice in learners' interactions in a design studio.

Theoretical Framework

We framed this study around the design studio as a signature pedagogy (Schön, 1985; Shulman, 2005). The studio implementation varies among design's different disciplines (Cennamo, 2016). This study is meant to expose more precisely the studio experience for early designers learning instructional design. We assume here that the studio experience of instructional design learning is different from the experience of studio in other disciplines and recognize that instructional design may not typically be taught in this manner, though there is a growing advocacy for the approach (Tracey, 2016). Signature pedagogies, such as the studio, include linguistic routines, and understanding the routines helps one understand the pedagogy itself. By recognizing the linguistic routines that comprise the learning that takes place in a design studio context, we can better understand the pedagogy (Dannels & Martin, 2008). We asked the following two research questions to support that purpose:

RQ1: How are designerly ways of knowing evidenced in the design discourse of these multidisciplinary students?

RQ2: How do the linguistic routines of design discourse emerge in these multidisciplinary design studio sessions?

Methods

We studied learner interlanguage (Kasper & Blum-Kulka, 1993) in design via a discourse analysis of their interactions during their process of designing a mobile application for learning French. Interlanguage is a borrowed term to denote a location in a learning trajectory between an inability to express and competence in expressions that identify a member of a sociolinguistic group. Discourse analysis assumes that linguistic routines have meaning because they are purposive enactments of identity and meaning negotiation (Dunn & Neumann, 2016).

Data was captured from an instructional experience in a design program at a large university in the southeastern United States. In the fall of 2014, a professor in this design program worked with the French department, to start a project to develop a language game app that would support first-year French students from several different majors to learn French in an engaging way (Howard et al., 2016). This project consisted of third- and fourth-year undergraduate multidisciplinary students participating in design studio sessions, during which they worked on designing the app. This project is still ongoing. Students rotate in and out of working on developing this instructional product. We chose to study the design discourse present in these studio sessions because of the opportunity their discussions offered for investigating how design knowledge emerges in learning.

We recorded sessions that took place during the fall semester of 2017. During this time, the learners were in teams and were working on the pre-beta expansion of the first version of the game. There were four students (three males and one female) and one instructor (female) working on this project in our recordings. We captured five sessions using audio recordings at select intervals across a single semester to create snapshots in time of their design discourse. One of the authors attended five meetings, approximately every third week during the semester, and recorded at least 1 hour of each of those sessions. An IRB protocol was completed through the university, and written informed consents from the participants were collected.

Data Sources

The data used in this study were transcriptions of audio recordings from those five sessions that one of the authors attended. The audio recordings were transcribed into an Excel worksheet, and utterances that we could not attribute to a specific individual speaker were eliminated from the dataset. Each turn was loaded into its own Excel cell. The corpus of interactions included approximately 500 turns with an average of 96.6 turns per session.

Table 7.1 The iteratively developed codebook created from design literature and applied to turns that expressed design discourse, ranked in order of frequency appearing in the dataset, from one, most often to nine, most rare

Frequency ranking	Design discourse	References
1	Tools	Clark (1994); Kozma (1994); Gustafson and Branch (1997); Van Merriënboer and Martens (2002)
2	Design tensions	Schön (1987); Tatar (2007)
3	User experience	Norman (2013)
4	Problem framing	Schön (1987), Lawson and Dorst (2009); Norman (2013); Dorst (2015)
5	External representations	Schön (1983); Cross (2011)
6	Problem-solving	Cross (1982); Lawson and Dorst (2009)
7	Aesthetics	Parrish (2009); Norman (2013)
8	Precedent	Schön (1983); Oxman (1994); Lawson (2004); Boling (2010)
9	Usability	Cross (1982); Norman (2013)

A review of the literature on design expertise and design learning (see Table 7.1) was used to create the codebook of content we searched for in the transcripts. We searched for types of designerly ways of knowing that manifest in discussions that took place during the process of design. After we collaboratively developed a codebook (Table 7.1) for content analysis, we applied it to a subset of the data. The development process took several iterations before the codebook was finalized. The codebook thus came from both our understandings of the literature and instances of designerly ways of knowing that manifest in the discourse of the students. Designerly ways of knowing (Cross, 1982; Dorst, 2015; Lawson & Dorst, 2009) that were suggested in the readings, but did not appear in the corpus of interactions, were not included in our codebook (design failures).

Analytical Procedures

We coded turns that expressed design discourse according to our codebook, creating a content analysis of design discourse for the studio sessions. The number of turns and words per turn were also examined in relation to the coding system. Discourse analysis offers an understanding of the ways people make meaning within the linguistic routines, and we use it here to better understand the design studio (Dannels & Martin, 2008). This is opposed to conversation analysis, which attempts to determine the practices that create orderliness of interactions (Sidnell, 2010) or discourse analyses of other types, i.e., structural, speech act, and pragmatic, which seek to understand how discourse is packaged or strategized. While not every type of design discourse suggested by the literature appeared in the discourse of the learners, we calculated simple descriptive statistics of what designerly talk was present. We focused on percentages of turns devoted to certain types of content in order to understand the linguistic behaviors of students and the instructor and to discover any recurring patterns or sequences of content that might inform this pedagogy. Iterative coding resulted in nine areas (see Table 7.1) where designerly talk emerged in the studio interactions among designers and among designers and a design instructor.

We first applied a structural analysis to orient ourselves to the dataset. To determine the composition of design discourse, we then calculated percentages of turns that contained design discourse for each individual. We then calculated the frequencies of the different types of design discourse and calculated the numbers of turns and words devoted to each. We broke these calculations down to the individual level to determine if any area was dominated by any individual. To determine how these areas emerged, we selected the two most frequent types of design discourse and calculated what turn type immediately preceded those turns.

Results and Discussion

Our structural analysis orients a reader to the nature of the discussion being analyzed. Scholars of discourse analysis advocate for an initial structural analysis as baseline measures because they accommodate a broad understanding of the discourse being studied and facilitate comparisons among discourse from other contexts and how different groups make meaning in different ways (Gee, 2011; Herring, 2007). For example, pedagogical discussions tend to have short turns except for one interlocutor who has more turns with more words of longer length than everybody else (the teacher), while discourse at a party is more balanced, with each interlocutor taking the floor for narratives. Spoken turns are generally shorter than the written turns one might find in discursive online spaces (Howard, 2012). Pedagogical threaded discussions tend to be comprised of messages of 50–100 words for undergraduates, while highly engaging media can support more complex interactions of 200–250 turns on average (Howard, 2012). In the studio space, as reported in Table 7.2, turns were generally short. In some cases, the responses were primarily backchanneling, where the listeners' utterances inform the speaker that the listener is following the discussion but does not advance the discussion. This is likely the reason why Student B's average words-per-turn is an outlier from the other averages.

These data suggest that the participation in the design discussions varied dramatically among learners. There were five different interlocutors in the data we collected. It is important to note that all five interlocutors were not present and active at each of the five sessions that were recorded. The variation in the number of turns for each individual depicts discussions that varied in participation and were more organic than contrived. For example, Student B had to stop working on the project close to the middle of the semester, and her fewer turns reflect her absence, but not a lack of participation in the sessions where she attended. Student B was

Table 7.2 A structural analysis of discussions among instructional design learners in an undergraduate design studio

Speaker	Number of turns	Average words per turn (*sd*[a])	Longest turn in words	Number of sessions attended
Student A	57	10.8 *(10.72)*	47	3
Teacher	123	19.4 *(30.7)*	272	4
Student B	65	5.3 *(4.55)*	19	2
Student C	88	12.5 *(10.15)*	41	5
Student D	131	13.5 *(19.43)*	102	3
Total	**464**	**13.45** ***(20.36)***	**272**	**5**

[a]The standard deviation sometimes appears larger than the average because single narratives can increase the variation dramatically, even beyond the mean, as we see in the teachers sd

only present and active for two of the six sessions that were recorded but still managed half as many turns as the teacher and managed more turns than Student A, who was present at four of the six sessions. Student D had the most turns of any of the participants and the highest average of words per turn and the longest turn among the students. The participant who was present at all of the sessions, Student C, had 88 turns in the discussions. The variation in turns strikes a contrast with the more uniform measures of discourse that evidenced designerly ways of knowing, suggesting that among these multidisciplinary learners, how they packaged their talk was less important than staying on task.

The number and length of turns by the teacher suggest that she was actively involved in the studio sessions with the students. These data also suggest that the teacher did not dominate the discourse but that all speakers – students and teacher – actively participated in the studio sessions. Each speaker had over 50 turns total in the data and averaged 13.45 (*sd* 20.36) words per turn. The longest turn for each speaker ranged from 19 to 272. The teacher had the longest turn with 272 words. The teacher also had the highest average of words per turn, 19.4. The teacher was actively working on this project with the students as part of her instructional method. This particular finding aligns with the findings from Howard and Gray (2015), where teachers also held longer turns, of higher frequency than individual undergraduates, but not more than the student group as a whole.

The Composition of Design Discourse

The composition of design discourse among these undergraduates was highly focused on the tools used in designing. Eighty-four percent of the discussion was coded as design discourse, and almost half (46%) of the design discourse was about

Table 7.3 Frequencies of designerly talk in the discussions among four instructional design learners and one teacher in an undergraduate design studio

Speaker	Number of turns	Number of turns coded as design discourse	Percentage of turns coded as design discourse (%)
Student A	57	41	71.9
Teacher	123	93	75.6
Student B	65	62	95.4
Student C	88	77	87.5
Student D	131	114	87.0
Total	**443**	**372**	**84.0**

tools. Each participant had more turns devoted to talk about tools than any other category of design. We reasoned that in this stage of the design process, during the expansion of the previous game and prior to user testing, a focus on the tools was a likely candidate. Knowledge of the tools in use was pivotal design knowledge that would be essential for design decisions to come.

The number of turns on task, evidencing designerly ways of knowing, suggests these learners were highly engaged in the learning process. In Table 7.3, we report the number of turns per speaker coded as design discourse more broadly, including the other areas of the taxonomy. We calculated the percentage of each interlocutor's turns that were coded as design discourse. Student D, who had the most turns of any of the participants, also had the highest number of turns coded as design discourse. Student B, who was only present for two of the five sessions, had the highest percentage of turns coded as design discourse. The turns not coded as design discourse covered different topics including class organization and other administrative activities. These measures give us an overview of how the learners engaged in the process of designing.

Somewhat surprisingly, three of the four students had a higher percentage of turns coded as design discourse than the teacher. In our iterative coding, we found instances of nine of the ten designerly ways of knowing that we found in the literature. We did not find discussions surrounding design failures in our corpus, despite design failures being one of the more sought-after areas of design discussion by reviewers of design cases (Howard, 2013). While our original expectation of how a class in the design studio might run was that the instructor would be the most on-task interlocutor, i.e., have more turns devoted to design discourse than the students, the analysis did not support this. We did not find that the instructor was more on-task, perhaps because the instructor also had to organize the class and the learning space in order for students to be on task. This suggests that facilitating learning is more than just teaching. These data also suggest that the students involved in this project are very engaged in this project.

Table 7.4 The discourse evidencing designerly ways of knowing found in the discussions among instructional designers in an undergraduate design studio

Discourse evidencing designerly way of knowing	Turns	Words	Average length of turns
Tools	179	2195	12.3
Usability	3	52	17.3
Problem framing	29	291	10.0
Problem-solving	19	174	9.2
Precedent	4	42	10.5
User experience	38	346	9.1
Aesthetic	19	282	14.8
Design tensions	63	1153	18.3
External representations	28	630	22.5
Total	**382**	**5165**	**13.5**

The data suggest that the most complex area of design discourse would be external representations, though this area also contained more teacher discourse than learner discourse. In Table 7.4, we report the amounts of turns and words for each type of design discourse found in our corpus. Reporting both turns and words devoted to each type of discussion provides insight into how these content areas are packaged in discursive terms. Talk about tools had the highest amount of turns and words found in the data but was not the most complex area to address. Talk about usability had the least amount of turns, and talk about precedent had the least amount of words. Discourse surrounding tools and design tensions play a large role in the studio sessions of early designers.

The majority of the discourse centered on the discussion of the different tools used to design the game. Talk about tools had the highest amount of turns and words (46% of the turns devoted to design discourse and 42.5% of the words devoted to design discourse). Talk about usability had the least amount of turns. This is not surprising because at this point in the design process, usability would not likely be a topic of discussion. We would expect usability to appear later in the design process when there is a final product or when the product, or design, is being tested. These data suggest that the tools used in the design process play a very large role for early designers engaged in designing an instructional game app. This also suggests that learners or design students focus on tools, and on how to use those tools, to help them in the design process in a studio setting. Table 7.5 is an example of design discourse coded as tool talk. We coded discourse as tool talk if the focus of the discussion revolved around the mechanisms that designers use to create.

There are two students involved in the excerpt in Table 7.5. Student B, who was the new student in the project for the fall semester, asked Student A about how to navigate a specific part of the tool, or the software, they used to design the language game. Student A goes on to explain how a specific feature of the tool, a blueprint, is used and where to find it. This example suggests that both new students and returning students understand the value and the necessity of understanding the tool in order to participate in the design of the language game app. Student B, the new

Table 7.5 An example of design discourse coded as tool talk, where a design learner struggles with the discourse surrounding a description of tools used to create the design

Speaker	Role	Turn
Student B	S	How did you get to that screen?
Student A	S	Okay, so up here is the list. When you open a level, this up here in the top right corner will give you this list of all of the things within that level. So like if I click on the stars, it is now selecting, where are they, it is selecting that section of stars. Section 1 is probably over here
Student B	S	Oh okay
Student A	S	This character is called 2D sidescroller. This character that's in here is classed a 2D sidescroller. Sometimes it will be named different, but because we started this from a template, it is called a 2D sidescroller
Student B	S	I gotcha
Student A	S	So usually we'll have some like pretty important name for the playable character or whatever. Um, let's see. So anything like that um that has anything that has a blueprint, this information over here to the right will be looped and you can just click it, and that will automatically bring up the blueprint. Yeah the blueprint just holds all the code and information for that character or pawn or whatever you've got out here. Um, alternatively, uh, you can come down here in one of these folders, well in any of these folders, there's a blueprint section

Table 7.6 An example of design discourse coded as design tensions showing learners grappling with one detail of their design and its problematic size on a different platform than what they had originally intended it for

Speaker	Role	Turn
Student C	S	So early on I said it could be zoomed in I kind of meant like how when it does that cut scene it is zoomed in That's what I meant
Student D	S	Oh
Student C	S	I mean. I don't know. It didn't come across to me as this was small until you said something and now thinking about it. If this is going to be on a phone, your character's going to be like the size of your pinky
Teacher	T	Yeah not even that big
Student D	S	Let's have shorter buildings in the future in this and the bigger ones on the computer

student, asks for help in navigating the tool, and Student A, the returning student, answers Student B's question and then goes on to explain other features of the tool. This suggests that early designers understand the importance of being able to use and navigate the tool in order to design the language game.

Talk about design tensions had the second highest amount of turns and words. Since Tatar (2007) defines design tensions in a very broad way, it is not surprising that any discussion about problems with the design fell into this category. Table 7.6 is an example of design discourse coded as design tensions. We coded discourse as

Table 7.7 The number of turns devoted to areas of design discourse of each individual participant

Design discourse	Student A	Teacher	Student B	Student C	Student D
Tools	17	35	45	34	49
Usability	0	0	1	0	2
Framing	7	0	6	8	8
Problem-solving	5	1	4	0	9
Precedent	1	0	0	1	2
User experience	9	6	4	11	8
Aesthetic	2	10	0	0	7
Design tensions	4	27	0	10	22
External representations	0	14	0	12	1

talk about design tensions if the focus of the discussion revolved around learners grappling with conflicts created by project constraints or design decisions made by the project team.

In Table 7.6, two students and the teacher are discussing the proportional sizes of certain background features of the language game. Student C has recognized that the sizes of the characters are not proportional to the rest of the background setting when the game is displayed on a phone. Student D, not the teacher, offers the solution to be used by using shorter buildings in the mobile version of the game versus taller buildings in the computer version. This suggests that the design studio setting does afford students the opportunity to grapple with design tensions.

In Table 7.7, we report the number of turns devoted to design discourse of each individual participant. We found that each participant had the highest number of turns devoted to talk about tools.

The discourse of each of the five interlocutors was most often coded as talk about tools, even for the teacher. Again, this suggests that early designers spend a lot of time discussing and engaging with tools when designing an instructional game app; and teaching how to use those tools was important design learning. These data suggest tool talk was rather dominant, and there was not an even dispersion of design discourse going on. Only one of the participants, Student D, had at least one instance of each type of design discourse. This could reflect either their status as early designers, the stage of the design process they were in, or both.

While we expected the teacher to focus even more on external representations like in Howard and Gray (2015), we actually found that the teacher's discussion was more balanced among the different types of design discourse. We expected to find the instructor redirecting learners to other areas, such as to give attention to the presentation of the designs. This teaching discourse was present in the data, but not as much as in previous studies (Howard & Gray, 2015). In this study, we find the teacher exploring with the learners more than redirecting their attention. This exploration could emerge because of the length and breadth of this project, the differences in disciplinary traditions surrounding design, or the representations used in different areas of design.

Table 7.8 The designerly ways of knowing that led to the emergence of tools and design tensions in the discussions

Designerly ways of knowing	Tools	Design tensions
Tools	174	0
Usability	1	0
Framing	0	1
Problem-solving	0	0
Precedent	1	0
User experience	0	1
Aesthetic	1	1
Design tensions	1	57
External representations	0	1
Non-design discourse	2	2

This project rotates new members in and out every semester and is still in the pre-beta expansion of the first version of the game. These data suggest that when working on an instructional design that spans multiple teams and multiple semesters in a design studio setting, the teacher is more involved as a fellow designer and peer than a teacher trying to direct the agenda of the project.

The Emergence of Design Discourse in Studio Sessions

Design discourse about tools and design tensions emerged from discussions rooted in themselves. To discern how specific design discourse emerged, we selected the two most frequent areas of discourse and looked to see the turn directly before it. Of course, in the context of discussion, we would expect to see coherent exchanges stay generally on the same topics, but we did not expect design discourse to be limited as these areas are all interrelated as parts of design knowledge. Tools, 179 turns, and design tensions, 63 turns, were the two design discourse types that appeared the most in the discussions. We examined the turns that appeared in the discussions right before the discussions changed to either tools or design tensions.

Two of the sessions we recorded started out with discussions surrounding tools, and a third session started with discussions surrounding design tensions. As can be seen in Table 7.8, there were 174 instances where discussions surrounding tools led to design discourse about tools. Similarly, there were 57 instances where turns devoted to design tensions led to more discussion about design tensions. There were two instances in the discussions where discussions surrounding design tensions and discussions about tools emerged from discussions that were not coded as design discourse. In other words, design discourse happens in discursive exchanges but not in isolated comments. The design discourse of framing, user experience, aesthetic, and external representations each led to discussion about design tensions one time in the discussions. The designerly ways of knowing of usability, precedent, aesthetic, and design tensions each led to discussion about tools one time in the discussions. This suggests that while the turn type most often begets itself, one type of design discourse leading to another happens more often than design discourse occurring in isolation.

These findings suggest that the linguistic routines of design discourse are highly cohesive, meaning they emerge from discussions rooted in themselves and vary rarely, i.e., discussions about tools precede and follow discussions about tools. We interpreted these chains of discourse as mini-discussions about designerly ways of knowing that are compartmentalized among themselves. We know that each of these designerly ways of knowing makes up an important aspect of design and design knowledge; however, as evidenced in our data, these designerly ways of knowing are very much separate ways of knowing that do not interact in the discussions of undergraduate students in a design studio.

Conclusion

In this study, we examined the composition of the design discourse and the emergence of the linguistic routines of students in a design studio setting. We found nine designerly ways of knowing evidenced in the design discourse of early designers: tools, design tensions, user experience, problem framing, external representations, problem-solving, aesthetics, precedent, and usability. The majority of the design discourse centered on tools, and usability was the least coded designerly way of knowing. We also found that the linguistic routines of the discourse of early designers emerge from discussions rooted in themselves.

From our perspective of traditional classroom teaching, unsupervised studio learning tasks might appear as potential time off task. That perspective is not supported by our data. With 84% of the discussions being devoted to design discourse, we found that these lessons and studio sessions were highly on-task and focused. We are both relatively new to teaching in the studio environment. In retrospect, we feel our teaching experiences may not have prepared us to appreciate this aspect of studio learning. In the traditional classroom setting, loosely structured lessons can easily run off topic; but here, what seems off topic is actually essential negotiation of design knowledge. The flexibility may be needed to accommodate the learning. As traditionally trained classroom instructors, this was surprising but we expect it would not be so for those used to studio teaching. In light of this, we advocate for more studio experiences for teachers not used to the setting. It might help broaden teaching experiences and introduce studio-based instructional tactics to the repertoires of classroom-based instructors.

We also found these sessions to be pedagogically intensive, with the teacher having more turns than the majority of the students and having longer turns than the students on average. Here again, our expectations of the studio environment were inaccurate. We did not expect the prominence of tool talk. Almost half of the design discourse was devoted to tools. This suggests to us that time spent on learning tools is not wasted in the context of early designers, and there are surely ways to support this learning that we do not explore in our teaching. This is an artifact of this specific iterative studio, where tasks and knowledge are passed along from semester to semester.

While we understand that the designerly ways of knowing are all interrelated and acknowledging these interconnections is important, the results of this study also suggest we might have much to gain from viewing these different types of design knowledge as distinct areas. Recognizing distinct areas of design knowledge is a call to be more aware in our teaching to support each one. What may seem very tangential may in fact be the only way to access this learning. The development of designerly ways of knowing may be only accessible through extended design discourse such as we saw with tools. This particular type of knowledge may not be accessible through direct instruction. These data also suggest that we should do a better job of targeting the broader range of designerly ways of knowing by supporting and facilitating a broader range of design discourse in our teaching of design.

This was an exploration of how designerly ways of knowing manifest in studio learners' discourse, so the limitations are likely to be many and varied. Some limitations of this study are that this sample does not look at any other examples of design expertise, cannot speak broadly to any other design context, and is limited to multidisciplinary learners learning design as opposed to design majors learning design. Clearly, identities will form differently among those groups, and like most design contexts, this one was unique.

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Chapter 8
Organizational Systems' Effect on Training Success: Why Covering the Content Is Not Enough

Maria del Socorro Hubbard and Andrew A. Tawfik

Context and Setting

Instructional designers can generally be counted on to follow formalized processes to develop training instruments for their clients and employers. This is especially true when new human performance systems are implemented that significantly impact workplace tasks. Despite their knowledge and professional commitment, instructional designers sometimes encounter business goals that diverge from best practices within the field. In many instances, instructional designers may find themselves looking for faster alternatives that fit better with project timelines. This could lead instructional designers to skip the performance assessment, overlook formulation of learning objectives, delay or abandon the creation of evaluation instruments, and bypass any type of guided learning process. They instead push out content that is technically accurate, but does not build skills or lead to organizational change. Workplaces that solely rely on content assume the risk of failing to prepare employees to be successful with new systems and tools. The consequences are manifested in the potential need to create work-arounds and unnecessary processes to make up for the lack of skill.

Lave and Wenger (1991) provide a relevant theoretical framework through which to study how training takes place in organizations. If one imagines organizational settings as environments where individuals work with their peers to accomplish tasks, then it may be said that organizational settings also encourage informal social learning among employees. Lave and Wenger (1991) further argue that communities of practice provide a setting whereby learning emerges and meaning-making takes place. As we detail below, the organization presented in this design case aims to support continuous learning and engender the ability to manage change.

M. del Socorro Hubbard · A. A. Tawfik (✉)
Department of Instructional Design & Technology, University of Memphis,
Memphis, TN, USA

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Nonprofit organizations often explore various strategies to maximize efficiency and support organization goals. An important part of this strategy is the process used by organizations to systematically provide accountability resources that allow managers to support dynamic learning. This design case details how a mid-sized nonprofit organization implemented a new HR information system beginning with *payroll*, *benefits*, and *timekeeping*, which are considered core HR transactional functions. The HR group in this organization examined their current HR information system against their strategic plan for talent management and concluded that the existing system was inadequate to support upcoming initiatives and agility needed in the nonprofit sector. To remedy this, the HR business group embarked on a search for a modern, cloud-based system that could integrate HR transactional functions and talent management functions, such as employee profiles, individual development plans, succession planning tools, and *performance appraisals*. This human performance technology was implemented to streamline various aspects of the organization while supporting the requisite efficiencies needed to catalyze change with the communities of practice.

The HR business group purchased a new system with the full support of the organization's senior leadership team and then hired an implementation partner to manage customizations, system testing, branding, and change management. The project was implemented in two phases. First, the plan was to implement the payroll, benefits, and timekeeping features in order to give employees an opportunity to learn basic system navigation. Following this, the plan was to implement the system's talent management, beginning with the p*erformance appraisal* forms and then employee relations case management and succession planning tools. The master plan for both phases included internal communication and marketing, employee training, and temporary post-implementation support.

There were four principle stakeholders within this organization as it related to this design case – the HR business group, the organization's functional business groups, the implementation partner, and the software developer. All were experiencing high stress with this project for various reasons. For example, the functional business communities were managing through the most important season of fundraising; the HR group was managing vacancies in key leadership and specialist positions; the implementation partner's staff assigned to this project was relatively inexperienced; and the software manufacturer was experiencing turnover in their team of consultants tasked with executing system configurations and customizations. Given all of these dynamic variables, the software developer conveyed to the HR business leaders that the planned implementation timeline was unusually aggressive. Unconvinced to change the plan, a project team was assembled, an implementation schedule was formulated, and the project was initiated.

The implementation schedule for payroll, benefits, and timekeeping reflected a "go live" date in the winter (called Phase 1). The project managers made every effort to keep the project on its timeline, but small delays eventually added up to major ones. As such, the project implementation soon intersected with the annual performance appraisal season which was scheduled for late spring. This situation forced the business leaders to make a decision. Specifically, they wondered if the implementation of the new performance appraisal system could be pushed back to the following year or whether it was best to introduce this additional system on the same timeline. The risks of combining the implementation with the new performance appraisals were many – system configurations would not be complete, there would not be enough time to test the new system, and a practice environment for training would not be available. Thus, any communities of practice could implement this, but be untrained how to properly amend their workplace behavior to accommodate this new technology. In spite of these risks, the business leaders decided to implement the new performance appraisal system along with the payroll, benefits, and timekeeping systems (called Phase 1a). The outcome was a trial and error, learn-by-doing-type training that resulted in confusion and a poor impression of the new technology that had been heralded as a modern, easy to navigate, integrated HR information system. Rather than a "content only" approach, this design case explores how a more holistic approach was necessitated for the system integration.

Designing Training for a New System

The organization in this design case is a mid-sized nonprofit with about 1,500 geographically dispersed employees. It is a corporate-style organization with a manager-to-employee ratio of about 1:4. The HR division manages the full range of services in the employee lifecycle, including *recruitment* and s*election*, benefits, payroll, *talent development*, and *employee relations*. The HR training team is comprised of six employees—two instructional designers/trainers, one facilitator, a coordinator, two advisors—one of whom is a performance management expert and a group manager. Together, this team created and agreed upon a training strategy to usher in the implementation of the new talent management system.

As outlined in the strategy, two training partners from each functional area (marketing, IT, business development, legal, and HR) were selected to assist in the content delivery and to act as first-line troubleshooters after implementation. For example, two employees from marketing assisted in the initial training sessions for all employees on basic issues, such as general system navigation. Afterward, the marketing training partner served as the first point of contact for problems experienced by the marketing department, thereby reducing the number of help requests made directly to HR. This approach leveraged the organization's affinity for leaders-as-teachers and amplified the HR training team's small number. The HR training team conducted a series of train-the-trainer sessions to prepare the training partners. The training partners expressed appreciation for the time spent in their preparation and for the easy-to-use tools, which included a scripted facilitator guide and formatted presentations.

After this preparation, the HR trainers and partners delivered 10 instructor-led sessions in one week for up to 100 employees. In addition to the large, one hour group training sessions, small group sessions were held for managers to answer specific questions about managing payroll, benefits, and timekeeping for their employees, especially when deadlines and cutoffs were concerned. To ensure access to training materials, an intranet site was also created to house the job aids, frequently asked questions (FAQs), video recordings of the live sessions, system demonstration videos, and a link to the practice environment. The organization had a strong sense of self-directed learners, so providing on-demand materials was seen as a way of providing resources that aligned with learners' needs.

The training sessions focused on navigation of the benefits, payroll, and timekeeping systems. Employees were encouraged to bring their laptops to follow along with the trainers in the practice environment. In addition, step-by-step aids included screen captures taken from the practice environment, which was designed for employees to visually "match up" what they saw on the screens. Trainers used the practice environment to give employees a thorough tour of the new system. During the sessions, employees could log in to the practice environment and follow along with the trainers. Upon completion, the evaluation feedback referenced appreciation for the opportunity to learn the new system in community with their peers.

By all accounts, this training strategy worked as planned for the benefits, payroll, and timekeeping system. The performance management system, however, was still under construction. The forms and accompanying processes were thus not complete, and a practice environment that reflected the new performance appraisal system elements was not available. In response, the instructional designers made an effort to prepare employees and managers for the upcoming system implementation by creating a document that described the (a) overall performance appraisal process steps (b) timeline and (c) a worksheet for employees to begin drafting their annual self-evaluation. Once the employee had completed their performance summary, they were given instructions to paste the summaries into the new system. However, this instructions proved to be too complex without a practice environment. A time gap of one month between the dissemination of this instruction and the performance appraisal system implementation further diminished the solution's usefulness.

Challenges That Arose During Implementation

The implementation schedule for the new performance management system was set at one month after the implementation of the payroll, benefits, and timekeeping systems in Phase 1. The aggressive timeline to configure the performance management system left no time to establish a mirrored and accurate practice environment. As noted earlier, the software maker had a sample system that could be purchased and utilized as a practice environment, but its configuration (icons, system forms) were very different from the system that was being implemented within this specific nonprofit organization. The HR business leaders decided it was not worth the expense to purchase that sample system because it would be too different from the system that was being configured. This business decision created difficulties for the implementation on multiple fronts. First, this meant employees would receive training on a system a month or more before they could put it to use. In the end, training for the new performance appraisal system was limited to a job aid that illustrated only basic navigation steps rather than the organizational goals supported by the new human performance technology. Accompanying the job aid was a verbal description of the new form and system on the order of, "This is how the new system is intended to work. The appraisal forms may resemble the paper versions you have been working with up to now. The categories and ratings will not change."

The HR group had high expectations that the new system would be easy to learn and use. However, the dependence on simple job aids and the absence of a practice environment for learning resulted in a workforce who felt ill-equipped to operate the system when it went live. Once again, this negatively affected the organizational change that was intended as part of this new technology. The depth of this consequence was visible in the need to hire extra specialists to provide temporary assistance to manage calls to HR for help with navigating the system.

While there were various immediate challenges, it was interesting how additional problems arose over time. Phase 1 of the project was implemented as planned with minimal assistance from the training partners and the HR group. One month later, the performance management phase (Phase 1a) was implemented and the performance appraisal process launched using the new system. The training partners reported to HR they were unable to manage the requests for assistance from their business units. Once the new system configurations were complete, the HR training team updated the generic performance management job aids with the actual screen elements. Unfortunately, it was too late in terms of how the content was received by the various communities of practice within the organization. Specifically, the performance management system felt too complex to navigate and the unfamiliar forms were hard to use.

Struggling to Create Learning That Goes Beyond Delivering the Content

Implications of this design case highlight the impact on employees' ability to manage change and the cost of insecurity when training fails to consider learning "beyond content." From a content perspective, the training strategy included live instructor-led sessions, step-by-step pictorial job aids, FAQs, and a fully functioning practice environment for the new system. However, it fell short in preparing employees to actually interact and transfer their learning when specific work tasks arose, such as an employee performance appraisal. A key lesson is that a more representative practice environment was essential to fully understand how the system would catalyze change in everyday practice. Instead of learning as a community, employees navigated the system and managed the appraisal forms on their own in the live system and under pressure to complete appraisals within 30 days. This created noticeable learner insecurity, which produced calls for additional help with the system. The call volume generated by employees and managers seeking assistance from the HR group resulted in unplanned overtime costs and contracted temporary specialists. The HR group, like the rest of the organization's employees, had not learned how the system worked. They were therefore not prepared for the influx of calls, along with the discomfort and disengagement that followed.

Advancements in learner engagement using modern learning tools offer innovative ways to improve learning experiences and knowledge transfer within communities of practice. Organizations consider these advancements important because effective employee training is known to promote a learning culture and reduce resistance to change (Sanchez, Arago, Arago, & Valle, 2003). Design tools used to create and deliver effective training have changed in recent years in terms of the ways information can be represented and the underpinning theories that drive educational experiences (Hedberg, 2002). In modern organizations, learning and development practitioners are encouraged to minimize decontextualized, formal training and instead support learning based on the needs of specific community tasks (Lombardozzi, 2016). Even with advances in training designs and learning tools, practitioners in the field struggle to align various stakeholders in ways that support holistic approaches to learning within an organization.

Why Was the Training Not Effective?

Organizations regard performance appraisals as a critical internal process aimed at improving employee performance and, ultimately, organizational effectiveness (Cascio & Aguinis, 2011). Performance appraisals are typically conducted annually to summarize and rate individual performance in terms of goal achievement and demonstration of competencies. Despite their utility as a way to measure and document performance outcomes, they are often regarded as problematic and managers often have negative attitudes towards the performance appraisals (du Plessis & van Niekerk, 2017). This problem is further magnified as most business managers have as many as thirty employees depending on the organization and nature of the work.

The organization in this case dealt with similar challenges and explored technology as a way to make their communities more efficiently aligned with organizational goals. Managers and employees alike expressed initial excitement over the prospect of the new online system that was expected to modernize and simplify the performance appraisal process. They felt it would be a welcomed improvement over the current paper-based system and tools. However, managers and employees across the organization discovered how ill-prepared they were when they attempted to complete the first appraisal in the new system. Upon reflection, the decisions made along the way also played an important role in the lack of project success. The HR business leaders and other business stakeholders appeared satisfied that learning objectives were disseminated through the tutorials and one-hour training session. However, the performance appraisal process and forms were vastly different from the paper-based system the employees were accustomed to using. Training on a generic system that did not look or work like the actual system was too abstract and hypothetical; therefore, the materials served as an impediment to transfer. The absence of a practice environment system also negatively affected the success of the training strategy. The combined force of these two conditions resulted in a workforce that was not prepared to interact with the new performance appraisal system. This became especially evident when the annual performance appraisal process was launched.

This design case elucidates other important principles about communities of practice and organizational learning. First, it shows the ways in which the instructional design strategy must account for the "organizational system" as a way to go beyond content. Second, it illustrates that managing change on the personal and organizational level requires systemic alignment between the resources and communities within which it is implemented. Business decisions influencing project timelines, the absence of a practice environment, poorly designed training materials, and a missed opportunity to leverage the built-in communities of practice resulted in employee resistance (White, 2017).

Lessons Learned

The organization examined in this design case has a strong culture of continuous learning within communities of practice. Seventy percent of its members were under 40 years of age and with five or fewer years of tenure. The remaining 30% of learners often consisted of managers with an age of 40+ years and 5–25 years of service. These appear to be favorable conditions for learning, and thus the project team was satisfied with a training strategy that leveraged the new system's seemingly intuitive nature. A formal needs analysis was not conducted and no other training alternatives were considered. Instead, there was an overreliance on covering the basic content as a form of training, which proved to be problematic. The business decisions related to project management of this system implementation resulted in constrained timelines for all training activities. The HR training team was concerned that "pushing out" training on a new system without a practice environment would result in frustrations with the system and possibly a poor impression of it As such, instructional designers developing the training materials felt boxed in and unable to deploy instruction beyond the basics. As the project moved forward, the business leaders, the project team, and employees felt the apparent tension.

What instructional design practices might be derived from this case study? With Lave and Wenger's (1991) situated learning principles in mind, we proffer the following:

1. Consider using change management tools to prepare the organization for changes, and spend more time with individuals that might encounter heavier individual resistance.

2. Emphasize the value of incorporating a test system that mirrors the actual system to give learners a realistic experience and a safe setting to practice new skills.
3. Manage learner insecurity and communicate expectations for the organization's communities of practice.

The size and scope of the new performance management system may have called for a project plan of its own. If it had, the implementation timeline might have aligned with the annual performance evaluation cycle, albeit in the following year. Even though it meant delaying implementation for another year, it would have allowed for thoughtful and thorough change management. In addition, it would have given employees a chance to learn the new content and skills in community with their peers and thus feel better supported by the organizational setting. In this case, however, the HR business group was not willing to delay the implementation of the performance appraisal system for another year. They instead felt it was worth the risk to focus on dissemination of information, as opposed to a more thorough training strategy. Future implementation strategies should consider how to go "beyond content" by exploring how to align knowledge gaps, learning resources, and communities of practice in terms of organizational goals.

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Chapter 9
Developing Crosscutting Competencies for a Transdisciplinary World: An Extension of Bloom's Taxonomy

Iryna Ashby, Marisa E. Exter, and Deena Varner

Globalization and technological innovations continue to lead to the creation of new roles and expectations for recent graduates. To compete in today's job market, new graduates must be prepared to go beyond discipline-specific competence and become skilled in communication, critical thinking, problem-solving, ethical judgment, teamwork, intercultural skills, and lifelong learning (Hart Research Associates, 2013; Messum, Wilkes, Peters, & Jackson, 2017; Nae, 2017) as well as demonstrate the ability to solve problems with solutions spanning traditional disciplinary boundaries (Bridle, Vrieling, Cardillo, Araya, & Hinojosa, 2013; Holley, 2017; Palmer, 2001; Repko, 2008). However, employers indicate that graduates often lack these skills (Hart Research Associates, 2013; Messum et al., 2017).

Interdisciplinary education is an effective way to help students develop creativity, innovation, and synergy while crossing disciplinary divides (Haynes, 2017). Interdisciplinary education is an umbrella term for a range of activities that disrupt disciplinary silos (Holley, 2017; Lattuca, 2001). It exists along a continuum from cross-disciplinarity, where educational experiences are designed to combine neighboring fields, to transdisciplinarity, where students synthesize multiple fields and develop their own conceptual frameworks (Klein, 2010; Rosenfield, 1992). Higher education often touts interdisciplinarity integration (Cooper, 2012). However, there are challenges to the process of meaningfully integrating multiple disciplines, including the need to restructure the learning process and implement teaching and learning strategies that ensure students develop interdisciplinary skills (Klein, 2005; Stozhko, Bortnik, Mironova, Tchernysheva, & Podshivalova, 2015). For students to

I. Ashby (✉) · M. E. Exter
Purdue University, West Lafayette, IN, USA
e-mail: iashby@purdue.edu; mexter@purdue.edu

D. Varner
NYU Shanghai, Shanghai, People's Republic of China
e-mail: deenavarner@nyu.edu

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effectively achieve either program-specific or personalized goals, interdisciplinary competencies (or a combination of knowledge, skills, abilities, and attitudes) need to be clearly defined.

Program designers must consider the complexity of learning. New competency acquisition is built on previous knowledge to ensure that skills and knowledge "develop and become integrated with other behaviors to form more complex behavior which is classified in a different way" (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956, p. 10). Bloom's taxonomy, a classificatory model for curriculum and performance-based objective development, is a popular model for ensuring higher-order levels of learning (Darwazeh, 2017). Bloom's taxonomy, as revised and fine-tuned by Anderson et al. (2001), provides a hierarchy of six levels: remembering, understanding, applying, analyzing, evaluating, and creating. These are intended to emphasize "what learners know (knowledge) and how they think (cognitive processes)" (Anderson et al., 2001, p. 38). While well-known in education, the original Bloom's taxonomy and Anderson's revised version have a number of limitations that should be considered in the design of educational experiences. The hierarchy and single dimensionality of the taxonomy appear to presume that learning is linear and moves from simple to complex behaviors (Furst, 1994; Darwazeh, 2017). Yet, some aspects of knowledge at the lower level may in fact be more complex than those at the top of the taxonomy's hierarchy (Soozandehfar & Adeli, 2016).

The goal of this chapter is to explore the applicability of Bloom's taxonomy to a transdisciplinary, competency-based undergraduate program and how modifications to the taxonomy might make it more suitable to such a setting.

Design for Acquisition of Crosscutting Skills for Jobs of the Twenty-First Century

The ongoing globalization of the job market and emergence of novel and unprecedented job functions require graduates to be prepared for "jobs that do not yet exist, to use technologies that have not yet been invented, and to solve problems that we don't even know are problems yet" (Darling-Hammond et al., 2008, p.2). Therefore, students must be prepared to continue to gain skills and knowledge beyond those required to graduate in a discipline-specific degree. The need for crosscutting and interdisciplinary competencies (otherwise known as "twenty-first-century" or "professional" skills) has gained weight in recent years (e.g., World Economic Forum, 2017). Scaffolding is required to ensure students acquire such transversal competencies (a combination of knowledge, skills, and abilities/attitudes). Scaffolding can be supported through a well-designed competency model that goes beyond discipline-specific knowledge and skills to help students develop into well-rounded individuals with unique transdisciplinary identities.

The transdisciplinary model discussed in this paper was initially developed in response to the need to maintain consistency in a set of crosscutting competencies

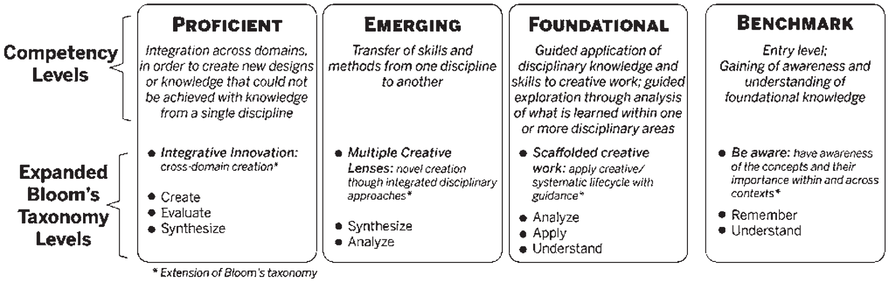

Fig. 9.1 Extended Bloom's taxonomy

created for the Transdisciplinary Studies in Technology (TST) undergraduate program at Purdue University. TST is a novel competency-based transdisciplinary program with the intent to bridge the gap between higher education, the needs of the twenty-first-century labor market, and the whole-person focus of liberal arts education. Instructors include faculty and staff from across disciplines. Students in this program build a unique transdisciplinary identity by creating an individualized plan of study that includes a set of core courses as well as courses in self-selected focus areas, at least one of which must be technical and one liberal arts-based.

The TST competency model was intended to ensure that students develop a strong foundation in the skills that are important across disciplines, such as critical thinking, communication, problem-solving, and ethical engagement. Designing such a competency model is challenging, as it must be discipline-agnostic while providing clear, measurable definitions and well-defined relationships among competencies that outline the progression toward mastery. Aligning with the transdisciplinary program vision, students are required to demonstrate not only competence in their disciplinary focus areas but also the ability to apply, transfer, and ultimately integrate traditional disciplinary knowledge and practice into their own novel work. This model was designed with built-in flexibility, which allows students to progress from basic single-domain competencies to transdisciplinary work authentically within projects they are already engaged in and that are meaningful to them. Although flexible in terms of the types of projects that can be submitted, such a model needs to include clear and precise language for each competency definition to ensure the transparency and measurability of each competency level. This in turn ensures transparency and consistency across students and assessors. We have also added behavioral indicators (BIs) for each level of the competency description to further clarify expectations for specific tasks or activities to ensure that each competency level can be credentialed and is clear for all stakeholders (including students, faculty, assessors, and employers). BIs allow for transparency and objectivity among both students and assessors. A framework based on the modified taxonomy was used to create both the BIs and the revised competency language (Fig. 9.1). Additionally, "indicator" language was adopted to help students internalize the work they need to do and the level of mastery to be achieved.

Our framework includes a knowledge dimension, in which students proceed from factual to abstract knowledge (Anderson et al., 2001). This allows students to learn how to learn and guides them in the development of lifelong learning as a habit of mind and key component of professional practice. Students demonstrate metacognition by reflecting in writing on how their artifacts, such as design projects, written essays, or group work, meet the behavioral indicators for each competency. In TST, these artifacts are evaluated by faculty mentors to ensure the growing depth and breadth of students' knowledge and skills and their alignment with the competency model.

Transdisciplinary Bloom's Taxonomy

Figure 9.1 represents the framework, which includes three main phases (foundational, emerging, and proficient), as well as a benchmark level. While it maintains the general hierarchy of the Bloom's taxonomy, some of the Bloom's levels are repeated across phases. Students will be expected to demonstrate lower-level BIs in their subsequent work.

For students to develop transdisciplinary thinking, they need to acquire a range of cognitive subskills (Van Merrienboer, 1997), including establishing a purpose and weighing and integrating disciplinary insights while maintaining a critical stance (Boix Mansilla, 2010). However, this process takes time, as it may be challenging for students to not only combine two disciplines when developing their artifacts but also integrate disciplinary or interdisciplinary insights and/or create their own (Spelt, Biemans, Tobi, Luning, & Mulder, 2009). Lattuca, Knight, and Bergom (2013) suggested key considerations for interdisciplinary or transdisciplinary thinking that are reflected in our framework: establish awareness of disciplinarity; appreciate disciplinary and non-disciplinary perspectives; recognize disciplinary limitations; evaluate critically through an interdisciplinary lens to find common ground; use reflexivity to understand own biases and other limitations while synthesizing disciplines; and, finally, synthesize disciplines by taking in insights from relevant areas to inform solutions that, as suggested by Newell (2001), would be incomplete if viewed through a single disciplinary lens.

This process is scaffolded across all three levels of the competency model, in order to give students the time to acquire and develop these skills. At the benchmark level, the focus is on establishing an awareness of disciplinarity and appreciating disciplinary and non-disciplinary perspectives. At the emerging level, students begin to recognize disciplinary limitations and to compare, contrast, combine, and/or transfer knowledge, skills, and abilities across disciplines to solve problems using more than one disciplinary lens. Finally, at the proficient level, students develop novel solutions by integrating disciplinary insights. The language used in BIs must be flexible enough to allow for the assessment of artifacts that showcase higher-order skills, including those practiced during project work, design work, and collaborative projects (e.g., Biasutti & El-Deghaidy, 2015); experiential or service

Competency Description/Statement	Behavioral Indicators
I define ethics in relationship to a specific context or challenge, and then identify a problem, action, or dilemma that has possible ethical implications. I identify an ethical framework or set of ethical guidelines to help me explain the ethical implications of my problem, and describe those implications.	A. I define ethics. B. I identify and describe a problem, action, or dilemma that has possible ethical implications (this might be encountered in a class, a design problem, or extracurricular project, or with something that happened (or is happening) in class or at work). C. I identify an ethical framework or set of ethical guidelines within a particular disciplinary perspective or professional field. I explain why this framework is relevant to my problem. D. I describe potential ethical implications of my problem, based on my selected ethical framework or set of ethical guidelines.

Fig. 9.2 Ethical engagement, foundational level: competency description and behavioral indicators

learning projects (e.g., Rooks & Winkler, 2012); reflections on learning and (e-) portfolios (e.g., Wang, 2009); and self- and peer assessment (e.g., Hersam, Lunak, & Light, 2004), among others.

Competency Levels and Definitions

Benchmark: While the benchmark level is not part of the competency model, it reflects the level that a student should have prior to working on competency acquisition. In general, students should have reached this benchmark level in high school or early in their general education courses. Students not meeting the benchmark may need to consider taking remedial courses or participate in informal/nonformal learning opportunities to ensure their readiness.

Foundational: This level provides well-scaffolded opportunities for students to engage in the competency. It introduces students to concepts and gives them the opportunity to exercise them in a small way. The requirements vary based on the competency description. Generally, students perform actions such as defining, comparing, describing, explaining, and planning. Any of the developing-level competencies can be achieved within project(s) undertaken as part of course work. In the example below (Fig. 9.2), students must first identify what constitutes ethics and how ethics may be at play within disciplinary perspectives or professional fields, and then they apply their findings to a current project or experience.

It is important to note that, at this stage, students are applying disciplinary knowledge from a single field. This focus allows students to develop insights and understand limitations prior to attempting to integrate other fields (Boix Mansilla & Duraisingh, 2007). For ethical engagement, students may use insights from an introductory philosophy, social scientific, professional, or technical course to begin identifying and defining ethical frameworks that may be relevant to a dilemma (e.g.,

Competency Description/Statement	Behavioral Indicators
I identify a problem, action, or dilemma facing the professional field I wish to enter, as well as the primary individuals or groups affected by this dilemma. I compare and contrast two ethical frameworks or sets of ethical guidelines, and create a plan of action that balances their points of disagreement. I evaluate how my plan would or does affect the individual, groups, or communities affected by the dilemma.	A. I describe a problem or dilemma facing the professional field I wish to enter, and explain why this may have ethical implications. B. I identify the primary individuals and/or groups affected by this dilemma and the possible impact of this dilemma on the larger community. C. I compare and contrast two ethical frameworks or sets of ethical guidelines that would be applicable to this problem; I enumerate their points of agreement and disagreement. D. I develop my own ethical framework, considering the implications of points of disagreement between the existing frameworks and gaps in what is considered within existing frameworks. E. I discuss how my framework may inform a plan of action that addresses the initial problem or dilemma. F. I evaluate how my plan, if implemented, would impact the primary individuals and/or groups affected by this dilemma as well as the larger community.

Fig. 9.3 Ethical engagement, emerging level: competency description and behavioral indicators

considering when and how it is appropriate to use data collected from human subjects) or project (e.g., considering ethical implications of manufacturing a product).

Foundational-level competencies are generally written such that they can be obtained during the first four to six semesters of an undergraduate program. We anticipate student responses may be somewhat naive, focused on a basic understanding of concepts rather than a deep understanding of either the competency area or discipline-specific knowledge they will gain through subsequent coursework. We anticipate that student submissions will include a basic or elementary level of reflection on the competency language and how their own work matches with the BIs.

Emerging: At this level, students learn to make use of knowledge, skills, and abilities across at least two fields or disciplines to solve problems. These problems are situated within students' projects, papers, or design work. The active verbs at this level, such as analyze, propose, test, devise, support, and reflect, allow students to engage intentionally with the skills and abilities foregrounded in each competency. Students will begin to transfer insights from one discipline to another or combine insights from two or more of the disciplines they identify as important to their project. In the ethical engagement competency, students will have already defined ethics and identified an ethical framework that is relevant to their work at the foundational phase; now they will analyze multiple different ethical frameworks and allow their understanding of these frameworks to analyze options they are considering taking in their own project work (Fig. 9.3).

We anticipate that traditional students will attain emerging competencies during their second and third year in an undergraduate degree program. During this timeframe, students should be taking a significant amount of coursework in discipline-specific areas. They should also be able to communicate at a more sophisticated level and exhibit greater metacognition and self-regulated learning than they could

Competency Description/Statement	Behavioral Indicators
I analyze how two ethical frameworks or sets of ethical guidelines might approach a problem, action, or dilemma I am facing. I propose two or more possible courses of action for my problem and analyze the ethical implications of each.	A. I identify and describe a problem or dilemma that I am facing and explain why it may have ethical implications. B. I describe the context and who or what might be impacted by it. C. I identify ethical frameworks or traditions, or sets of ethical guidelines from two or more disciplinary areas or professional fields, and justify why these are relevant to this problem or dilemma in this context. D. I discuss how each framework approaches the problem or dilemma. E. I propose two or more possible courses of action for my problem, informed by the ethical frameworks I have identified. F. I identify potential ethical implications of each of these courses of action.

Fig. 9.4 Ethical engagement, proficient level: competency description and behavioral indicators

during their first year. Competency submissions will be tied to meaningful projects, papers, or other artifacts that students may be creating as part of coursework. We would expect that students will be able to reflect on their own learning and how it impacts the work they have done.

Proficient: At this point, students should be ready to fully engage in transdisciplinary thinking by integrating insights and approaches from multiple disciplines and developing new ones (Fig. 9.4). Students are also encouraged to engage with community and other stakeholders to create new or shared conceptual frameworks that go beyond disciplinary boundaries (Choi & Pak, 2006; Holley, 2017; Klein, 2010; Lattuca, Voigt, & Fath, 2004; Rosenfield, 1992). The use of active verbs in the behavioral indicators once more reflects this level, e.g., justify, organize, revise, solve, critique, and enhance. This would typically be done in the context of a large-scale project. For example, within the TST program, students might demonstrate competence in several areas through work done while designing, building, evaluating, and presenting third year independent projects or fourth year team capstone projects. It is expected that this work will be increasingly independent and self-directed as students begin working on proficient competencies.

We anticipate that most students will submit proficient-level work during their third and fourth year in a 4-year undergraduate program. Related work typically would tie into exploration of a topic or engagement in a project that requires significant independent planning and implementation. While this may be conducted as part of student teamwork, it should be primarily student—rather than instructor–driven. Therefore, BIs are less detailed and more flexible, stressing reflection and metacognition. Students are expected to think deeply about their own transdisciplinary identity, how this connects to the work they do, and how they think about it. They should also consider how what they have learned through gaining this competency will impact their future work and/or personal life.

First Steps Toward Validating the Taxonomy

To ensure internal alignment and the alignment with the extended taxonomy, as well as student workload for each level, all levels were compared with each other vertically (within one competency) and horizontally (across the same level of all competencies developed to date). A list of active verbs for each level was identified and some language was modified to ensure this alignment. Revised competencies were reviewed by the teaching faculty and will be evaluated by external peers and students to ensure that the language is friendly and clear.

We conducted two types of usability testing to determine whether the taxonomy made sense to students and faculty: (1) a think aloud and focus group with several students across different years of enrollment in the program and (2) a work session with the faculty to review the language and overall clarity of the documents.

In the think-aloud session, students considered a specific topic or artifact they might use and what steps they might take to demonstrate competency acquisition. They highlighted the ease of use and clarity of the language and expectations and how they could see the progression in their competency development. The areas that were not clear to them were noted and modified in the subsequent revisions (e.g., additional information was added to the supplementary glossary).

Discussions with faculty members required more focus on the design of the model itself and what students' progression would look like from a theoretical point of view. Also discussed was the implementation of the model in the classroom, including the scaffolding that would be needed to move from a single domain acquisition to cross-disciplinary and transdisciplinary points of view. Feedback from faculty required ongoing discussion to ensure that all stakeholders understood the modifications and the reasoning behind them.

Considerations in Designing and Testing the Model

Considerations listed below emerged, in part, through reflection on the challenges we experienced during our design and testing process.

Planning

Need for interdisciplinary collaboration Although each competency was intended to be crosscutting, we found the need to engage disciplinary subject matter experts and existing sources (such as the Association of American Colleges and Universities rubrics) for individual competencies to ensure that each level has the appropriate level of difficulty and that each BI is relevant and applicable to the performance expectations. For example, our team member with a background in English studies led the design of the written communication competency to ensure that concepts and terminology used in the developing and emerging levels were consistent with those used in Purdue's core English courses and that proficient-level BIs represented what would be expected from a sophisticated graduate of a 4-year degree.

Recognition of disciplinary lenses Being a professional in a specific field often creates disciplinary lenses or boundaries. Program designers and instructors may find it challenging to cross boundaries due to disciplinary differences or lack of readiness (Baker & Daumer, 2015; Kandiko, 2012; Reynolds, 2012; Exter, Gray, & Fernandez, in submission). We found that the best approach was to discuss each competency in depth in person, both within the competency development team and with other members of the program. Initial conversations did not necessarily bring disciplinary differences to light, as we often use language differently. Therefore, multiple extended conversations about each competency and competency level were necessary. While it took additional time, this step allowed us to ensure that the language used and the expectations were clear and meaningful for all.

Design

Align the language This is a multilayered challenge. We had to ensure that the language would be clear for all stakeholders, including students, parents, faculty, potential employers, and assessors (who may or may not be faculty). Each competency description and BI was discussed in full to minimize unintended ambiguity, including the use of discipline-specific terminology. A glossary was written to address the use of more complex language when necessary.

Align the overarching university, school/college, and program expectations into the design While this step sounds like a natural one to do, the alignment of all expectations to ensure that students are able to gain the competencies within the timeframe with program-specific and university-wide courses has been a significant and ongoing undertaking.

Implementation and Testing

Ongoing evaluation and feedback on the model A model that is tightly connected and impacts students' education cannot be created in vacuum. It needs to be clear for all the involved stakeholders, particularly for the immediate users, like students, faculty, and assessors. As such, their input is important at different stages of design and implementation. We found that it took a significant amount of time to collect and implement feedback. We anticipate that we will continue to adjust competency language, BIs, and the model as a whole once it is in use for a longer period of time.

Conclusion and Implications

The ability to synthesize and integrate knowledge and skills across multiple domains and the acquisition of cross-functional competencies help prepare graduates to face the challenges of the ever-changing globalized job market and the emergence of new knowledge and technologies within and across fields. Delivering such an experience requires a planned integration and scaffolding of knowledge and skill building into the model design.

The model presented in this chapter can be used or adapted for use in a number of ways. It may be particularly useful in programs that allow students a fair amount of freedom in coursework selection but aim to develop students' ability to form a transdisciplinary identity and synthesize what they have learned across disciplinary coursework. The use of a competency model for assessment further allows for authentic, flexible, and self-guided learning opportunities. The model could also be used to scaffold general education requirements in more traditional degree programs—either as a way to make individual general education courses more meaningful or as part of an effort to embed professional skills into discipline-specific coursework, particularly in disciplines such as math and science, and in professional domains. In each case, the model would not have to be used in its entirety for all competencies. For example, in the Transdisciplinary Studies in Technology program, students are required to achieve foundational competence in all 20 areas, emerge in 15, and be proficient in 10. Other programs may wish to target only some of the competencies or require fewer at the higher levels, allowing students to attain some background in each area but specialize in only a few.

While this model was designed for a 4-year undergraduate program, it could be adapted for use in 2-year or vocational programs by creating additional scaffolding at the foundational level and leaving out or modifying expectations for the proficient level. The model might also be adapted for use in graduate programs, perhaps allowing for more freedom and self-direction in the foundational level or combining the foundational and emerging levels.

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Chapter 10
Technological Tribal Territories: How Culture Influences Learning Beyond Content in Educational Technologies: A Narrative Review of Literature

Newton Buliva

Culture impacts how people think and do things and also influences whether educational technology content is accepted or rejected by learners. To some extent, culture also determines learners' persistence in interacting with technology, and some cultures even encourage the repurposing of technology to accommodate their needs. Furthermore, human perception processes are continuously being influenced by their culture (Nisbett & Miyamoto, 2005). Culture assists in forming worldviews for learners, who see information and content through its lenses. Kuhn (1970) illustrated this by suggesting that if two people, standing at the same place, gaze in the same direction and are given a stimulus, they will not experience the same outcome. This, he notes, is because the same stimuli can produce very different sensations for different people because of their cultural backgrounds. Kuhn also suggests that individuals who belong to the same group and share similar education, language, experience, and culture are likely to have a similar response to stimulus. Similarly, culture colors learners' response to educational technology content.

Culture in Educational Technology

Although the study of culture has its origins in the discipline of anthropology where researchers generally studied isolated communities (Tierney & Lanford, 2018), this study uses Hofstede's (2011b) definition of culture as a collective programming of the mind. It manifests itself not only in values but in more superficial ways like symbols, heroes, and rituals. Hofstede (2011) also notes that culture encompasses the unwritten rules of how language, empathy, collaboration, and competition are

N. Buliva (✉)
University of North Texas, Denton, TX, USA

B. Hokanson et al. (eds.), *Educational Technology Beyond Content*, Educational Communications and Technology: Issues and Innovations,
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used among groups of people. He further states that culture provides moral standards on how to be accepted into a group through symbols, heroes, rituals, laws, religions, taboos, and other practices. Culture also defines the requirements of being accepted into a group. Hofstede, however, cautions that often culture's core remains hidden in unconscious values. Spencer-Oatey (2008) notes that a definition of culture remains "fuzzy" as it influences people in different ways, even if it is a set of basic assumptions and values, among other perimeters, that are shared by a group of people. Young (2008) notes that in instructional design, definitions of culture are based not only on anthropological perspectives but also on sociological and educational perspectives.

Since culture has a profound influence on people, successful learning beyond content must therefore consider the influence of culture on learners. Students do not come to classrooms as *tabula rasa*—blank slates. By the time learners are interacting with an instructor and content, they are already members of some culture or grouping. Benson (2003) notes that students arrive in classrooms with thoughts and practices of daily living that are imbued with their various cultures. She advises that the wide diversity in the cultural background of today's students makes it imperative for educators to consider varying cultural norms in classroom relationships. Frick (2018) further explains that learners should not be required to learn facts and concepts that they do not care about, which have no perceived practical value and are disconnected from unique elements of their culture. Stockman (2018) underlines this by pointing out that the reality for learners is one which they have constructed. That is, learners try to make sense of objects around them, constructing and reconstructing them, to explain and interact with their environment. Stockman notes that people also construct the framework of interacting with technology, and this framework engages their beliefs and actions (intentional or otherwise), and it is an ever-evolving, powerful process of meaning negotiation.

Globalization has had a substantial impact on learning, which has meant that other cultures learn from the dominant culture. Suarez-Orozco and Qin-Hilliard (2004) note that educational systems worldwide continue to mimic each other by borrowing curricula, teaching methods, and assessments and tests. In this way, cultural norms and values may be transferred from one corner of the world to another. Learners are thus expected to acquire a worldly cultural sophistication to be able to navigate such culturally rich and diverse educational content as presented by globalization of learning.

Research Questions

Research questions posed in this paper are as follows:

(a) To what extent do learners' cultures influence their interaction with educational technology?
(b) To what extent is learning successful or unsuccessful because of the influence of culture on educational content?
(c) To what extent do educational technology content creators' cultures influence the content they create?

Methodology

Considering that culture encompasses vast topics and subtopics, this research is based on a narrative review of literature so as to focus only on limited research terms. The search centered on terms like educational technology, culture in educational technology, and impact of culture on educational technology. This review scoured major educational databases like Association for Educational Communications and Technology (AECT) *TeckTrends*, JSTOR, ERIC, SAGE, EBSCOhost, PsycINFO, ProQuest, Springer, Elsevier, and Google Scholar, among others.

Baumeister and Leary (1997) state that one purpose of a review of literature research is to reveal problems, weaknesses, contradictions, or controversies in an area of investigation and from multiple sources. The literature review method was also selected because it enabled the research to examine the gap in knowledge on the effects of culture on educational technology. In addition, the narrative review of literature method was chosen because it connects various articles and provides clarity to the topic. Cronin, Ryan, and Coughlan (2008) point out that a narrative review of literature identifies inconsistencies in a body of knowledge, thus helping the researcher to determine or define research questions or hypotheses. Results from this research could spark a new paradigm of creating educational content that is perpetually consistent with the cultural consideration of the learners.

This research considered culture only in the context of learning design and how this affects learners. Benson, Joseph, and Moore (2017) have noted that meaningful learning occurs when authentic learning activities are designed within natural contexts, which can improve transference to new and real-world problems. Such natural contexts are embodied within learners' cultures, and learning design practitioners should take this into consideration in their plans. Asino, Giacumo, and Chen (2017) state that it is important for learning designers to take into consideration the culture of their target audiences. They observe that without explicit focus on culture as a necessary component of technology learning design, those designing for audiences representing different cultural backgrounds risk creation of a diminished or even exclusionary experience of their audiences.

As it has been noted before, the definition of culture is fluid because it encompasses a myriad aspects of life. Considering that culture is wide and all-encompassing, this review does not intend to interrogate all aspects of culture but only limits itself to how culture influences and impacts learners on the design of educational websites and educational gaming.

Educational Website Design

Increasingly, educational institutions are availing their services and products across hundreds of cultures across the world through online education. In order to effectively interact with such diversified students and faculty bodies, educational websites and learning technologies must take into consideration their audiences' varied cultures while constructing these resources. Callahan (2005) notes that cultural differences have become an important issue in international interface design, but these website designs rarely pay attention to the cultural differences of their clients.

The language with which educational websites are written also affects how learners interact with them. Language can either enable learners to quickly interact with the content, or it can deter them from understanding the intended meaning, depending on their cultural backgrounds. Language also has powerful significance in culture as it allows communication between learners and the instructor. Often when it is not used within the local cultural context, it can distort meaning. An example is the use of different names for the same thing. For example, the game with 11 opposing players per team, one round ball and two goals, is called "soccer" in the USA, yet the rest of the world identifies it as "football." Another example is the "shopping cart" in the USA, "shopping basket" in the UK, and "shopping trolley" in Australia, all referring to the same thing. Therefore, in designing educational websites, instructional designers should remain alert to the cultural nuances and significance of language in their websites and tailor these to their audience.

In designing educational websites, several researchers caution that the audiences' cultures should play an important part in the process. For example, research on how various colors are culturally perceived by different audiences is an important starting point in addressing cultural biases in website design (Archee & Gurney, 2013). They found that different communities attached various cultural meanings to colors as used in website design. They thus urge designers to be purposeful in choosing colors and contextualizing them to the cultures of their audiences.

A significant amount of educational technology learning is conducted through website access, especially through learning management systems (LMSs). Positive outcomes have been realized when the website design is adapted to users' cognitive styles and abilities, including their cultures. Kralisch, Eisend, and Berendt (2005) especially note that culture can be understood in terms of the distribution of certain cognitive styles, needs, and preferences among the population of a country or a certain region. Using empirical studies, Kralisch et al. (2005) suggest that users have preferences for certain website structures and information presentations based on their culture. These are governed by whether they are from monochronic or polychronic cultures, which play a major role in learners' preferences. These, they note, can be fine-tuned by altering degrees of navigational freedom, reading order, text lengths, number of texts, and cross-referencing, among others.

Educational websites often use audio that is embedded in their websites to retain learner engagement. This audio can be music, which is a significant representation of culture. Over the years, the development of technologies has allowed the dispersion of music to many parts of the world. Music and sound in educational technologies have been used to prompt learners, to provide an interlude between learning units, and to celebrate milestones achieved by learners and other reminders. Because educational technology often derives from North America and Western Europe, this musical expression reflects an Anglocentric tradition in many cases. This means that the cultures of indigenous people and people who do not identify with Western cultures are often musically underrepresented in educational technology. Music is the salt by which culture is seasoned. Music allows cultural expression, it enriches and defines cultures, and it helps define cultural identity. Similarly, as McLoughlin and Oliver (2000) have noted, successful instructional design is often culturally inclusive such that learners can easily access learning resources in a manner that is aligned to their values, beliefs, and styles of learning. These researchers explain that highly contextualized content that is culturally specific is likely to meet the needs of the learners for whom it is intended.

Educational Gaming

Educational games have increasingly become instrumental in supplementing learner understanding of content. However, games are often laden with cultural overtones and constructs. To understand the rules required to participate in some educational games, learners need to immerse themselves in the cultural content with which the game has been designed. Learners who do not identify with the cultural symbolism within these games may not benefit from this instruction.

One attribute of gaming in educational technology is the use of animation. Animations are an important supplement to improve learners' understanding of the content given how graphics afford learners' comprehension of content and foster insight, especially in understanding abstract concepts. However, graphics are best interpreted when the content designer understands learners' cultural backgrounds. As Tversky, Morrison, and Betrancourt (2002) argue, visual presentation may not be a problem for learners; rather it is the perception and cognitive limitations in the processing of a changing visual that may deny the learner full understanding of the content. These cognitive limitations are partly due to the cultural incongruence between the learner and the content designer.

Educational gaming systems appear to perpetuate the society's dominant cultures. This has led to researchers like Henderson (2007) calling for the exploration of the systemic issues in educational learning systems that address power, control, and disadvantage present in these systems. She notes that the exploration of these issues is not present in models that attempt to address multicultural inclusion in learning technologies design. Dickson-Deane, Bradshaw, and Asino (2018) emphasize this point by noting that in educational technology-related research, culture tends to be ignored, treated with shallowness, invoked to speak about race, or used for blanket characterization of various groups that do not represent and conform to dominant perspectives.

Hamari, Koivisto, and Sarsa's (2014) study found that educational gamification increases learner motivation and engagement in the learning tasks, as well as increasing learner enjoyment in these tasks. However, gamification also has negative outcomes, such as the effects of increased competition, difficulty evaluating learning, and design features that may not address learner needs. The effects of increased competition are especially felt in cultures which do not promote active competition among learners. Many cultures promote cooperation and group learning among learners; however, educational games that actively promote a single winner at the expense of other learners neither reflect nor integrate the cultural backgrounds of these learners. Often it is also difficult to evaluate learners who use games because the measurement of effectiveness varies from motivation and engagement-related psychological outcomes to use behavior-related outcomes (Hamari et al., 2014). Other researchers have shown that student engagement is useful only if it is based on educational reasons (da Rocha Seixas, Gomes, & de Melo Filho, 2016; Beer, Clark, & Jones, 2010), and much of educational gamification does not show this. On poorly designed gamification features, researchers have found that many gamification-based solutions fail because they have been created on a whim, whereby they mix bits and pieces of gaming components without a clear and formal design process (Mora, Riera, Gonzalez, & Arnedo-Moreno, 2015). Poor attempts at gamification alienate learners, demotivate them, and can never fix a poor learning design model (Kumar, 2013).

Conclusion

In creating educational technology content, it is imperative that the influence of culture be taken into consideration. Al Lily, Borovoi, Foland, and Vlaev (2016) suggest that instead of overlooking societal and cultural values during technological developments in educational settings, these values should be given recognition and political weight by policy-makers and researchers. It is also noteworthy that the importation of educational technologies may contribute to an unbalanced power relationship that may make others reluctant to engage with foreign technologies. To make educational technologies culturally acceptable to locals, they should be modified for local contexts.

Parrish and Linder-VanBerschot (2010) remind instructional designers not to overlook culture in the analysis phase of the ADDIE process. They note that it is essential for instructional designers to familiarize themselves with the learners' cultures throughout the implementation phase, even through the evaluation stage. They suggest the inclusion of a cultural expert as part of the design team or having a team member plan a training event on culture before implementation of a website design. Similarly, Asino (2015) calls for culture-specific learning designs that integrate learners' languages and communicative lenses (e.g., by using visual kinesthetic and textual tools) that exemplify a more culture-specific design for learning that engages the audience to whom the learning is targeted.

Educational technologies are now global learning tools, and their use is continuing to increase. A study on the integration of culture in the unified theory of acceptance and use of technology (UTAT) model by Nistor, Lerche, Weinberger, Ceobani, and Hermann (2014) concluded that since higher education is increasingly being internationalized, the design of content, integration activities, gamification, and others must consider different expectations for the learners because of their varied cultural backgrounds. Designers of educational technology should thus adopt appropriate pedagogical frameworks that recognize the role of culture in learning. For educational technology to successfully engage learners, it should be designed to take into consideration learners' and instructors' cultural perspectives. As Zhao and Frank (2003) have suggested, technological innovation is less likely to be adopted if it deviates too greatly from the existing values, beliefs, and practices of teachers and administrators in a learning environment. As such, practitioners must consider how to reach diverse learners because education, without regard to culture, may not always address the learners' needs.

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Chapter 11
The Playable Case Study: An Online Simulation for Skill and Attitudinal Learning

Desiree M. Winters, Jason K. McDonald, Derek L. Hansen, Tanner W. Johnson, Jonathan Balzotti, Elizabeth Bonsignore, and Justin Scott Giboney

Introduction

One of the recurring challenges in education is how to help students develop the skills and critical thinking strategies that transfer from academia to professional practice. Expertise in any field is a complex network consisting of not only content knowledge but also skills, views, attitudes, and other dispositions that create a change in one's sense of purpose and identity. This leads to the patterns of thinking and acting that reflect those of a professional in the discipline (Lave & Wenger, 1991; Shaffer, 2006). Yet, despite this being well-known in educational research (Broudy, 2017; National Research Council, 2000), instructional systems still tend to focus on teaching the information related to a field or, in some cases, basic skills that might be used by a professional in practice. Too often, the attitudinal aspects of a discipline are not addressed, especially not in a manner integrated with the knowledge and skills with which they are related (Baartman & De Bruijn, 2011).

In this chapter we examine how knowledge- and skill-based learning might be integrated with broader views of learning that also account for changes in perceptions of the discipline and attitudes toward professional practice. We do so by reporting our work on a mixed-reality educational simulation that we call a Playable Case Study (PCS). First, we describe the elements that define a PCS. Next, we describe a specific PCS designed to introduce students to the field of cybersecurity and report survey data from a recent pilot study that illustrates the types of

D. M. Winters (✉) · D. L. Hansen · T. W. Johnson · J. Balzotti · J. S. Giboney
Brigham Young University, Provo, UT, USA

J. K. McDonald
Learning, Design, and Technology, University of Tennessee, Knoxville, TN, United States

E. Bonsignore
University of Maryland, College Park, MD, USA

B. Hokanson et al. (eds.), *Educational Technology Beyond Content*, Educational Communications and Technology: Issues and Innovations,
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attitudinal- and skill-based learning this type of simulation might encourage. Finally, we describe insights we gained from our findings about how the PCS simulation could further facilitate students' learning more than only the knowledge or factual components of a discipline.

What Is a Playable Case Study?

Playable Case Studies (PCSs) are interactive simulations that place students in an authentic scenario where they take the role of a member of a professional team (Balzotti, Hansen, Fine, & Ebeling, 2017). Like "virtual internships" (Chesler et al., 2015), they allow students to take on the role of a professional before they have the expertise to do so in a professional setting. The simulation poses a real-world problem associated with the professional discipline under study and unfolds in the form of a fictional story. Students interact with other team members, clients, disciplinary experts, or the public (all of whom are characters in the story) to solve the problem in an authentic manner. Students are also full participants in the developing narrative and have opportunities to influence the direction the story takes as well as the form in which they solve the problem under consideration. The PCS is also similar to the construct of epistemic games, a term which Shaffer (2006) used to express the "possible mechanism through which sufficiently rich experiences in computer-supported games based on real-world practices may help students deal more effectively with situations in the real-world and in school subjects" (Shaffer, 2006, p. 223). Indeed, a growing body of literature on "virtual internships" has supported this hypothesis, showing how they can lead to increases in career intent and self-efficacy (Chesler, et al., 2016). But rather than being either a fully computer-based activity or a simulation situated in the real world, a PCS includes components of both an immersive, simulated online environment as well as accompanying in-class activities and lessons facilitated by a teacher to provide educational scaffolding.

The PCS approach has also been inspired by a genre of transmedia storytelling known as alternate reality gaming (ARG), where the tools, messages, and interactions of the game are embedded into peoples' (players') everyday lives (Bonsignore, Hansen, Kraus, & Ruppel, 2013; Jagoda, Gilliam, McDonald, & Russell, 2015; Niemeyer, Garcia, & Naima, 2009). The culture encouraged by these means of interaction is known as "This Is Not a Game" (TINAG), meaning the simulation strives against interface forms that participants perceive to have been fabricated. Interactions take place in the context of authentic digital or face-to-face modes of communication as much as possible (Bonsignore et al., 2013). Whereas a traditional ARG is most often tied to a one-time event, usually driven by an entertainment or marketing goal (Hansen, Bonsignore, Ruppel, Visconti, & Kraus, 2013), the PCS is explicitly tied to educational goals and classroom activities. Students interact with the story's fictional characters via videoconferencing, e-mail, texting, chatbots, file sharing, and other disciplinary modes of communication. The teacher controls the scenario, taking the ARG role of the "puppet master" (Bonsignore et al., 2013, p. 27), but also supplements these interactions with assistance in solving the problem, providing opportunities for students to reflect on the experience and completing assessment activities.

The Cybermatics PCS: Design Description and Pilot Test

Having described the general PCS framework, we now present an example of a PCS we have developed called Cybermatics, named after a fictitious company which serves as the setting for the simulation. The Cybermatics PCS introduces students to the field of cybersecurity and aims at helping them learn what a cybersecurity career entails, along with what values are important to a cybersecurity professional. We chose cybersecurity as a focus because of the increasing demand for cybersecurity professionals in the United States and in the world. The United States, along with nations around the world, is seeking ways to attract more people to this critical field (Kay, Pudas, & Young, 2012). Being sought after are people who are skilled at adapting to change and comfortable with learning and applying new skills in constantly evolving industries, as well as people with skills such as teamwork, communication, and leadership and with a strong sense of ethics and integrity. For students to be successful as security analysts, they need to develop attitudes, skills, and values that will enable them to think creatively, problem-solve, contribute to a team, actively pursue new knowledge, and follow ethical patterns of behavior.

Cybermatics Design

The Cybermatics PCS is structured around five simulated days in the professional life of a penetration tester or an "ethical hacker," who is hired by companies to look for possible insecurities in their corporate networks. On the first day, students are hired into a cybersecurity firm known as Cybermatics and are assigned to a team beginning a penetration test for a home automation company called RipTech. The goal of the test is to try and breech RipTech's systems and identify vulnerabilities that can be patched. Throughout the simulation, students complete a number of technical tasks, including performing an SQL injection, cracking passwords, finding hidden files in a Linux system, and reporting the results of their work.

By completing each simulated day within the PCS, students learn terminology, technical skills to complete assigned tasks, and soft skills of working in a penetration test environment. All of these are situated in an authentic environment. Tasks for each day are assigned by the team's lead character and completed through a simulated set of tools, including (a) videoconferencing (prerecorded video segments), (b) a documentation section for code documentation and training guides, (c) a chat messaging system (actually a simple chatbot), (d) a terminal shell for running Linux commands, and (e) a reporting section for coauthoring the final penetration testing report (see Figs. 11.1, 11.2, 11.3 and 11.4).

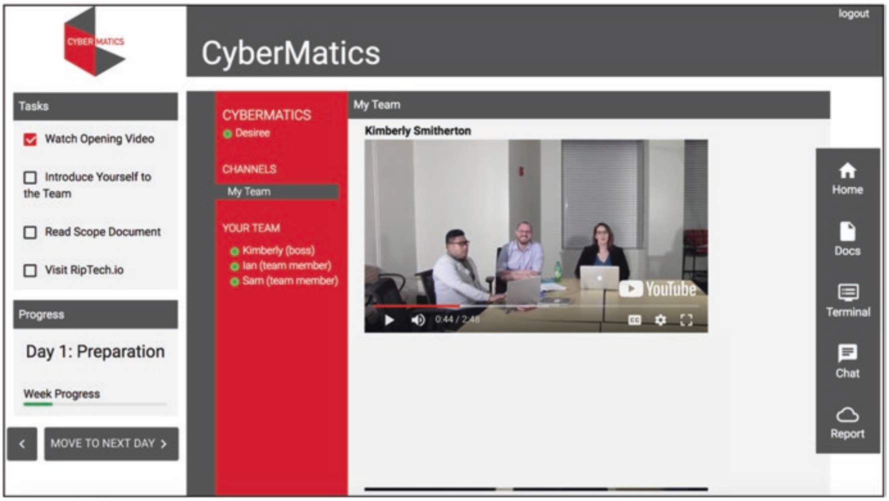

Fig. 11.1 Students meet with their virtual team through the videoconferencing interface

Fig. 11.2 Students find/use cybersecurity documentation to reinforce the content knowledge needed for the simulation

All of the PCS tasks are embedded in an overarching narrative, where students discover that a RipTech employee has built in a backdoor to the company's network. This would allow hackers to access customer data. As they work as part of the simulated team (e.g., responding to issues raised by characters in the simulation, performing assignments given to them by other characters, contributing information to team-based activities), their investigation results in identifying the employee and

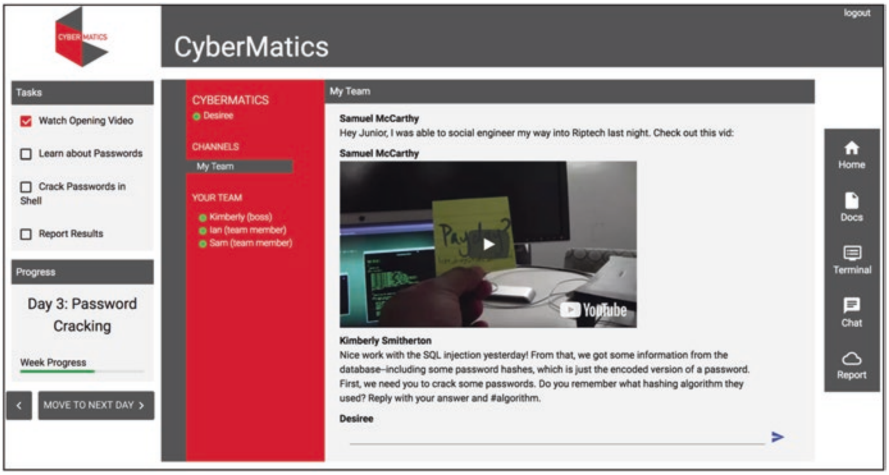

Fig. 11.3 A simple chatbot messaging system gives students additional information needed to complete scenarios/tasks

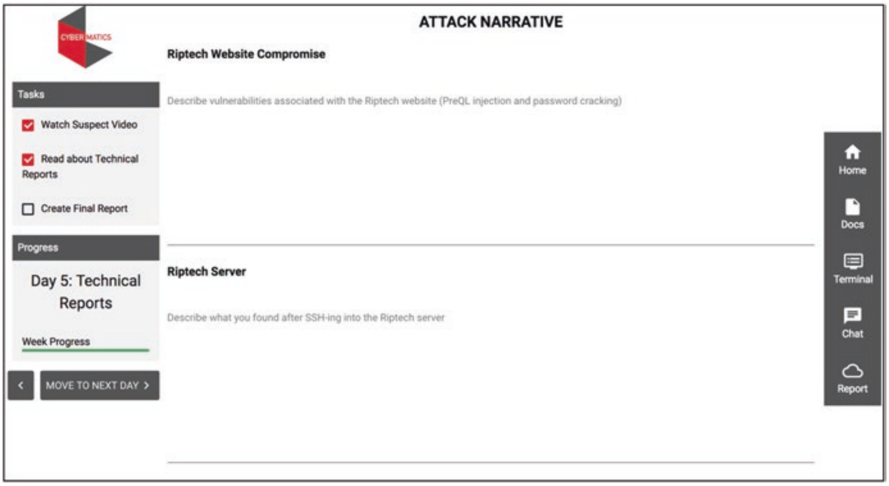

Fig. 11.4 The final report is where students synthesize what they discovered throughout the simulation experience

recording evidence of the wrongdoing, both of which are presented to the RipTech CEO in a final report.

There is flexibility as to how the PCS can be implemented in the classroom. Each simulated day in the PCS does not necessary correspond to a day in the real world. The PCS is meant for teachers to integrate into other learning activities associated with the teaching of cybersecurity over approximately a 2-week period. At various points throughout the unit, teachers may choose to have students complete portions of the Cybermatics PCS in-class and assign other portions as homework. Additionally, teachers may allow students to complete the PCS in teams; however, the online portion of the simulation has been designed as an individual experience. Students do not interact with each other during the simulation (all characters they encounter are fictional and provided by the narrative). Alternatively, the PCS activities may be incorporated as part of an online curriculum.

Cybermatics Pilot Test

To understand how the Cybermatics PCS might help students learn important skills and attitudes related to cybersecurity, we pilot tested it in an introductory, university information technology (IT) class. We gathered information from students through a pre- and post-survey (Creswell & Clark, 2017), administered just before and just after completing the PCS. Fifty-four students completed the PCS, with 51 of those providing demographic data, which is summarized in Table 11.1. Of the students in the pilot, 29 were declared as IT majors, 3 were open (or undeclared) majors, and the remaining 19 students were dispersed among other majors on campus: some closely related to cybersecurity, such as computer science, and others less similar, such as pre-management and communications. Most (86%) of the participants were between 18 and 23 years old, with the remainder being older.

The purpose of the survey was to gauge the students' interest and understanding of cybersecurity and their confidence in cybersecurity-related tasks. It consisted of both quantitative and qualitative questions, with questions such as, "What responsibilities/skills does a cyber security professional have?" In the post-survey only, students were asked additional questions regarding their experience with the PCS, including, "How have your perceptions about cybersecurity changed after completing the simulation?" and "This simulation made me more likely to pursue a career in cybersecurity. Yes or No?"

Table 11.1 Participant demographics

Year in school	**Count**	**Percentage**
Freshmen	16	31.3%
Sophomore	16	31.3%
Junior	14	27.5%
Senior	5	9.8%
Sex	**Count**	**Percentage**
Male	43	84.3%
Female	8	15.7%
Total	51	

Quantitative data on students' self-reported interest and self-efficacy was analyzed by calculating the percentage of students who responded "yes" to the yes/no survey questions, indicating that they intended to continue learning about the topics presented in the simulation, that the simulation made them more likely to pursue a career in cybersecurity, that the simulation made them more confident in their cybersecurity skills, and that they were able to complete all the tasks in the simulation effectively.

The qualitative data in the surveys was analyzed by themes emerging from the responses (Merriam & Tisdell, 2015). One member of the data analysis team reviewed the qualitative responses and created an initial codebook of emerging themes. A second member of the team subsequently studied the qualitative comments and refined this initial codebook. Then multiple team members, including the initial coders, reviewed how codes had been applied to individual comments and updated the codebook to resolve any conflicts between the previous reviews. Finally, the two original coders proceeded to recode the qualitative responses from both the pre- and post-surveys. They compared their results, made minor adjustments to their coding approach, and completed the final coding of themes that are reported here.

Findings from the Pilot Test

We found the PCS to be successful in affecting students' perceptions of and interest in the field, as well as helping students build a greater understanding of the field and develop some relevant skills. Although the majority of the participating students reported having little to no previous cybersecurity experience, 81% agreed that they intended to continue learning about the topics presented in the simulation. Seventy-two percent of students who participated in the simulation reported that the simulation made them more likely to pursue a career in cybersecurity. Seventy-seven percent reported that the simulation made them more confident in their ability to succeed in cybersecurity.

When asked to provide qualitative responses to questions regarding their experience with the PCS, students talked about specific elements of the experience that contributed to their learning, as well as ways in which the simulation altered their perceptions about, and interest in, cybersecurity. Tables 11.2 and 11.3 report themes that indicate how students' perceptions and attitudes were affected by the PCS, based on responses to the questions, "What did you like about the simulation?" and "How have your perceptions about cybersecurity changed after completing the simulation?"

Comments associated with these codes revealed how students' experience with the PCS influenced their skill development, perceptions about the work of cybersecurity professionals, and interest in the field as a possible career option. In the report that follows, we explore these themes using language from students' qualitative responses.

Table 11.2 Student responses to the question: what did you like about the simulation?

Theme	Total (pre- and post-survey)	Cohen's kappa
Realism – elements of the PCS seemed realistic	30	0.91
Educational – the simulation caused or aided in learning	14	0.94
Interactive – the simulation seemed interactive	7	0.72
Teamwork – simulation activities involved working with virtual teams	6	0.98
Helpful – elements of the PCS were helpful/useful	3	0.94
Problem-solving – simulation activities involved critical thinking and problem-solving	2	0.98
Experience level – congruence between simulation expectations and students' actual experience	2	0.96
Clarity – instructions were clear	1	0.91
Usability – few irritations in the simulation interface	–	0.98

Table 11.3 Student responses to the question: how have your perceptions of cybersecurity changed after completing the simulation?

Theme	Total (pre- and post-survey)	Cohen's kappa
Understanding – overall change in students' understanding of cybersecurity as a field, of related tasks, or of what a career in cybersecurity entails	20	0.87
No change	12	0.93
Importance – increased sense of the importance or relevance of cybersecurity	7	0.98
Interest – simulation had some effect on students' interest in cybersecurity or in pursuing a related career	6	0.91
Concern – increased concern about issues related to cybersecurity or feelings of personal vulnerability	2	0.93
Challenge – view that cybersecurity tasks are more challenging but less daunting than students previously thought	1	0.91

PCS influences on skill development Even though the tasks the students performed in the PCS were simplified versions of the work penetration testers perform, students reported that as they worked through the simulation, they did learn skills relevant to authentic cybersecurity tasks. One student commented, "I feel like I learned skills that I would actually use if I went on to learn more about cyber security." Another said, "I was able to learn simple coding to solve a problem."

In performing these tasks, students recognized and appreciated the scaffolding of the simulation and how they ultimately learned by doing, with an element of exploration to figure out a solution. One student noted, "I enjoyed how [the simulation] walked you through [the job] but left just enough info and instruction such that you still had to move through and test various methods out." Another said, "I like that it was interactive and not just 'read this, and then do this and press next, etc.', but rather that we got to figure things out." Yet another added, "I liked how the simulation showed a possible project or assignment someone in cyber security could be given. I didn't know what kind of project someone in cyber security would work on. …I learned more from the simulation than I would have reading about it on Wikipedia."

Students also enjoyed the educational aspect of the PCS and indicated that it helped them learn in a "hands-on" way, as indicated by the following comment, "The simulation was very hands on and allowed me to take the problem completely into my hands." And another student observed, "It was very engaging and helped give more 'hands-on' experience."

Perceptions about cybersecurity professionals Some students also indicated ways in which the PCS changed their perceptions of cybersecurity. These students indicated that their perception of cybersecurity changed from being "some obscure job description" to being "more realistic," "more hands-on," "more understandable," "more complex," and "more complicated." What had before been a shallow, and perhaps one-dimensional, perception became greatly enriched by the students' experiences with the simulation. One student, after completing the simulation, simply said, "I have a more realistic view of the day-to-day life of a security specialist." Many of his peers also developed a more enriched perception of what a cybersecurity professional actually does from their experience with the PCS. While this greater understanding does, in part, arise from content knowledge, the realistic, immersive experience of the simulation that allowed students to have an experience in the role of a cybersecurity professional allowed them to put knowledge in context, creating a holistic portrayal of the job. One student illustrated how the PCS helped her overcome stereotyped perceptions of cybersecurity in a particularly memorable way when she said, "Individuals in cyber security don't just sit in a bedroom in their pajamas eating day old pizza hacking without any human interaction. Cyber security is a team effort, and you have to be able to actively learn things that are relevant to the project. Knowing what it means to be ethical and having a diverse skill set are important to be successful."

Between the pre- and post-surveys, student comments about the skills and responsibilities of a cybersecurity professional also illustrate shift from more stereotyped to more accurate views of the scope of the field. As students' views become more accurate, they demonstrate greater content knowledge by using more precise language and also demonstrate greater understanding of the field with broader and more complete representations.

Before the simulation, for instance, one student said, "[Penetration testers] need to maintain systems safe from hackers." After the simulation, this same student responded:

> A Cybersecurity professional has to be able to communicate effectively with his team, he has to understand how databases are structured and how information is stored in order to know how to protect it. He has to be able to know what can be done and what should not be done - ethically, and then he has to follow that ethical code that he has developed in order to be trustworthy and professional in his work.

Another student, before participating in the simulation, said that cybersecurity professionals "need to be able to think like a malicious hacker would and have the skills to hack a system, so they can test for vulnerabilities. They need information on how to make the systems more secure and safe from hackers." In the post-simulation survey, this student reported:

> [Professionals] need to be ethical and follow the rules set out in the scope document. They need to be able to have good critical thinking skills and be dedicated to documenting the processes down. They need to have good programming skills and be able to think outside the box. They need to be able to communicate and work well with others and be good about sharing ideas.

We see further evidence of this perception change in the evolution between student's pre- and post-simulation survey comments regarding the skills and responsibilities of a cybersecurity professional (see Table 11.4). Many students' comments before participating in the simulation reflected a basic and stereotyped view, essentially that cybersecurity professionals focus on preventative security (mostly data security, with some references to system and network security). Four students referenced soft skills such as communication and/or teamwork; five referenced problem-solving, critical thinking, and/or creative thinking skills; and two mentioned the importance of ethics. After completing the PCS, this rose to 17 students reporting

Table 11.4 Comparing student responses to the question: what responsibilities/skills does a cybersecurity professional have?(pre- and post-simulation survey comparison)

Theme	Pre-survey total	Cohen's kappa	Post-survey total	Cohen's kappa
Preventative security – ensuring protection, security, and confidentiality of electronic data and networks; detecting potential threats	41	0.98	26	0.96
Knowledgeable – computer skills/knowledge/having training relevant to computers, IT, etc.	6	0.87	3	0.80
Stay informed – stay up-to-date on the most current information in the field	5	0.98	3	1.00
Reactionary security – investigate security breaches in networks, systems, or hardware, and fix security issues	5	0.89	2	0.91
Creative thinking – ability to think creatively and from different perspectives	4	0.98	10	1.00
Programming – explicit reference to programming/coding	2	1.00	13	0.98
Ethical – explicit reference to the ethics of cybersecurity	2	1.00	13	0.94
Attention to detail – being detail-oriented in work processes or assignments	1	1.00	1	0.98
Problem-solving – ability to analyze and think critically to solve problems	–	1.00	13	0.98

the importance of professionals to possess soft skills; 19 mentioned problem-solving, critical thinking, and/or creative thinking skills; and 13 referred to the importance of ethics.

Student interest in cybersecurity The PCS seemed to contribute to two kinds of effect on students' own interest in the field. On one hand, 81% of the students who participated in the PCS reported that they intended to continue learning about the topics presented in the simulation. Most of these students had little to no previous cybersecurity experience. After completing the simulation, one student noted:

> I'd really like to learn more about cyber security now. Computer science and excessive coding are two of the main reasons why I'd like to deal more with hardware like servers, but I'd certainly like to take a few classes on cyber security to become more informed on the subject.

Students with previous experience also indicated that they wanted to learn more; such is the case for a student with 4 years of experience in cybersecurity competitions who said, after completing the simulation, "I never really considered pen testing before, but now I want to learn more about pen testing as a useful skill to help secure my company's systems in the future."

The PCS also influenced how attainable students perceived a career in cybersecurity. After completing the simulation tasks, some students reported that cybersecurity seemed more understandable or doable, or less daunting than before, while other students reported that it seemed more challenging or more complicated. Student in both groups reported that the simulation made them more likely to pursue a career in cybersecurity. Perceiving cybersecurity as more doable seemed to help some students see cybersecurity as a potential career. One such student stated, "I feel like cyber security is an option now as opposed to before where I thought it would be completely over my head." Another said, "[it] seems like cyber security is something I could do, when though I've never even heard of it before. I am definitely more aware and more likely to go into cyber security as a professional." And perceiving the field as more challenging or complicated did not necessarily deter students from a career in cybersecurity, as illustrated by the student who said, "I find it harder than what I thought it would be, but I believe that it poses a challenge that I am excited to face."

Not every student demonstrated an interest in a cybersecurity career, however. In fact, some students explicitly indicate not being interested in cybersecurity after completing the simulation. One student's reflections on her experience with the PCS indicated that it deterred from a career in cybersecurity; she said, "I didn't really know what cyber security entailed before, but I learned enough to determine that it's not necessarily the profession for me, which is actually really good to know." As this student noted, it is not necessarily a negative outcome that students do not decide to pursue a cybersecurity career because of the PCS. This response now seems to be based on a more realistic assessment of the field, whereas before their reactions may not have been accurately grounded in the realities of cybersecurity practice.

Insights About the PCS: Facilitating Broader Views of Student Learning

Cybermatics has given us insights into the ways that the PCS educational platform can influence students beyond transferring content knowledge. We saw that students began to adopt the values of a cybersecurity professional as they assumed the role of one in the PCS. Similar to the findings in previous research on virtual internships as a means of providing meaningful experiences that help students assimilate the distinct skills, knowledge, values, identity, and epistemology of a specific community of practice (Chesler et al., 2015), we saw similar assimilation evidenced through student's changes in perception after participating in the PCS. We noticed this particularly in students' increased appreciation for ethics as an essential value for a cybersecurity professional after participating in the simulation, which was designed purposely to emphasize the importance of ethics in cybersecurity. In the simulation, emphasis was placed on the importance of staying within the legal scope document in all activities. The fact that the PCS was successful in helping students assimilate this essential value of the cybersecurity community of practice and therefore develop a greater attitudinal affiliation with the field demonstrates the capability of the PCS platform of helping students adopt values and attitudes which will help them identify with a specific community.

Furthermore, the PCS platform allows students to have an immersive experience in a given field or community of practice insomuch that they will be able to replace false preconceptions with more accurate perceptions. This is a particularly desirable goal in the field of cybersecurity, as stereotypes of computer science tend to dissuade some individuals, particularly women, from careers in the field (Cheryan, Plaut, Davies, & Steele, 2009; Diekman, Brown, Johnston, & Clark, 2010; Master, Cheryan, & Meltzoff, 2016). Students' comments indicate that the students were able to project themselves into the role of a cybersecurity professional, and as they did so, their attitudes toward the field shifted from a stereotyped view to a more realistic view. This finding poses exciting opportunities for the Cybermatics PCS to play a role in attracting students to the field of cybersecurity: While many students expressed an interest in learning more about cybersecurity after completing the simulation, and a couple of students indicated that the simulation helped them determine that cybersecurity is not the profession they wish to pursue, students in both areas seemed to have developed a more complete understanding of the what a cybersecurity professional's work is really like. This more accurate understanding is essential for students who are making decisions that will ultimately set them on a path toward their future career. It also has intriguing implications for the possibilities that the PCS platform has in abolishing misconceptions and helping students gain more accurate understandings and therefore more grounded decisions on whether or not to pursue studies in other areas.

One of our objectives in designing the PCS was to help students see themselves as people who could be successful in the cybersecurity field. Some students who reported that the simulation made them more interested in pursuing a career in cybersecurity felt that the simulation made cybersecurity seem more challenging or more complicated than they had originally thought, while others claimed that the simulation made cybersecurity seem less daunting or more doable. Therefore, we speculate that there is value in making the unfamiliar familiar to students and that certain types of students desire challenge. If this is the case, it seems that students in the former category (perceiving cybersecurity to be more challenging) view the concept of a challenge favorably and feel capable of meeting the challenge or capable of developing the skills required to do so, while students in the latter category (perceiving cybersecurity to be more doable) seemed to feel that the unknown was made more familiar and was therefore made more accessible to them through the simulation. Future research is needed to determine why students presented these two different responses regarding the way the simulation reflected their perception of the challenging nature of the field while still reporting that the simulation made them more likely to pursue a career in cybersecurity.

Conclusion

In this chapter, we have examined how knowledge- and skill-based learning might be integrated with broader views of learning that also account for changes in views and attitudes. Through discussion of a pilot study conducted on an educational simulation called a Playable Case Study, we have suggested that this type of simulation holds promise for helping to integrate skill and attitudinal learning into traditional knowledge frameworks. Based on our results, we view the PCS model as one approach for helping students develop accurate perceptions of a professional field under study, thereby increasing some students' interest in the field and allowing them to make more informed decisions about whether or not to pursue further learning (or even a career) in that discipline. We also see potential for the PCS model in helping students adopt the values of a specific field and project themselves into the role of a professional in that field. While this is certainly valuable in cybersecurity, a particularly rapidly growing field, we believe the PCS model could be adapted to many different fields or disciplines and begin to help students develop the skills, adopt the values, and form more accurate perceptions of those fields.

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Chapter 12
A Content-Agnostic Praxis for Transdisciplinary Education

Deena Varner, Colin M. Gray, and Marisa E. Exter

Introduction

Transdisciplinary Studies in Technology (TST) is a hybrid competency-based undergraduate program at Purdue University in which students develop innovative solutions to complex, real-world problems. The program was developed as part of a larger initiative within the Purdue Polytechnic Institute to create educational experiences aimed at preparing students for career success, even if those careers may not yet exist (Exter, Dionne, & Lukasik, 2015; Purdue Polytechnic, 2018). Central to the program's design was an emphasis on the equal standing and importance of the content, theories, practices, and methodological approaches of both liberal arts and technology (Exter, Ashby, Gray, Wilder, & Krause, 2017). Ideally, the true integration of these perspectives would be core to a complex and holistic understanding of contemporary technological and social challenges. This humanistic-technological approach allows technologists to address the social dimensions of technological problems and humanists to address the technological dimensions of social problems. Ultimately, our goal has been to remove the distinction between technologist and humanist, so that graduates approach all problems systemically and develop innovations that bridge the social-technological divide.

Students in the TST program declare at least two disciplinary or interdisciplinary focus areas from across the university. At least one must be technology focused and at least one must be liberal arts focused. Students enroll in the program's 8-h *Studio*

D. Varner (✉)
NYU Shanghai, Shanghai, People's Republic of China
e-mail: deenavarner@nyu.edu

C. M. Gray · M. E. Exter
Purdue University, West Lafayette, IN, USA

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class for their first six semesters, and then participate in a capstone project during their final two semesters with students from other majors in the Polytechnic Institute. Students remain together in their cohort throughout their 4-year experience in the program, taking the variable-content Studio each semester. Thus, program outcomes are met in part through a spiral model of learning (Exter et al., 2015; Van Epps, Ashby, Gray, & Exter, 2016), in which students broaden their depth of knowledge and practical experience across the program's 20 competencies over the 4-year experience.

The 20 TST competencies are content agnostic insofar as they foreground the attainment of broad-based and transferable twenty-first-century skills such as problem solving; design thinking; systems thinking; entrepreneurship; quantitative reasoning; oral, written, and audiovisual communication; arts and culture engagement; critical thinking; leadership; and responding to conflict. Students learn, apply, and are assessed on these skills in Studio and are supported in developing a digital portfolio of their competencies in the program's Portfolio class (Van Epps et al., 2016). The digital portfolio is envisioned as a holistic archive that represents students' competencies and their integration of disciplinary perspectives as they move through the respective levels of each competency.

As faculty that have contributed to this program, we view transdisciplinarity as both a process and a paradigm. As a process, students move through several stages, first becoming familiar with disciplinary content and methods, then transferring knowledge and skills from one discipline to another, and finally selecting from and using multiple disciplinary perspectives (see Ashby, Exer, & Varner, 2020). As a paradigm, transdisciplinarity is a framework for acknowledging that all methodological approaches have limitations and for overcoming some of these limitations by working *across, beyond,* and *through* multiple disciplines in order to solve specific problems or accomplish certain goals. In the TST Studio, students learn to adopt this process and paradigm as they use sometimes disparate knowledges and methodological approaches to confront ill-structured, real-world problems (Gray, El Debs, Exter, & Krause, 2016; Gray, Exter, & Krause, 2017). While students attain much of their disciplinary background and related knowledge outside the TST program (i.e., through learning experiences across the university or outside of it), the program is designed to support students' exploration of these disciplines in the context of social and technological innovation. This environment encourages students to reflect on disciplinarity and to transfer and synthesize key concepts, common forms of evidence, methodologies, and approaches to inquiry from multiple disciplines.

Both Studio and Portfolio classes are discipline agnostic. Historically, faculty have come from diverse disciplinary backgrounds in both liberal arts and STEM fields. Courses are designed to support students in meeting their own academic and practical goals. For this reason, faculty disciplinary expertise is less important than their ability to guide and mentor students to ask pertinent questions about their fields of interest, navigate and disrupt various disciplinary conventions, and become adept at applying the program's competencies across disciplinary formations. This framework allows students and future practitioners to gauge the limitations, rules,

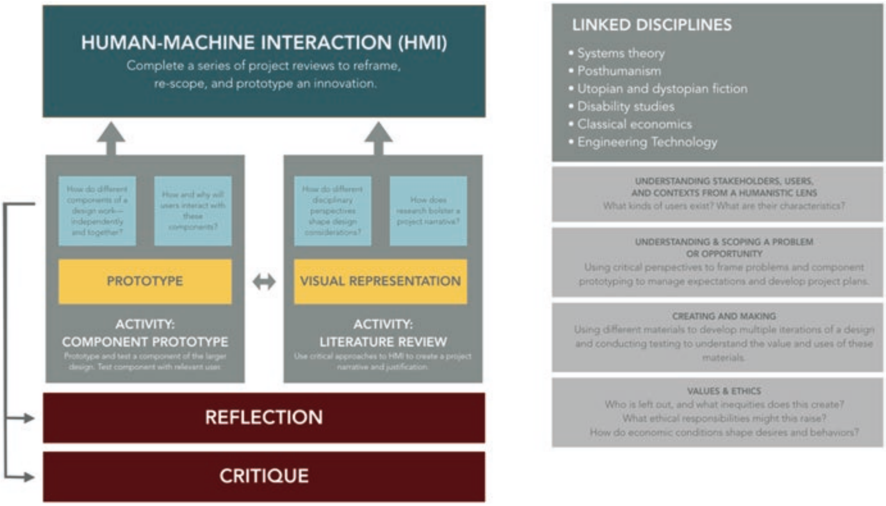

Fig. 12.1 Studio course with the theme of human-machine interaction

and biases of their chosen focus areas; to "play" with the various knowledge, skills, and abilities that they attain across the university curriculum; and to develop a unique transdisciplinary identity. Course content is contingent on its applicability to students' goals and its ability to help students grapple with disciplinary integration.

Vignette: Grappling with Multiple Design Dimensions

In their third year in the program, our first cohort was tasked with designing their own completely self-directed projects. They spent the first semester conducting research and developing project proposals. By the end of the semester, however, most students had proposed projects that were simply too large in scope to be completed meaningfully by the end of the year—a similar challenge experienced in the students' second year (Gray et al., 2017). Thus, the second semester course had two major goals. The first was to help students engage deeply with the processes of project scoping and time management, so that they could develop prototypes of their self-directed designs by the end of their third year. The second was to continue practicing relevant disciplinary integration and applying humanistic approaches to what were largely technology- or design-focused problems.

Most students were working on human-centered design projects. One student was interested in educational game design, while another wanted to build a lifestyle website, and yet another was interested in improving spacesuit technology. Thus, the course was designed to focus on human-machine interaction vis-à-vis the theme of cyborgs (see Fig. 12.1). At the level of its transdisciplinary epistemological considerations, the course aimed for students to consider how technology is inseparable from what we call humanity. In other words, how could students' projects be shaped by the understanding that technology is not just a supplement to human life but one of its constitutive elements?

Like most Studio courses, this one asked students to engage with a variety of disciplinary and interdisciplinary content that addressed the course theme: A French new wave film, a contemporary novel, passages from classical economics, a podcast episode about paradigm shifts in technology, an ethnographic study. And it also provided students with materials and a structure to support them in reiterating, re-scoping, and then prototyping their projects. Students conducted four project reviews. For each, they explained how their understanding of human-machine interaction had deepened and contributed to a new design iteration, and each review focused on a different aspect of project scoping and prototyping. Initially, some students were disappointed that their "big ideas" were substantially reduced. Faculty responded to students' disappointment by encouraging them to consider that design work is almost never done in total isolation and that their big ideas may have been accomplished had they been working in large project teams. While the disappointment of some remained palpable, even these students mostly felt proud that they had ended the year with a professional design prototype that could be shared with potential stakeholders.

Praxis

Action and practice are commonly thought to be different from, and even opposed to, the abstract thinking that often characterizes theory. While Aristotle was the originator of such a distinction, he also developed a concept of praxis or *creative doing* inspired by theory, which undermines this same distinction. In this chapter, we refer to praxis as the dialectical synthesis of theory and practice, not with the goal not the putting theory *into* practice, but rather of creating knowledges and practices vis-à-vis theoretically informed action. Neither theory nor practice plays a dominant or subservient role. Instead, through a synthesis of practice and theoretical knowledge, practice emerges from theory and theory emerges from practice. Paulo Freire (1970/2006) positions the development and activation of praxis in a pragmatist frame, describing this interaction as "reflection and action which truly transform reality" (p. 100). This understanding of praxis also resonates with reflection on action (c.f., Schön, 1983) in the design tradition, which, along with a commitment to design as a way of knowing and acting, facilitates the "reconstitution of *sophia* [(wisdom) via] the integration of *thought* and *action* through design" (Nelson & Stolterman, 2012, p. 11, emphasis in the original).

Academic formations have become increasingly interdisciplinary. Over the last decade, for example, the digital humanities have emerged as an important domain for developing new, technology-driven methodological approaches (e.g., Warwick, Terras, & Nyhan, 2012). And technology and design spaces have increasingly come to understand the importance of humanistic and social scientific knowledge in producing innovative solutions to complex problems (e.g., Rogers, 2004). However, these integrations many times continue to speak only to the broad disciplinary formations from which they emerge. Digital history projects, for example, have used technology to shift what historical knowledge looks like, but rarely do they shift what technological knowledge looks like. Similarly, technology programs that incorporate liberal arts thinking have shifted what technological knowledge looks like, but much more rarely have they shifted what liberal arts knowledge looks like. Our vision for TST students is the development of a praxis that may push these epistemological distinctions further still, in order to produce the kinds of shifts we may not even be able to envision yet. Students are asked to engage with and even create humanistic knowledge for the purposes of advancing their technical, creative, and design work. Ideally, they will also view the practical and technical skills they learn as tools for producing new methodologies, methods, and theories across the sometimes very different domains they wish to work in, including in liberal arts spaces. This may mean, for example, that students designing educational games will not only use their knowledge from the discipline of education to shape their game designs, but that they will use their knowledge of game design to ask new questions and produce new knowledge in the education space.

As it is for Freire, praxis is often taken to be a tool of revolution or subversion. Or as Nelson and Stolterman (2012) contend, praxis is a mechanism for creating the *not-yet-existing*. We view praxis as a particularly apt grounding metaphor for the curriculum we offer and the learning that takes place in our program, since our paradigm, at its core, is disruptive of the oftentimes rigid disciplinary, organizational, and hierarchical structures which constitute the traditional university and the relationships, for example among students and faculty, which exist there. We frequently encounter difficulties when we try to articulate the merging of technological with social scientific and humanistic inquiry and practice and find ourselves, however unintentionally and as impacted by our disciplinary training, relying on language and concepts that seem to indicate that one serves the other.

As a multidisciplinary team, we also confront frequent misunderstandings or miscommunications, in part because of our reliance on own disciplinary lenses and languages. A computer scientist and a sociologist may have very different views about high level concepts such as systems thinking, not to mention practical and epistemological dissimilarities about what constitutes, for example, texts, reading, or empathy. Finally, we must also take into account the meaning our language and concepts may have for students who are not yet steeped in any disciplinary vocabulary, as well as parents and other stakeholders. Our own praxis, as researchers, curriculum designers, and instructors, has been to enact the same kind of creative doing—in the research and teaching spaces—that we ask our students to participate in, creative doing that will eventually allow us to find new concepts and new practices to bridge the epistemological and practical divides that seem to separate technology and the liberal arts.

Competency-based education more broadly, insofar as it focuses on students' behaviors rather than the level of their performance or how they compare to their peers, also unsettles the traditional model of student learning and assessment.

Within such a paradigm students may be freer to engage with faculty as mentors and collaborators rather than as authority figures or knowledge experts. The TST program, as discipline agnostic, encourages faculty to collaborate with and bring into the classroom knowledge experts from across the university and to serve as guides in the learning process rather than experts. With this model of instruction and faculty mentorship as its basis, undergraduate education can facilitate students' development of praxis to effect social and technological innovation across disciplinary boundaries by facilitating deep engagement with three interrelated processes: habits of mind, ways of knowing, and the adoption of a transdisciplinary, content-agnostic skillset.

Habits of Mind

We define habits of mind as attitudes or orientations towards learning, problems, and knowledge. Here, we describe three interrelated habits of mind that allow students to develop a self-reflexive relationship to their work, peers, and environments: critique, empathy, and reflection.

By critique, we refer to a means of engaging with, communicating, and evaluating designed artifacts at any stage of their creation or use. A mindset of critique connotes that students are open-minded, flexible, and willing to engage in deep collaboration with peers, coworkers, faculty, and stakeholders (e.g., Gray, 2013). Critique is central to design education and to the TST studio experience, where students are consistently engaged in project work. In 2017, both formal and informal critiques were integrated into the first-year studio experience on a near-weekly basis. This first-year, first-semester experience was designed to highlight two major aspects of the design process: problem framing and iteration. During each learning module, students framed a problem from a predetermined context, defined in advance by the instructional team and outlined in the syllabus, by working through and then applying interdisciplinary content. One day of each learning module was dedicated to informal, small-group peer critique, and one day was reserved for more formal, full-group faculty and peer critique. In this more formal setting, students were required to note and make decisions as to the relevance of each comment and to justify their decisions about whether or not to incorporate each comment. In critique, several transdisciplinary competencies are foregrounded, including oral communication and active listening.

Our second habit of mind, empathy, is activated in the process of active listening. Empathy is a core "soft skill" (e.g., Walther, Miller, & Sochacka, 2017) that allows students to grapple with difference and examine and address systemic social inequities, for example, those related to race, class, and gender. Empathy is also a cornerstone of design education and practice, insofar as it allows students and practitioners to understand and address the needs of stakeholders. It is the ability to shift perspectives and acknowledge the inner experiences of those who may not share the designer's background (e.g. Thomas & McDonagh, 2013) with regard to age, race, gender, political or religious beliefs, and so on. In user-centered design, empathy increases the likelihood that practitioners will grasp the complexities of users' lived experiences and the contexts in which their lives are lived (e.g. Koskinen, Battarbee, & Mattelmäki, 2003). The transdisciplinary nature of our program allows students to engage in the kind of robust qualitative research necessary to foster this kind of deep empathy. By studying a variety of humanistic and social scientific methodologies for producing knowledge, students may move beyond cursory examinations of demographic data, for example, and instead develop robust theoretical or ethnographic studies to better understand the contours of their users' lives.

Our third habit of mind, reflection, is one of the primary pedagogical tools we have for fostering this kind of empathy. Reflection allows students to engage with their stakeholders and their own learning experiences, develop a sense of their progress in attaining and mastering skills over time, engage in self-critique, and become more effective, lifelong learners (e.g., Tracey & Hutchinson, 2016). Reflection is built into our curriculum in several ways. First, as they create submissions documenting their attainment of competencies, students not only have to show evidence of the skill or ability, but they also explain how the skill or ability was attained over the course of a project or learning experience. The metacognition required in this process ensures that students are able to transfer a skill or ability across a range of problems or projects. This reflection process often entails a description of the project or learning experience, an identification of which aspects of the project or process meet the specific outcomes outlined in the competency, and an evaluation of the strengths and weaknesses of the project or process. Narrating their own learning in this way allows students to develop a sense of their work as embedded and implicated in broader systems and to "tell the story" of their work to others.

Reflection has at times functioned as a hidden aspect of the curriculum, and it has been among the more difficult habits of mind for students to adopt in consistent and meaningful ways. For this reason, reflection was added as an explicit outcome in the 2017 first-year Portfolio class. While students struggled to identify the importance of reflection to their practice, they showed significant improvement in their reflective skills over the course of the semester versus previous cohorts, where reflection remained implicit. Reflection is a means to an end, for example, insofar as it is a tool to aid in or improve communication, but by focusing on reflection as an end in itself, rather than *only* a means to an end, students may be more likely to use reflection as a tool to improve their empathic abilities. By reflecting consistently and over time on their personal and professional experiences, goals, and values, students develop a sense of personal and social responsibility, the way these are reflected in, and how they can drive, their work (Nelson & Stolterman, 2012).

Ways of Knowing

We define ways of knowing as conceptual or theoretical frameworks for understanding the world, as well its socially and culturally situated challenges. Broadly speaking, students should develop a sense of the way knowledge is produced and disseminated across a variety of disciplinary and real-world domains. They should be able to identify some of the epistemological assumptions undergirding disciplinary formations and to analyze and interpret how these epistemological assumptions shape the kinds of questions that are asked, knowledges produced, and innovations implemented across these domains (Gray & Fernandez, 2018). For example, if a student is interested in solving an ill-structured or systemic problem, she or he will ask questions about this problem that emerge from a variety of disciplinary and real world spaces, including, potentially, unusual or even ill-fitting spaces. By understanding that problems are context-specific, understood differently across different domains, and open to interpretation, students can develop rigorous research and practice agendas for solving problems while remaining intellectually flexible.

Different topics and content are incorporated into Studio each semester, allowing students to engage with and frame their problems in novel ways. While content in the TST program is often contingent and replaceable, it is nonetheless an important tool for guiding students through these processes. In the 2017 first-year experience, focused on problem framing and iteration, interdisciplinary content played a central role in allowing students to grapple with knowledge production. We provided students with a simple, albeit ill-structured, problem: that playground equipment is often non-innovative, outdated, and boring. The goal was for students to frame and reframe this problem in various ways throughout the course of the semester, based on sometimes well-suited and sometimes tangentially related interdisciplinary content. A well-suited content area, for example, was embodiment. Students read material from the fields of phenomenology and gender studies and were asked to take an embodied approach to playground equipment design. They viewed the playground from different embodied positions, threw tennis balls with their non-dominant hands, and practiced moving their bodies based on stereotypes they had about gender. A tangentially related content area was criminal anthropology. In this learning module, students read nineteenth-century criminology in order to understand the once-dominant epistemological view that personality and behavior were dictated exclusively by biology. The semester's content was chosen, in other words, to showcase a diversity of epistemological and methodological frameworks that students could use to frame ill-structured problems.

Students in the program choose their own disciplinary focus areas, and they bring related content and methodology into Studio. A central feature of the instructional model is collaboration among faculty and students. In this way, faculty should allow students' emerging disciplinary identities to shape future iterations of the learning experience. For example, when students are interested in psychology or education, faculty may choose to incorporate articles or studies from these disciplines in order to work through them with the entire class. This gives individual students, and the class as a whole, the opportunity to grapple with questions of epistemology and methodology that may not arise in the undergraduate curriculum from which it is drawn. By working through material with students as non-experts, faculty can guide students through the process of transferring and synthesizing sometimes disparate ideas and methods in the context of project work.

Transdisciplinary, Content-Agnostic Skillset

Our program includes five content-agnostic competency areas, which have been honed across the 4 years of the program's existence (Ashby et al., 2020; Ashby, Exter, Matei, & Evans, 2016; Exter, Ashby, & Caskurlu, 2017; Exter, Caskurlu, Ashby, & Dionne, 2016): create and innovate; engage in culture, values, and the arts; inquire and analyze; communicate; and interact with others. For brevity's sake, we will discuss only the first three. Each of these areas comprises a subset of related skills and abilities.

By attaining competence in creativity and innovation, students will achieve proficiency in design thinking, problem solving, entrepreneurship, and systems thinking. Engagement with design processes is a central methodology for student creativity and innovation. Design is transdisciplinary or discipline agnostic insofar as it is a body of knowledge and practices whose aim is to address ill-structured problems that are situated in complex and often interrelated systems. Performance indicators for design thinking include identifying and framing problems, identifying and testing multiple design solutions, conducting user research and testing, and prototyping. While design thinking is one method for solving problems, students also develop competence in other problem solving methodologies in the context of the problem solving competency. In these two areas, students observe, empathize, conceive, plan, execute, test, and reflect in order to identify problems, create solutions, or adopt new practices. Systems thinking encourages students to describe, analyze, and envision a system as a dynamic entity of interacting and interdependent elements acting as a whole. As systems thinkers, students' creativity and innovation are strengthened by their ability to see how problems are situated in complex social, cultural, legal, political, and other systems. Similarly, entrepreneurship fosters creativity and innovation insofar as it encourages students to understand potential needs, markets, and stakeholders and to develop and act on opportunities that will have value to those markets and stakeholders.

In the second area, engage in culture, values, and the arts, students make decisions and accept responsibility in the context of culture, values, and worldviews, and they act with an understanding of the socioeconomic, ecological, and cultural interdependence of contemporary, global life. In culture engagement, students identify what constitutes culture and cultural groups; analyze how actions, perspectives, and values emerge from culture; and evaluate their own cultural perspectives and biases. In arts engagement, they identify and analyze how art and made objects, as well as aesthetic values, emerge from culture and how art makes statements or tells stories about culture. In ethical engagement, students identify the ethical stakes of their problems or projects and analyze the ethical implications of different courses of action.

Finally, in inquire and analyze, students learn to integrate, synthesize, and produce new knowledges and make informed and critical judgments about the world around them. They learn to think critically, discriminating between relevant and irrelevant information, analyze and synthesize information or knowledge about a topic, and question their own and others' assumptions. In this area, students also demonstrate competence in quantitative reasoning, both analyzing and creating information represented quantitatively and drawing conclusions from this data. By embracing the kind of complexity foregrounded in these areas, students can draw on multiple epistemological and methodological frameworks to understand and solve problems.

Conclusion

While the curricular areas we have discussed are conceptually discrete, they are also interrelated, and students are better able to grasp their holistic nature armed with the habits of mind and ways of knowing outlined above. At the same time, this learning process is non-linear. Habits of mind do not come "before" or "after" ways of knowing or the attainment of transdisciplinary knowledge, skills, and abilities. Instead, these three processes are interrelated and often overlapping in the curriculum; some of the habits of mind and ways of knowing we have identified are also embedded in our transdisciplinary skillset, and some habits of mind, such as reflection, are required to demonstrate competence in the content-agnostic skillset.

The program offers two courses, the Studio and Portfolio classes. As we continue to develop this learning experience, ideally these courses should be well integrated, with faculty from each collaborating to show students how they may be using a variety of content-agnostic skills, such as culture engagement, systems thinking, quantitative reasoning, or communication, even where these skills are not the explicit topic of instruction. Such integration and collaboration can make the curriculum more transparent to students and encourage them to participate more actively in each aspect of the learning process. Ideally, the kind of learning that will happen in the TST program will blend design and technical education with humanistic and social scientific education. At the same time, it will merge theory with practice, inviting students to develop their own praxis for implementing the kinds of social and technological changes they wish to effect in the world.

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Chapter 13
Designing Instruction for the Age of Singularity: A Transactional View as to How Knowledge Is Synthesized

Robert F. Kenny and Glenda A. Hartley Gunter

Environment is process, not container – Marshall McLuhan

Background

Historically, knowledge has been viewed as an asset in that, once it is "owned" (i.e., acquired) by an individual, it can never be taken away (Rowley, 2000). First and foremost, we need to distinguish between the concepts of information acquisition and knowledge acquisition. The latter is the third in a five-step process of deep learning with data, information, understanding, and wisdom filling out the continuum (Ackoff, 1999). For this reason, we suggest that the term "knowledge acquisition" that appears to be so often in the literature may actually be a misnomer (Compton & Jensen, 1990). What many may be referring to is actually information acquisition. For the purposes of this chapter, however, we may interchange the two terms with this caveat in mind.

The authors suggest that Google may be a catalyst for changing one's connotation of information/knowledge and how it is acquired (Brown, 2000; Dalkir, 2017). Many believe that we have only recently begun to enter a "post Guttenberg" era in which printed text is no longer viewed as the primary medium to teach and learn things (Kenny, 2011). As Web browsers and search algorithms have evolved, they have facilitated deeper informational dives by learners who more fully contextualize during the knowledge acquisition process (Efimova, 2004). At the turn of the current century, during what is often referred to as the beginning of the Information

R. F. Kenny (✉)
Florida Gulf Coast University, Fort Myers, FL, USA
e-mail: rkenny@fgcu.edu

G. A. Hartley Gunter
University of Central Florida, Orlando, FL, USA

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Era, knowledge (not information) was still valued as a thing to be owned and coveted with information and data remaining as commodities (McLoughlin & Lee, 2007). We suggest that we are fast closing in on an evolving view of how Artificial Intelligence (AI) is attempting to add knowledge to the list of commodities that exist in the learning experience. Alphabet, Inc. (the holding company that owns Google) has been working on this perspective for some time. This initiative, led by one of its AI visionaries and former Directors of Engineering, Ray Kurzweil, appears to have as its corporate mission to be the primary and unitary source for not only information acquisition but also knowledge assimilation and synthesis (Gilder, 2018).

Being futuristic about learning often involves a great deal of awkwardness and forces one to face controversial issues that have no apparent solution. Not surprisingly, one such perspective emanates from Kurzweil himself who predicted that technological singularity would happen sometime in the next 30 years (Reedy & Galeon, 2017). According to Kurzweil, *singularity* is that point in the evolution of humans when they transcend their purely biological characteristics. He hypothesized that the invention of an artificial "super" intelligence (something that Google has been attempting to create) would trigger runaway technological growth with an upgradable intelligent agent (i.e., a computer) that would far surpass all human intelligence.

Kurzweil, although he is often credited with initially suggesting the concept of singularity, may not have been the first to make such a reference. In 1994, McLuhan (as quoted posthumously by his son) stated:

> Hypnotized by their rear-view mirrors, philosophers and scientists alike tried to focus the figure of man in the old ground of nineteenth-century industrial mechanism and congestion. They failed to bridge from the old figure to the new. It is man who has become both figure and ground via the electro-technical extension of his awareness. With the extension of his nervous system as a total information environment, man bridges art and nature. (p. 11)

Many believe that Kurzweil's predictions are a logical next step in McLuhan's original ideas about technology being an extension of man. Pondering the effects of the dependence that humans currently have on the electromagnetic spectrum, in its extreme, this overdependence brings to mind how our enemies could actually devastate our cultural existence without even firing a shot (Kopp, 1996).

In this apocalyptic view, it may not matter if man and machine may ever become as one, as Kurzweil suggests because we are approaching a time when this dehumanized notion of media and technology effects on man's thinking may become real and not just a symbolic extension. This view of evolution and the way that Alphabet, Inc., is approaching is not dissimilar to what is known as the "Infinite Monkey Theorem" that is often referred to in classical literature and popularized in the early twentieth century by Émile Borel (1913) and others (Eddington, 1928). That theory is often quoted as the basis for the notion that it is statistically probable that an infinite number of monkeys sitting in front of an infinite number of typewriters and given an infinite amount of time would be able to recreate the world's great works. According to George Gilder (2018), Alphabet's implementation of AI, as once led by Kurzweil and others, is founded simply on a concept by which Alphabet would overcome the time and resources barriers by providing what was previously thought to be an unlimited amount of information at speeds approaching the speed of light. Gilder and others have disputed Alphabet's conceptualization of artificial intelligence on multiple levels – first and foremost because even story creation alluded to in the Infinite Monkey Theorem has long been thought of as residing in the human domain (Haven, 2007).

It is for certain, however, that humans are becoming more attached to – and more dependent on – their ubiquitous smartphones, watches, tablets, etc. Our everyday existence plainly depends extensively on our being continuously connected to portable, complex, and infinitely immense databases of information (Hay & Couldry, 2011; Manovich, 2014). According to Gilder (2018), this interconnectivity is at the heart of Alphabet's "system of the world" in which universal knowledge (i.e., AI) is attainable using their iterative processing of enormous amounts of data that are transmitted at a pace reaching the speed of light. Accordingly, Google's version of AI manifests itself based on the predictability of infinite statistical theories involved with intense processing speeds and infinite amounts of accessible data that modifies the relationship between humans and computers in which computing provides predictable outcomes and the latter takes over.

The debate that has ensued centers on whether this interaction between "man and machine" humanizes the computing experience or whether it mechanizes the human experience. We side with Gilder who suggests that humans will always succeed in this relationship because it is humans who remain as the primary source of assimilation of information into understanding and then into wisdom. Unexpected outcomes and unintended consequences will always occur in spite of Alphabet's attempts to categorize knowledge acquisition in purely finite (and predictable) terms. It is in this surprisal environment where real learning takes place.

The New Ecosystem in Which Learning Resides

The authors suggest that, while progress towards AI and singularity may transform instructional design (ID) in many ways, for the foreseeable future, the relationship between humans and computers will remain a transactional one that is intermediated. These transactions will, in our view, necessitate a new paradigm for developing instruction that encompasses a systematic view on how media intermediates learning and understanding.

What remains to be determined are the characteristics of these mediated human–computer transactions. As such, we must move beyond assessing mediated literacy in purely singular terms. No longer is information acquisition dependent solely on text and other analog media as the primary mediator. We must expand our focus on the myriad of other interactive and digital forms and how they affect the human and computer transactional relationship. McLuhan was once quoted as saying "first we build tools, then they build us." (Caulking, 1967, p. 52). This may take on the form of virtual or augmented reality or an autonomous personal learning "lifeline" or assistant (Bruder, 2014; Hopkins, Sylvester, & Tate, 2013). Few can argue with the basic premise that computers do more than simply compute. Just like their human counterparts, computers can see, hear, and think. Alexa is becoming so ubiquitous that many households now contain several of these devices – one for each room in their house. In the recent film, *Her* (2014), millions suspended their disbelief that a person could actually fall in love with their computer.

In the 1990s, researchers Byron Reeves and Clifford Nass built a theory based on several studies that were eventually published in their book: *The Media Equation: How People Treat Computers, Television and New Media Like Real People and Places* (1996). The theoretical foundation for this paradigm did not originate solely from an anthropomorphic perspective. Participants were not simply giving animate characteristics to inanimate objects. But subjects in these studies demonstrated repeatedly emotional attributions and responses such as temperament, affection, Pollyanna, or positivity bias effects, as well as empathy towards the computers that could be modified through scripted interactions. The effects of these phenomena on individuals who experience these media types were often profound, leading them to behave and to respond to these experiences in unexpected ways, most of which they are completely unaware. Numerous studies that have evolved from the research in psychology, social science, and other fields indicate that this type of reaction is automatic and unavoidable and happens more often than people realize (Office of Educational Technology, 2017; Thigpen, 2014). Reeves and Nass (1996) argue that "Individuals' interactions with computers, television, and new media are fundamentally social and natural, just like interactions in real life" (p. 5).

As the technology has evolved, so has the perspective of instructional design that expands our views on what it means to be "literate" (National Education Association, n.d.). A limited view that is based solely on text is what we refer to as being "letterate." Taking our cue from George Orwell (Fukuyama, 2003), the need has evolved to teach media literacy (i.e., be learning how to recognize and deal with potential biases that inculcate into the information flow, especially what that information is not properly filtered in a conscious way). Borrowing from McLuhan, not only do we need to become more aware of how media has evolved but so do we need to become more aware of the interactions between media and those messages.

An Evolving Media Ecosystem

What does this all mean to instructional designers? Our focus on the media literacy aspects of these developments is based on the transactional relationship of the messages that occur between media/technology and humans in light of how they affect both the message (i.e., informational content) and the message (i.e., the learner) as Marshal McLuhan so aptly predicted (McLuhan & Parker, 1969). In this context, using the word "instructional" may no longer be the operative adjective associated with what instructional designers do (as in "*instructional* design"). In the past, learning experiences were designed around the simple passing of content. Google and Wikipedia and other forms of interactive information acquisition models are smarter and ubiquitous to the extent that the simple act of acquiring information has become a secondary mission for classroom experiences. But the technological delivery can also be bias or, in some cases, conceal the information to the point of being misinterpreted. It is with this underpinning that the study of mediated transactions must be examined.

We suggest that content delivery may no longer be a primary focus for instructional designers but rather how content is intermediated as it is passed along. Most would agree that text is only one of many forms of media types that can be used in delivering instruction. As media has become more digitally socialized, perhaps a more complete way to analyze the various mediated delivery methodologies is to assess the interactions in terms of how people interact with those media.

A mediated, ecological approach to assessing the learning environment is based on how it is measured and defined by the mediated (eco) system in which it is delivered. This involves a dual relationship in which we co-assess the media and the persons using them. If one agrees with the premise that technology is mediating both the messenger and the messenger, then, it makes sense to examine the construct and the characteristics of the various media types with regard to how that content is delivered, contextualized (and potentially biased) to provide insights to the process of first acquiring knowledge, and then transformed into wisdom.

McLuhan and Parker (1969) was once quoted as saying that "environments are not just containers, but are processes that change the content totally" (p. 200). Using this view, we look at media ecology as an informed process by which we assimilate information in the first step of synthesizing knowledge that potentially leads to understanding and wisdom. We suggest these last two steps are what limit the ability to artificially create intelligence. In this relationship it is the humans that become the mediators. Media ecology becomes a model rather than a set of rules. Model identification is at root of Chaos Theory, which we define as any representational structure – physical, verbal, pictorial, symbolic, and/or mathematical – that has at least some abstract features in common with that which it purports to represent and which serves to classify, describe, and relate the parts of a process to permit predictions and correlated unintended outcomes. Media ecology came out of broad model development in communications studies at NYU and University of Toronto (Strate, 2006):

> Media ecology is the study of transactions among people, their messages, and their message systems. More particularly, media ecology studies how media of communication affect human perception, feeling, understanding and value; and how our interaction with media facilitates or impedes our chances for survival. The word ecology implies the study of environments—their structure, content, and impact on people. An environment is, after all, a complex message system, which regulates ways of feeling and behaving. It structures what we can see and say and, therefore, do.

Recalling what McLuhan defines as "media" as a process and not a specific container or format (i.e., paper, papyrus, or even digital), media ecology seeks to identify the role played in those transactions by media/technology through which they are transacted. The term we tend to use to describe this process is "mediated transactions."

As an academic discipline within the instructional technology paradigm, media ecology is still in its infancy. We suggest that there are succinct, implied strong connections between the mediated communications and their effect on instructional design and are based on the premise is that content and communication media are codependent. In this scenario, content is understood best as a function of communication that facilitates a shift in emphasis of acquisition from information to knowledge to wisdom. In this environment, information cannot exist independently of any medium. Pioneer media ecologist Neal Postman (2000) suggested that, because of the symbolic forms in which information is encoded, different technologies provide different intellectual and emotional biases. In short, all media carry with it certain characteristics that help them shape how information is interpreted.

We believe that using this context for media ecology is an appropriate scholarly approach to investigate its utility as an academic discipline in instructional design and technology programs. The most interesting thing about media ecology is that, like other ecological studies, it is also based on a biological metaphor. Placing media and ecology together suggests that neither takes precedence. Taking this further, we offer the Petri dish as a metaphor of how to enhance this representation. Replacing the concept of 'substance' with 'technology' a medium is a technology within which a culture grows; that is to say, it "gives form to a culture's politics, social organization, and ways of thinking" (Strate, 2006, p. 15). The interest we hold in it as an academic discipline is based on "assessing the interactions between media and humans and the need to maintain a 'symbolic balance'" (Postman, 2000, p. 11). In this context, media ecology is the study of transactions that occur among people, their instructional messages, and their message systems.

Media ecology investigates how mediated communications affect human perception, feelings, and understanding in terms of their environments, structures, and impact on people. We can connect this metaphor to how individuals interact with media on a daily basis and for long periods, allowing a longitudinal study of the evolution of media that correlates strongly to a Darwinian view of the evolution of humans and the tools they use. This approach brings us all back to media as an extension of man (McLuhan, 1994). The study of media in this way and comparing how it interacts with our civilization is the environmental (i.e., ecological) aspect. The context of media interpretations evolve through natural selection and human behavior.

In short, media ecology provides an approach to acquiring information through a transactional lens that allows us to study its impact on human behavior. In this case, the emphasis is on the change that takes place with the individual rather than the specific academic content being learned or transacted. In further support of the media ecology viewpoint, it is important to note that the dominant mode of communication for a period of time also defines the intrinsic value connected to that communication method(s) for that period. The mediated content becomes a tool for change that is manifest in the behaviors, thoughts, and actions of the learner. The goal becomes an advancement of all these principles.

A Preliminary Model to Define Educational Media in Terms of an Ecosystem

To gain a full picture of this view, one must first combine Shannon and Weaver's Information Transmission Model (1963) with McLuhan's views on media (1994). The medium utilized is what provides the tool for interpreting context. In this view, bias could be viewed as a good thing – the stimulus to cause one to think critically, such as the disequilibration (Piaget & Cook, 1952). While McLuhan focused on how the medium was able to modify or alter the message, its corollary is also true. The medium a person uses most often also modifies that user (Kenny, 2011). Kurzwiel's views on singularity suggest that a purely direct-connect informational environment is diametrically opposed alternative to a mediated environment. In the former, there is no direct intervening media.

We suggest that a more realistic prediction about the future will include the idea that media and technology in some form will always intercede. The issue is to determine in what form of media that intervention will take place. Suzanne Langer (1957) noted that most of our coded communicational forms are analogical in nature. She refers to them as being presentational, and they are subject to being represented both in factual and emotional terms, thus, providing the opportunity to evaluate them in terms of being true or false. A direct connect environment would be more closely related to a purely emotional/interpretation similar to what occurs in the arts. With the arts, some believe it is difficult to validate content/context because of the amount of affect involved. It is accepted generally that some forms of mediation allows a more precise definition than others. Thus, we are making our case for studying media ecology, and it is an academically sound approach to advancing the cause of instructional design.

We are in the process of designing a model by which designers can evaluate technology/media based on the basic characteristics of that medium and how humans interact with them and vice versa in the information acquisition process. The first step is to begin disaggregating media into set types with the understanding that the additional process of digitization will bias that disassembly and will further our analysis. Digitization will become a part of an eventual three-dimensional assessment and will come at a later time.

We propose that media can be analyzed using 12 broad categories whose characteristics define the interaction/transactional relationship with the information receiver. Utilizing a set of classifications as developed over time will assist designers to make better media choices in their designs. As an initial pass, 11 categories are proposed with the understanding that there will be in the longer term further research and refinement. The intent is to eventually create a robust system for evaluation that includes both an expansion and a consolidation of the categories through the use of formative assessment and to delve further into more interactive media and their digitized forms.

Our initial efforts at defining a succinct model included creating a course in our educational technology programs in which we ask students to develop their own tables for these three categories. The result was a paring down of our original list of 25 categories to 11. Our beta tested minimal viable version begins with two basic media types to test out our initial assumptions: text and graphics/video. We then gingerly delved into some more interactive forms for contrast. It should be noted that we have yet to fully look into the effect of digitization on these initial types as that would add an unnecessary confound as we begin our thinking process.

The resulting table is intended to assist with the development of more creative universal design (UDL) decisions on the part of instructional designers. While the intent of UDL is to potentially eliminate the need for having to make hard decisions, we suggest that the model will serve to augment content in UDL courses.

We believe that more categories may evolve as we dig deeper into this line of thinking. We also believe that some consolidation could also take place as this model becomes more systematized. The current list of categories and initial associated research questions for each includes the following:

- *Age effect*. Are the media more endearing to one age group or another or is it age neutral?
- *Gender effect*. Does one media type endear itself to one gender than another or is it gender neutral?
- *Cognitive load*. Does this media type add unneeded loads on the ability of the mind to process the accompanying information?
- *Learner engagement*. To what extent are learners interested and engaged in experiences, feeling connections, culture, etc., and does it motivate them to think critically?
- *Interactivity*. Does this medium inspire, promote various levels of interaction/immersion?
- *Individual vs. group effect*. Does this media type enhance collaboration, team cohesiveness, and group consensus? Or is it better suited to individual access and interpretation?

- *Mutual shaping of ideas*. If it is better suited to groups, does this medium enhance the ability for a group to come to a consensus?
- *Learner dispositions*. (i.e., attitudes/perceptions). Does the media type enhance changes in attitudes and/or bias/limit opinion making?
- *Placement/position*. Does the placement of information within the context of other information change its meaning? Are there considerations for gaps (i.e., "reading between the lines") for this media?
- *Portability*. Is this media conducive to being moved/shown/transported using multiple platforms?
- *Intellectual property rights*. What are the issues related to ownership of the information/content?

Following is an example of what the first row of the profile table for media types that shows, for illustrative purposes, what an entry for test media might look like. Only one category is filled in on the first row of a complete table that would show the remaining 10. Our model will evolve as we validate the categories with some being consolidated and including other possible additions in further revisions.

Media element	Advantage	Disadvantage/limitations	Relevant alterations	Comparison to other media
Age effect	Content developed with age appropriateness and development stages in mind based on a target audience, such as the reading level, spacing, and ways chunking can create learner interest and comprehension, based on age, development, and appropriateness.	Audiences may not have enough experience based on age to create visuals to match the text. More experienced learners may have developed life experiences to create connections.	Content created with font, spacing, adding graphics, and media to create an appropriate level for the target audience to be engaged.	*Text* Is content written for a target audience and written with age appropriate terminology, vocabulary, and meaning, Can the text based on age effect engage the learner? *Graphics* Graphics provides a realistic image that aids in learner comprehension. The age of the target audience range from an underdeveloped to well-developed vocabulary. Vivid imagery such as people in pain or in a state of happiness can be conveyed very easily to the audiences. *Immersive/interactive* Content plays an important role in In the interactive virtual environments. The degree of difficulty is progressive where task build from simple and to more complexity as the user makes progress through the system. However, gameplay, strategy, and media should be appropriate based on age.

Summary

In short, we are not convinced that singularity will be achieved to the extent that Kurzweil has suggested. For the foreseeable future, the transactional relationship between computers and humans will be a mediated experience. Studying media ecology in this context is our attempt to characterize the essence of that interaction as it relates to the artificiality of that intellectual experience. As Gilder (2018) suggests access to predictable information, regardless of the amount provided and speed of its delivery does, in fact, renders as artificial any intelligence that may result.

Based on the feedback we have received about our initial version, we will further develop the model, descriptions, and concepts and determine whether there are additional media types that can be disaggregated. We intend to develop a complete profile/table that demonstrates how a particular media type is defined by each category and how they affect both the message and the message receiver in terms of what McLuhan had intended. We also plan to investigate further the transactional relationships between information being gathered and the learner.

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Chapter 14
Threading Self-Regulation and Self-Efficacy in a Flipped College Spanish Course

Nadia Jaramillo Cherrez

Introduction

To communicate effectively and confidently in a second language, language learning should go beyond knowledge of grammar, vocabulary, and culture. Second language learning should also encourage the development of autonomous learners who take charge of their learning and are confident in their use of the language for communicative purposes. Since learning a second language requires high levels of motivation, time, and persistence (Seker, 2016), learners need to be more conscious about their learning process and the outcomes in order to initiate and regulate their own learning (Sinclair, 2000). This means that learners need to use cognitive and metacognitive strategies that aid in the process of setting goals, use effective learning strategies, and assess their own learning progress (Zimmerman, 2001). In addition, language learners' own beliefs or self-efficacy about their language abilities are highly influential in their own language performance (Rahimi & Abedini, 2009). While through self-regulation learners can monitor their learning progress, through self-efficacy they can pay attention to their capabilities; both aspects are to be hypothesized to influence learning, motivation, and autonomy (Berk, 2003; Zimmerman & Schunk, 2011). In second language learning, self-regulation helps learners to manage their learning process successfully and extract maximum benefits within the context of the learning environment (Arnold & Harris, 2017; Barnard, Lan, To, Paton, & Lai, 2009; Lynch & Dembo, 2004).

Self-regulation is tied to the nature of the learning environment; therefore, learning in a blended or online context requires higher levels of autonomy and readiness

N. Jaramillo Cherrez (✉)
Oregon State University Ecampus, Corvallis, OR, USA

Iowa State University, Ames, IA, United States
e-mail: nadia.jaramillo@oregonstate.edu

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to cope with the demands of such environments (Barnard et al., 2009; Lee & Tsai, 2011; Williams & Hellman, 2004). In the flipped approach, a model for blended learning, the need to develop self-regulation and self-efficacy is evident because students are expected to study the content outside of classroom on their own; while in the classroom, they engage in problem-solving activities (Bergman & Sams, 2012). In a flipped language class, self-regulation and self-efficacy are also necessary because it involves learners' autonomy and accountability to develop linguistic knowledge through online work outside the classroom, as well as active engagement in highly dynamic communicative activities in class. Therefore, this study set out to explore self-regulation skills and self-efficacy beliefs in a flipped language course in a higher education setting. I begin this chapter by examining some relevant literature relating to self-regulation and self-efficacy. This is followed by a description of a flipped Spanish course and an outline of the process for threading self-regulation and promoting self-efficacy. Finally, I present the study that explored self-regulation skills and self-efficacy in the flipped Spanish course.

Self-Regulation and Self-Efficacy

The connection between self-regulation and self-efficacy suggests that learners who believe in their own abilities to perform a task are likely to employ self-regulatory skills (Hidi & Ainley, 2008). Through self-regulation, learners constantly monitor their progress, adjust their learning strategies, and refocus their efforts for more successful outcomes (Berk, 2003; Zimmerman & Schunk, 2011). Research shows that students with high levels of self-regulatory behaviors demonstrate higher levels of metacognitive and critical thinking skills (Adigüzel & Orhan, 2017; Altay & Saracaloğlu, 2017). Learners also become more dynamic players in their own learning and develop positive perceptions of the use of technology (Nasseri & Motallebzadeh, 2016). Since blended and online learning environments can represent a challenging and overwhelming experience for students (Lee & Tsai, 2011), it is desirable that students develop their self-regulation skills to become independent learners (El-Senousy & Alquda, 2017). Further, the beliefs that people have in their own capabilities to perform an activity and in the results of that performance strongly influences self-regulation behaviors (Zimmerman & Schunk, 2011). Students who believe in their capabilities to perform academically tend to "use more cognitive and metacognitive strategies, and, regardless of previous achievement or ability, work harder, persist longer, and persevere in the face of adversity" (Pajares, 2002, p. 117). Self-efficacy is thus intrinsically linked to self-regulation as it pertains to the active participation of learners in their own learning process through the use of metacognitive, motivational, and behavioral strategies and tools (Zimmerman, Bandura, & Martinez-Pons, 1992). Studies have found that self-efficacy influences achievement as well as motivation (Stevens, Olivarez, Lan, & Tallent-Runnels, 2004), suggesting that those students with higher levels of self-efficacy seek more challenging tasks and experience greater autonomy (Stevens et al., 2004).

Self-Regulation and Self-Efficacy in Second Language Learning

In computer-assisted language learning environments, self-regulation and self-efficacy become key elements for learners to regulate their learning process for more effective language development and uses of technology (Lai & Gu, 2011). Research on L2 learning has shown several aspects that influence self-regulation and motivation, such as the learning environment (Alzubaidi, Aldridge, & Khine, 2016), self-efficacy, personality, and proficiency (Gyhasi, Yazdani, & Farsani, 2013; Köksal & Dündar, 2017). Self-regulation in technology supported instruction relates positively to language learning gains (Cheng & Chau, 2013) and motivation (Chang, 2005; Liu, Lan, & Ho, 2014). Studies have also reported on students' positive perception of an engagement with technology to regulate their learning (Kizil & Savran, 2016). In relation to self-efficacy, research has found that language proficiency, motivation, and learning strategies are linked to the beliefs of one's own language capabilities and confidence (Abedini, Rahimi, & Zare-ee, 2011; Chang & Shen, 2005). Studies show that self-efficacy is associated with mastery of a goal (Lee & Lee, 2001) and the value associated with learning the second language (Bong, 2001).

The Flipped Spanish Course

The focus of this chapter is a college intermediate Spanish course at a Midwestern university in the United States that was designed using the flipped learning approach in order to maximize the communicative opportunities of the students. The flipped Spanish course included online preparatory assignments, in-class communicative activities, and post-class homework assignments. The preparatory assignments were selected from the online platform that came with the class textbook. These assignments provided explicit instruction and practice on grammatical structures, use of vocabulary, listening and reading activities, and pronunciation practice. Specific feedback and thresholds were set for practice tasks and quizzes within the online tasks. The in-class activities were designed to engage students in pair and small group conversations. Through these activities, students were expected to reactivate the linguistic knowledge developed online. The class activities were related to the textbook topics, current events in the news, students' own topics, and other events in daily life. An additional component in the flipped Spanish course was homework assignments to review the content and explanations covered in the class and prepare for the upcoming online work. Students also had a self-evaluation assignment to assess their weekly participation in the class activities (Fig. 14.1).

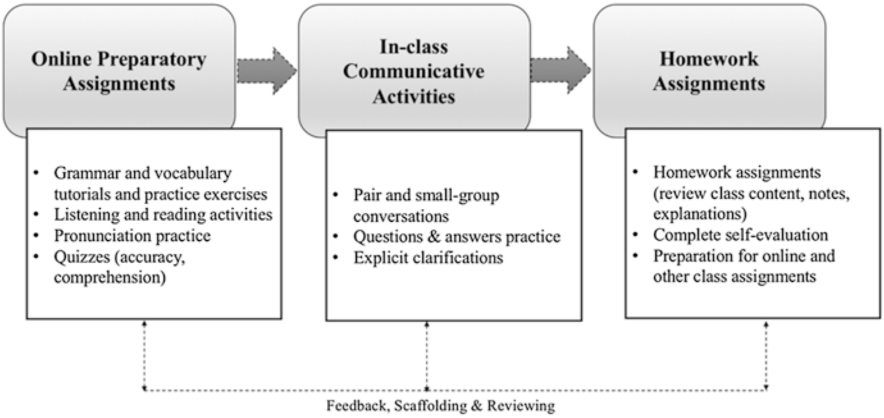

Fig. 14.1 Components of the flipped Spanish course

Threading Self-Regulation and Self-Efficacy

In the flipped intermediate Spanish course, students had to be more organized to complete all assigned tasks, manage time effectively, and evaluate their readiness to enter into the highly communicative class. It was necessary to foster students' predispositions, skills, and competences to accomplish the online as well as the class tasks successfully. Research has shown that speaking in the L2 might trigger feelings of anxiety and embarrassment because students perceive that their language performance is not good enough (Gregersen & Horwitz, 2002), leading them to be afraid of losing face and being criticized (Gonzalez-Lloret & Ortega, 2014). Therefore, students in this Spanish course needed to face their fears and increase their confidence to communicate with others with relative fluency and spontaneity. To help students in the development of their self-regulation skills and awareness of their self-efficacy beliefs, several approaches were taken throughout the course with the expectation that these approaches help students adjust and cope with the demands of the flipped course. Table 14.1 outlines these approaches.

The Study

This study set out to investigate students' development of self-regulation skills and their awareness of self-efficacy beliefs in the flipped Spanish course using a mixed-methods design. This study sought to answer: (1) whether students in the flipped Spanish course developed their self-regulation skills in terms of goal setting, environment structuring, time management, help seeking, task strategies, and self-evaluation and (2) what perceptions students in the flipped Spanish course had of their self-efficacy to use Spanish for more communicative purposes.

Table 14.1 Threading self-regulation skills and self-efficacy awareness in the flipped Spanish course

Flipped course components	Threading guided self-regulation skills and self-efficacy awareness
Online preparatory assignments	Clear course structure and rationale Explicit expectations, requirements, and suggestions for learner autonomy Definite roles and responsibilities for students and instructor Transparent weekly calendar and assignments Concise tutorial on the types of tasks Clear feedback and settings for each task Varied quizzes/check points Self-monitored progress in Connect/LearnSmart
In class communicative activities	Clear communicative tasks, goals, and expectations on speaking Guided progression in speaking confidence (moving from individual to pair, to small, and to big group work) Explicit rubric for oral communicative performance Use of Spanish at all times (English for housekeeping and whenever necessary) Regular checkpoints on students' progress and predispositions
Homework assignments	Holistic weekly self-evaluation Follow-up weekly practice assignments for mastery of content

Participants

The participants included all students enrolled in the intermediate Spanish course ($n = 21$). There were 15 females and 6 males whose ages ranged between 18 and 23 years old. Among these, 20 students had English as their first language, and only one had Korean as first language. Most students in this study (15) had more than 3 years of Spanish studies, while four students had between 1 and 3 years of studies, and two had less than 1 year of Spanish studies.

Data Collection and Procedures

All students enrolled in the flipped course were introduced to the format of the course on the first day of classes in Spring 2017. The course instructor described the online preparatory assignments, face-to-face activities, and expectations. Students were also provided with guidance throughout the semester on their learning accountability and responsibilities. Detailed instructions were added to syllabus, schedule, and assignments.

The data were collected through a pre-post survey approach and a focus-group interview with students. The 24-item online self-regulated learning questionnaire (OSLQ) (Barnard et al., 2009) was used to measure the self-regulation skills.

This survey included six subscales, each with a 5-point Likert response (strongly agree, 5; strongly disagree, 1): goal setting (five questions, $\alpha = 0.82$), environment structuring (4 questions, $\alpha = 0.81$), time management (three questions, $\alpha = 0.70$), help seeking (four questions, $\alpha = 0.75$), task strategies (4 questions, $\alpha = 0.82$), and self-evaluation (four questions, $\alpha = 0.88$). Additional questions were included in the post-survey to gather insights into students' self-efficacy to use Spanish to communicate with others (e.g., speaking, writing, listening, reading, linguistic resources) and to connect language and culture. In addition, the study used a focus-group interview with students to explore their perceptions, attitudes, and actions (Maxwell, 2012; Patton, 2005) in relation to their self-regulation and self-efficacy. Open-ended questions were used in the interview as way to gather in-depth data that could help answer the second research question and interpret the survey results. The additional questions in the survey and in the interview protocol were read by a researcher outside of this study to ensure clarity and consistency of language. The OLSQ questionnaire was administered online twice, on the second week (pre-measurement) and on the last week of the semester (post-measurement). The focus-group interview took place on the last week of classes.

Data Analysis

The analysis of the data involved descriptive and inferential statistics for the pre- and post-survey data and content analysis for the qualitative data. The analysis in the focus-group interview followed a question-based coding (MacQueen, McLellan, Bartholow, & Milstein, 2008) to gather an initial sense of the topics. Then, axial coding was performed in order to group the existing initial codes into more meaningful and analytical categories that exemplify the major themes (Creswell, 2012; Miles et al., 2014; Saldaña, 2016). To ensure the trustworthiness of the data, a second researcher coded the open-ended questions and interviews independently. Then, following the question-based coding process, we compared each of the initial codes, the analytical categories, and major themes. If there were discrepancies at any stage, we resolved the differences by discussing and analyzing the supporting details in the data until we reached an agreement.

Results

The results of this exploratory study are presented in the following sections. The presentation of these results follows each research question.

Development of Spanish Learners' Self-Regulation Skills

The survey results indicated that students in the flipped intermediate Spanish course appeared to have developed self-regulation skills after taking the course. The results showed that students were able to set goals, managed their time, used strategies for task completion, engaged in self-evaluation, selected a quiet learning environment, and sought help when needed. Specifically, goal setting ($t(20) = 3.91$), time management ($t(20) = 2.09$), task strategies ($t(20) = 2.74$), and self-evaluation ($t(20) = 2.09$) showed statistically significant differences ($p < 0.05$) when the results of the pre-survey were compared to the results of the post-survey. These results suggest that through the course structure and guided strategies students managed to set goals and manage their time to plan the ways in which they would complete the online CALL prior to class.

The findings of the focus-group interview showed that students used multiple self-regulatory strategies to cope with the demands of the flipped course. Several students shared that oftentimes they met outside of class to review the online content or practice speaking because "It's really hard to study language alone" and it was "pretty useful too to double check the answers [in the online work]." Some students also acknowledged that adjusting to learning outside of class could be hard, especially because "If you fly through the exercises you can get to know without actually soaking in…, it's important for the students to know that you have to learn it there... you are not going to learn it in class." Further, a student mentioned about a strategy he used to take more responsibility of his own learning and "learn how to study with online [content]…so now instead of just doing exercises to learn it…I use the exercises to test the learning, so my score on tests reflects on how I learnt it on the online portion."

Learners' Perception of Self-Efficacy in the Use of Spanish

The self-efficacy beliefs to use Spanish for more communicative purposes related to speaking and writing skills, as well as cultural awareness. The statistics results showed significant differences ($p < 0.05$) only in students' beliefs of their ability to write in Spanish ($t(20) = 2.65$), and to understand spoken discourse ($t(20) = 2.64$). Additionally, students had highly positive perceptions of their capabilities to use basic grammar, comprehend written texts, and converse in Spanish (100%). Other positive self-efficacy beliefs included the ability to incorporate grammar and vocabulary in context (>92%) and demonstrate cultural understanding (>72%). The areas in which students had negative perceptions of their self-efficacy beliefs included having a clear understanding of spoken Spanish (<50%) and retaining grammar and vocabulary in long term memory (<60%).

The findings in the focus-group interview showed students' increased perceptions of their own language capabilities and accomplishment of learning goals.

For example, one student mentioned he could get the "use of vocabulary pretty quickly…but it's hard like one place I really struggle with is the spontaneous speaking." He also recognized his own struggles when engaging in conversations with the instructor because he perceived he had "no idea what to say, but I also think, it's just you can't memorize all things basically, and all these rules that come really really fast." Another student mentioned the benefit of having "small groups where maybe you aren't afraid to speak or attempt to speak" because this strategy helped them to be more willing to talk. Several students also felt a personal connection to the class topics which seemed to have increased their motivation. As one student indicated, when the class content involved authentic uses of Spanish in real situations, they could "connect with those people and see a little bit more that culture. So that's where I get all more excited again about learning Spanish,… when we relate." Overall, these findings suggest that learners in this study were more aware of their self-efficacy beliefs and could feel more confident and capable of using Spanish to communicate with others.

Discussion and Conclusion

This study investigated self-regulation skills and self-efficacy beliefs in a flipped college Spanish course to help contribute to our understanding of students' autonomy and accountability in a flipped learning approach. The results showed statistically significant results for goal setting, time management, task strategies, and self-evaluation. In line with previous studies (Lee & Lee, 2001; Seker, 2016; Sinclair, 2000), these results suggest that other non-linguistic skills and a more conscious attention to one's own individual learning process in the blended environment are needed when learning a second language. Self-regulation skills are learners' strength traits for learning (Oxford, 2016) and their self-efficacy beliefs constitute a driving force to motivation and a strong predictor of learning performance (Schunk, 2005). Therefore, cultivating self-regulation and self-efficacy practices in workable and achievable ways becomes another second language learning goal, in particular in a flipped environment.

As self-regulation is inextricable connected to the learning environment, this study has shown the possibility to thread self-regulation as well as self-efficacy in the flipped learning environment which demands higher level of learners' autonomy and readiness to be successful. As other research has indicated (Lee & Lee, 2001; Lee & Tsai, 2011; Sun, Wu, & Lee, 2017), this study also showed that through threading self-regulation and self-efficacy, students were able to not only monitor their learning but also adopt strategies that help them keep focused on their tasks and engaged in their learning processes. Hence, the flipped learning model seems to offer a potential venue for where self-regulation and self-efficacy can be integrated while learning a second language (Sun et al., 2017). Nevertheless, due to the exploratory nature of this study, the results presented in this chapter need to be taken with caution. Utilizing a larger sample and a control group was outside of the scope of this study, which adds limitations in the interpretation and generalizability of results.

Significance of Self-Regulation and Self-Efficacy in Flipped Language Learning

A few points resulting from this exploratory study deserve attention. First, flipped language learning should be designed beyond a redistribution of learning spaces, where linguistic content (e.g., grammar, vocabulary, reading) is delivered online and communicative activities take place in the classroom. Given the implications for designing a flipped language learning environment to be truly responsive to the conditions for second language acquisition (SLA), a clear rationale behind the implementation of a flipped model, as well as clear learning and learners' expectations, should be determined. While the overarching goal of learning a second language is to be able to communicate with others, establishing realistic expectations and requirements beyond language learning will help learners have a more successful learning experience. Guiding students on the pre-work and their understanding of the demands of the flipped approach to cope with the expectations to navigate the pedagogical approach is necessary (Moranski & Henery, 2017). Finally, connecting linguistic to non-linguistic goals such as self-regulation skills and self-efficacy beliefs offers the possibility to help students transform the way they approach their own learning. In this way, learners build their own accountability and reinforce confidence in their language capabilities, including a sense of security, positive attitudes, and motivation (Moyer, 2018).

Self-regulation skills need to be taught because students do not come equipped with them nor they develop the skills effectively to meet the learning outcomes and complete the required activities. Guiding the learners in their learning as well as in the development of self-regulation and self-efficacy will help them direct efforts to be successful in achieving their language learning goals. It will also help students identify ways to sustain these efforts, overcome obstacles, and catalyze their own strengths to set learning standards and evaluate their own efforts (Pajares, 2002). It is important to note that self-efficacy beliefs and self-regulation are key elements to design learning activities that build upon second language acquisition principles (Mills, Pajares, & Herron, 2007). By preparing second language learners beyond content, we will also be preparing them to thrive in and face the challenges of a fast-changing world.

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Chapter 15
Learning Through Play

Kathy Essmiller

Essential questions

Why cultivate playful approaches to learning?
What does learning through play look like?
How can educational technology facilitate learning through play?

Introduction

As we step further into an "age of wonder," characterized by technology and digital media (Tan, 2015), educators are exploring pedagogical techniques seldom implemented in the tradition-bound halls of secondary and higher education. Twenty-first-century students need to be able to generate new ideas and create novel ways to solve problems; combining the resources of the digital age classroom with attitudes of play can help students synthesize information and experiences to achieve these lofty goals. However, questions arise when considering deviation from traditional practices. The purpose of this chapter is to help those hoping to educate beyond content through the integration of educational technology. Specifically, this chapter will define attitudes and practices of play, articulate the potential benefits of such an approach, describe what attitudes of play look like in practice and exploration, and identify how educational technology facilitates attitudes of play.

K. Essmiller (✉)
Oklahoma State University, Stillwater, OK, USA

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What Is Play and Why Should We Care?

An understanding of play may be developed by setting it opposite our understanding of work. Take a moment to consider your average work or school day. What drives your choices and actions? Which criteria determine whether or not you can claim success? What governs how you spend your time? Most likely, you would describe a day in which success is defined by linear progression through tasks designed to reach a specific purpose. Your choices and actions were driven by the need to achieve this success, either to satisfy a personally set goal or to accomplish a compulsory goal set for you by someone else. Ideally, you were provided with the resources necessary to accomplish the specific purpose, and your time was devoted to applying those resources as previously determined. Play is often quite the opposite; in fact, taking such an approach to play will neutralize its benefits. How, then, do we define this ambiguous term with which most are familiar but whose practice in education and industry few truly understand?

Play is defined primarily in terms of intent. Rather than being a goal-oriented pursuit whose conclusion is predictable and measurable, play is a non-linear "quest for experience" (Ward, 2009, p. 164), a journey through which the process of experimentation and exploration is more important than the outcome itself (Ward, 2009). Play can appear purposeless, is voluntary, and takes place apart from "the ordinary" (Eberle, 2014, p. 215). Playful attitudes find joy and transformation in the process and are not guided by planned "external material gain or profit" (Harrison & West, 2014, p. 93). Playful practices incorporate "anticipation, surprise, pleasure, understanding, and strength" (Eberle, 2014, p. 214), as efficiency is "put on the back burner" (Ward, 2009) in favor of voluntary, freely chosen activities. Play involves both rule-making and rule-breaking, as might be remembered from the noisy negotiations of neighborhood games (Eberle, 2014) and can alternate between rigid adherence to agreed upon expectations and mischievous deviation from those same expectations. Truly bringing the definition of play into focus is challenging, and the borders are hazy (Eberle, 2014); according to Huizinga, calling it instinct says nothing, while calling it "mind or will" says "too much" (Eberle, 2014, p. 218). A summary might simply assert that play is not a product, but is a "creative, embodied" activity which "unfolds in its own right" (Harrison & West, 2014, p. 93).

Given a hazy understanding of play and an awareness of the difficulty of measuring the success of this non-product-driven practice, stakeholders may question the value of such non-goal-oriented activities, placing educators and learning designers in the challenging position of having to articulate the benefits of an intangible practice. The benefits, however, are clear. People employing attitudes of play show increase in intrinsic motivation and creativity (Eberle, 2014; Harrison & West, 2014; Ward, 2009). Incorporation of playful approaches also develops creative skills (Davies et al., 2013; Randolph, Kangas, Ruokamo, & Hyvonen, 2016; Ward, 2009). Innovation and strategic thinking are further improved (Harrison & West, 2014; Lotts, 2016; Schulz, Geithner, Woelfel, & Kryzwinski, 2015), and as participants learn to cope with the complex environments of play, they experience reduced levels of anxiety when presented with challenges and opportunities (Davies et al., 2013; Harrison & West, 2014; Lotts, 2016; Schulz et al., 2015; Ward, 2009). Although the practice of play may need to be re-learned, it is inherent to human nature; having identified the benefits of learning through play, it is a short jump to incorporation of this practice with which all are innately familiar (Broadhead & van der Aalsvoort, 2009).

What Does Learning Through Play Look Like?

Ward (2009) integrated playful approaches and educational technology into a secondary level music composition unit. As part of the playful approach, Ward orchestrated a classroom atmosphere which was informal, relevant, interesting, and enthusiastic (Ward, 2009). The classroom was "multi-levelled" (Ward, 2009) and the content was open-ended and, true to play, had a relatively undefined purpose (Harrison & West, 2014; Ward, 2009). Ward (2009) further maintained a spirit of fun through intentionally interesting, enthusiastic delivery of content and maintained a flexible environment in which students experienced little pressure and were allowed to work at their own pace (Davies et al., 2013; Ward, 2009). To preserve the low pressure, flexible environment, Ward encouraged students to be guided by Miles Davis' admonition not to fear mistakes, as "there are none" (Ward, 2009, p. 155). Given this opportunity to put aside a fear of failure and with nontraditional creation valued as different rather than labeled as wrong, students were free to imagine, innovate, and take risks in exploring new solutions (Ward, 2009). Ward found that within this playful approach, his students eschewed provided help sheets, choosing to "experiment until something happened that they liked" (Ward, 2009, p. 163). Environments incorporating playful attitudes toward learning will embrace growth through the journey and see value in process which progresses and unfolds at different rates (Eberle, 2014). Practice will "transcend theory, appraisal, and performance" (Ward, 2009, p. 154), as learners embrace the "wandering nature of play" (Eberle, 2014, p. 219) through a "series of connected events" (Eberle, 2014, p. 220). This is evidenced in Ward's recounting that many "children who created great work were frequently unable to describe their methods in detail" (Ward, 2009, p. 163).

de Beer (2016) completed an autoethnographic study exploring the role of play in design. DeBeers, a jewelry designer, suspected the "rigidly imposed design process" (de Beer, 2016, p. 98) imposed upon his jewelry design disallowed play and thus impaired the creativity of his work. As part of his study, deBeer intentionally set free his playful self, giving himself permission to brainstorm. This "playful self" (de Beer, 2016) engaged in process by creating many test pieces incorporating new ideas, some of which worked and some of which did not (p. 106). This "freewheeling approach" (de Beer, 2016, p. 107) felt adventurous to deBeer as he embraced the nonlinear aspects of play in the creative process (de Beer, 2016). His work became divergent as he developed the ability to "tolerate ambiguity" in his creative process (de Beer, 2016, p. 11). Although jewelry design is inherently product focused, having identified the creative benefits of playful attitudes, deBeer determined to continue to make space for play by focusing on the process, idea generation, and creating prototypes in materials different than would be used in the final product (de Beer, 2016).

In addition to the above, play is a "unique and significant type of human activity" (Harrison & West, 2014), through which interaction with others requires "mutuality and sensitivity" (Eberle, 2014, p. 224). Relationships and power structures are rearranged as social groups construct knowledge and traditions unique to the community of play (Eberle, 2014; Harrison & West, 2014). Ward (2009) intentionally redefined his role as instructor to be one of the group members and helpers, and throughout the playful project, his students grew to see themselves as a team. The flexible nature of rules as enacted in playful practice helped students develop their poise and composure as they grew confident in their ability to discern others' intentions and resolve conflict (Eberle, 2014).

Play techniques can be employed to fulfill work-like objectives in many cases (Statler, Heracleous, & Jacobs, 2011). Work or classroom environments can afford themselves of the recursive, engaging, and fun aspects of play through practices chosen deliberately to trigger playful attitudes (Harrison & West, 2014; Lotts, 2016; Statler et al., 2011). These "play cues" (Harrison & West, 2014, p. 71) incorporate things and processes not generally associated with the workplace or classroom (Statler et al., 2011). Play cues, perhaps snacks or toys (Harrison & West, 2014), send signals which blur work and play releasing participants to "behave in new ways" (Harrison & West, 2014, p. 75) without fully disconnecting them from the realities and responsibilities of product-oriented endeavors (Davies et al., 2013).

How Can Educational Technology Facilitate Attitudes of Play?

Educators in this "age of information and innovation" (Randolph et al., 2016, p. 418) live in a digital culture in which access to new technology heightens the importance of partnering information with "playful and creative thought" (Randolph et al., 2016, p. 419). As resources continue to become more intuitive and easier to use, educators and designers are free to consider not just what the resources can do, but what the resources can do for their students. Educational technology can facilitate playful exploration, liberating creativity and empowering interactive thinkers.

Ward (2009) considered the integration of educational technology into his class' playful venture into music composition essential to his students' creative process. The technology's ability to recode symbols and sounds allowed students to depart from traditional compositional techniques and use sound differently than would be possible in the fixed tonal environment of Western musical instruments. Equipped with catalysts such as the sound of a running motorcycle engine, students playfully broke the traditional definition of music, confidently creating without tonal boundaries to compose with "texture rather than pitch" (Ward, 2009, p. 155). The instant feedback provided by the digital technology improved students' intrinsic motivation and allowed them to embrace and capitalize upon even unintentional creative actions (Ward, 2009). Playful use of digital technology allowed students to escape curricular and cultural limitations, overcoming their preconceived understanding of what constituted the making of music. Given permission to approach their compositions playfully, Ward found the students less likely to blindly accept compositional norms, expressing their own ideas in discussions and evaluations.

Educational technology provides an effective platform for experimenting with playful practices. Consider a digital resource for either your personal or your students' playful exploration. What cues might help facilitate a playful approach? Will you establish or define a clear, measurable goal? Why or why not? As you continue your playful exploration, consider what challenges to playful approaches might be present in a structured learning environment. How could those challenges be addressed? The promised benefits of play in helping students develop skills and strategies beyond mere content suggest it is worthwhile to consider ways in which to use educational technology to blend playful practices into a goal-oriented educational environment.

Conclusion

Resources of the digital age classroom can combine with attitudes of play to help students push beyond content to generate new ideas and practice novel problem-solving strategies. This chapter has defined and identified the benefits of play, articulated what attitudes of play look like in practice and exploration, and identified ways in which educational technology can facilitate attitudes of play. Educators hoping to facilitate innovative and experimental practices in their students can confidently and effectively do so through the integration of educational technology and playful practices.

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Chapter 16
Relationships, Feedback, and Student Growth in the Design Studio: A Case Study

Esther Michela and Jason K. McDonald

Introduction

A seasoned professor sits down at a large square table with a group of six eager, entrepreneurially minded students. To start, the group discusses one member's recent leg injury, surgery, and ongoing recovery. Five similar groups spread out at tables across the room. A professor at the back of the room stands with a student at one of the many whiteboards lining the walls. There, the student draws a diagram and they consider it together. Another professor at the front of the room stands with a student at another whiteboard, deeply engaged in a discussion, sometimes drawing or writing on the board to illustrate. Another student joins them, at first listening, then asks a question. The first student takes the marker and explains the legal concept, adding emphasis to the written explanation. Around the room professors speak and listen. Students ask questions and respond. The noise from all of the different conversations seems not to distract from the focused engagement. Back in the original group, a woman in the class, Sasha, responds to a question, sharing the insights she has gained from her research with their target customers.

The design studio has historically been viewed as a bridge between formal academic learning environments and the professional world. Considered a traditional educational approach in programs such as architecture and visual design, an increasing number of fields are adopting and adapting design studio for their use, including human-computer interaction (Cennamo et al., 2011), industrial design (Brandt et al., 2011), instructional design (McDonald, Rich, & Gubler, 2018), and business (Barry & Meisiek, 2015). While each discipline modifies studio pedagogy to meet its needs, most retain similar features, including a studio instructor with a primary

E. Michela (✉) · J. K. McDonald
Learning, Design, and Technology, University of Tennessee, Knoxville, TN, United States

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responsibility to provide feedback that communicates professional design knowledge (Cross, 2004; Schrand & Eliason, 2012), and who does so in various ways depending on the needs and skill levels of the students (Belkis, 2000).

One method that studio instructors have traditionally used to share design knowledge is through some form of critique. Critiques, or crits, can vary in purpose, levels of formality, and the participants involved, ranging from formal assessments through jury reviews (Salama & El-Attar, 2010), to informal conversations between teachers and students during reviews (Howard & Gray, 2014), or informal critiques between peers (Gray, 2013). Study of studio critiques have taken place in fields where it is a traditional, pedagogical form, such as architecture (Austerlitz, 2007), as well as fields where studio is a more emergent pedagogy like engineering (Chowdhury, Kusano, Johri, & Sharma, 2014). In this research, the practices of critique, in all their forms, have been identified as one way the studio "serves to socialize students into becoming professional designers" (Dannels & Martin, 2008, p. 151). Yet, while students can see critiques as an important source of information from an expert who they wish to please (Goldschmidt, Hochman, & Dafni, 2010), the experiences are nevertheless often viewed with trepidation on the part of the students, as they involve judgment of their work and, in some fields, have historically been characterized by harsh interactions (Anthony, 1991).

In this study, the critique is studied from the perspective of how, as an instructor-student interaction, it can influence the learning experience beyond only the acquisition of course content knowledge. While this, in and of itself, is not a new insight, we assert that viewing the critique in this way can help clarify how the phenomenon can be shaped by instructors to help benefit their students' development and growth. Studio critiques create opportunities for teachers to interact with students in an intensely focused manner. As we have researched this process in a university-level studio course, we have seen that an implication of this type of engagement is the opportunity critiques can provide instructors to build positive relationships with their students. Instead of provoking fear or dread in students (as is sometimes concluded), critiques may, in fact, provide a unique opportunity for instructors to support students in developing dispositions that will be necessary as a foundation for their professional identities. In this chapter, we explore one particular example of this possibility by examining the experience of a student enrolled in an interdisciplinary, entrepreneurship, studio course. We focus our inquiry into her experience by asking the questions: *How did one female undergraduate describe her experience being critiqued in a studio-style, interdisciplinary, entrepreneurship course? And what does her experience suggest about using critique as a method to influence student development of attributes other than learning the content knowledge of a discipline?*

Background: How We Developed the Case

This case study is drawn from a series of interviews carried out with studio instructors and students about their experience with the critique. The particular experiences we focus on are those of a woman, Sasha, enrolled in a yearlong, studio-style course on developing a start-up business. The course included students from a variety of disciplines including management, mechanical engineering, industrial design, and computer science. Faculty representing these disciplines were also assigned to teach the course. Students were placed in teams and given several thousand dollars of funding to pursue an innovative business idea. During the first part of the year, students learned the process of innovation and how to develop a business concept. This was followed by a summer internship. Students then returned to campus and, in their teams, refined their business plans, conducted marketing research, and built product prototypes. Each team was assigned a primary instructor who was largely responsible to critique their work; however all instructors would critique team projects at various milestones.

The class met twice each week. Some class sessions were devoted to instructors presenting principles from their domains relating to the entrepreneurial process. In other sessions, instructors critiqued team's projects in at least two ways. First, a number of class sessions were structured to allow instructors to informally critique the current state of each team's project. Such a class was described in this chapter's opening vignette. Additionally, four times each semester, teams formally pitched their project to all the instructors and other students in the class at once, meaning they presented an overview of their progress-to-date and tried to communicate the value their work was creating for their customers. After these presentations, all of the instructors gave detailed feedback to the team through questions and observations about the quality of their work and their presentation skills.

We conducted three, 45–60-min interviews with Sasha over the course of her last semester in the class. Interviews were based on a prepared set of questions, but we encouraged Sasha to tell her own story even if it meant we did not complete an interview protocol. We also encouraged Sasha to use terms that were meaningful to her, so words like feedback and critique appear in her comments interchangeably. (We, as authors, use the term *feedback* to describe the substance of what instructors told their students to help them improve and the term *critique* to describe the act or process of how that feedback was given.) After our first interview, we also conducted one observation of Sasha's interactions with her professors in the studio. We primarily used the observation to prompt discussion of certain topics with Sasha in future interviews; however, in framing the case study, we also used the observation to provide some general description of the setting as we viewed it.

Each interview was transcribed and coded by using a deductive process. We carried out our coding process by examining the transcripts for significant events or statements of understanding on Sasha's part, refining our observations into thematic codes based on words or phrases that Sasha expressed during our interviews. As we analyzed the interviews, we sought to understand the meaningful aspects of her experience, perspective, goals, and outcomes.

To address issues of trustworthiness through our research process, we also completed member checks by sharing emerging themes with Sasha during our third interview with her. This gave her a chance to respond, either confirming, refining, or challenging these initial interpretations. We also shared a draft of the manuscript with Sasha with her quotes highlighted and asked her to respond with any concerns about the accuracy of her statements and our interpretations. She responded that she felt accurately represented and suggested no changes to how we interpreted her comments.

The Case of Sasha: Finding Value in Critiques

In this section, we explore two of the major themes that emerged from Sasha's interviews: how she learned to value critique and the value she placed on the relationships built with the instructors in the course.

Theme 1: Learning to Value Critique

In our interviews, Sasha contrasted her previous experiences receiving feedback in non-studio courses with her current experience. This course was Sasha's first experience in a studio setting, and she observed, "it was very unique coming into the classroom setting … kindergarten through thus far has all just been really traditional academic experiences."

Over her college career and after a semester in a studio, Sasha had changed from disliking any negative or corrective feedback to valuing direct and specific feedback. Sasha viewed her previous experiences receiving feedback from professors throughout college as merely someone pointing out her mistakes, which was uncomfortable and unwelcome. She characterized herself as a perfectionist, "and so that kind of lends itself to being like, 'don't tell me I'm wrong or did something wrong,' I just wanted to have perfect scores." Her initial tendency was to reject negative feedback, but at this point of her college experience, she asserted that her attitude towards critique had shifted. Sasha now viewed herself as someone who "crave[s] feedback" for the different ways it can help her:

> There's definitely been times where I've been very, very upset if I got a bad grade on a paper … in my mind it was like, 'they're wrong for thinking I'm wrong. I'm not actually wrong.' … I don't think I would have that attitude right now; I feel like I would want to go talk to them about like, 'okay, where did I go wrong, and tell me how I can do better next time.'

Feedback through informal critiques Sasha explained that the feedback she received in the studio served an important function in navigating the many unfamiliar aspects of entrepreneurship. She described the class sessions where instructors offered informal critiques as productive, active interchanges where "you're never just sitting there and they're giving you feedback. You're always actively responding or actively asking questions for the feedback." Sasha viewed these sessions as fruitful opportunities to solve specific challenges through extended discussion. Her instructor(s) might respond to a specific question she or a member of her team asked, but "then they kind of open up more and maybe they'll offer some feedback elsewhere once you get really talking about the project." The feedback Sasha and her team received might take the form of probing questions or the suggestion of new entrepreneurship principles, from which they could then build upon to improve their project.

Feedback through formal critiques Sasha and her team also received feedback as they "pitched" their product to all the instructors of their course. Pitches were formal presentations in front of the entire class and pool of instructors, where teams summarized their progress and presented the current state of their project. Instructors then individually critiqued each team from the viewpoints of their particular disciplinary background. As the business student on her team, Sasha was more involved in planning and delivering the pitches and marketing research than in the physical product development. Perhaps because she was so involved in this part of the process, Sasha believed that feedback after pitches had a different feel than she experienced during informal critiques. She jokingly referred to it as, "public criticism? I don't know. [Laughs] Competitive public criticism." For her, this public environment was not a problem, per se. "I love pressure and I love competition, and so that's just the most pressured, competitive environment." However, she also described how her instructors responded to pitches by "asking specific questions … and then kind of offer insights," but because of time constraints, she did not have the opportunity to engage in a dialogue to understand the feedback as much as she would have liked.

Sasha expressed that the relative lack of feedback after a pitch, at least compared to other critiques she received was not helpful to the progress of her group's project. "Feedback is super important in these courses to really get learning, and I feel like more specific and more structured feedback would probably be helpful." She interpreted limited feedback as a sign that her instructors were "disengaged" or "not really excited about the project, so it must not be good." She welcomed negative feedback more than silence, expressing that:

> Even when you're giving lots of feedback and--even if it's critical and harsh—to me that means that you are invested in the idea succeeding, where if you're not giving feedback at all it's like … we [the instructors] don't have really much to say—positive or negative—because we don't care.

Feedback from multiple sources Sasha acknowledged that not every suggestion from an individual instructor was helpful, but that fact itself did not seem to worry her. She had come to believe that there was value in hearing suggestions from multiple sources, even if she disagreed with that feedback. Sasha saw that even conflicting advice, which different instructors provided frequently, was productive, because regardless of the suggestion or the expertise of the critic, the team's responsibility was to take the ideas and test them on their own.

> It's been really good for us to pin those things up against each other and test, and figure out what assumption we're going to go off of based on what people say and learning how to back-up things versus just taking an 'n' of one and going for it. [Laughs]

In fact, at this point of her experience Sasha was confident enough in her ability to sift through what feedback was valuable and what was not, that she was willing to call feedback she disagreed with as actually wrong, "you grow so much from feedback, even if it's wrong—even just learning that it is wrong is super powerful."

Additionally, by the end of the semester, Sasha and her team had gone beyond what was expected of them in the class and started to attend trade shows and professional conferences to seek feedback they did not think they could receive from their instructors. She said her and her team wanted to "just present the idea in front of people that have no connection to us" and hear what they had to say. Because their goal was to make the team's business idea as successful as it could be, she realized that they needed to move beyond the feedback their instructors could provide and get input from people who might even become future competitors:

> I think that school should prepare you for life, and we were at this conference … we got so much conflicting feedback … and you have to learn how to navigate all that. There's not going to be clear, like, "This is the exact right answer," you have to look at everything with maybe a little bit an eye of criticism and find ways. And so, I think learning to do that now is good.

Theme 2: Deeper Relationships

Throughout the three interviews, Sasha spoke several times about the deeper relationships she built with her instructors through the studio course and how this was expressed in the critique cycle. The relationships developed as Sasha was critiqued by her professors transcended them solely teaching her course content or skills, extending to helping her think about her personal life and professional goals in different ways.

Value of professional relationships The design of this course was intentionally set up to foster close relationships between instructors and students. At the beginning of the program, each team went to lunch with the instructor assigned to work most closely with them, which for Sasha "was totally separate from any academic experience I've ever had." It was there that they "built that friendship from the start and so we can joke around with him and have funny conversations, serious conversations, so it's more like a relationship that's beyond just academic." The frequent conversations over the two semesters of the studio provided opportunities to build a "giving, receiving, giving, receiving type of relationship." She contrasted this with her experiences with previous instructors.

> Other professors have kind of seemed untouchable … when we have regular sit down and you talk conversation-type of mentoring days, you really grow to develop a strong relationship with the professors … it's hard to develop that relationship with professors in a traditional lecture-based class.

Sasha described a juxtaposition between the intensity and the relaxed nature of the class and attributed "more of that friendship relationship" built between the students and instructors to the fact that "we're all focusing on solving issues and problems… They are definitely the most intense professors with feedback that I've had, but also somehow the environment is just more relaxed and you can talk to them about anything and joke around." Some of the intensity came through the pitches, or as she jokingly referred to them "the public beatdowns … that's when it feels real, getting feedback in front of forty people; you can't ignore it; everyone heard it, and so you really have to address it and so that's been really beneficial for me."

Because of the relationships that had been developed, even with intense moments, Sasha did not view the critiques her team received as "harsh." She came to see direct feedback as serving to find holes and weaknesses in their plan, which is what she felt she needed to continue making progress toward a successful product.

> I want to be proved wrong before we go on … if this isn't going to work, we want to invalidate it, and all of our hypotheses are kind of directed to that, what are the possible ways where this could not work out?

In pursuit of that goal, she believed that instructors were sensitive to the fact that "this is our first experience—all of our first experience kind of doing something like this" so she did not interpret their feedback as vicious, even when it was direct.

Obstacles of closer relationships While stronger relationships were valuable to Sasha, she acknowledged that they could also lead to some problems. She felt that the closeness lead some students in her team to feel obligated to follow an instructor's suggestions or create a product that would meet the instructor's needs. But Sasha believed the remedy for this was already built in to the structure of the class:

> I think that the encouragement to test and always test the assumptions and to really get feedback from the industry and from customers has been kind of a good buffer of that. They'll [the instructors] give us feedback, "But you should really test this and see how it applies in your market," and that's been really good.

At other times, she felt that instructors were not "straightforward enough" in their feedback, partly because their role involved nurturing relationships and encouraging students because "it's not like … they're venture capitalist that can just be jerks to you and flat out tell you, 'I hate it,'. That's not going to work because they kind of have to facilitate that and cuddle you and make sure you're okay."

Despite the possible drawbacks, however, Sasha highly valued the relationships that she had built in this course. “I think taking yourself out of the academic situation and really trying to build real relationships, and asking questions beyond just the topics that you’re studying, is the foundation for having that one-on-one interaction and having a better relationship.” In fact, she valued these relationships so highly that she asked two of her instructors to be part of her senior thesis committee.

Discussion and Conclusion

The purpose of this case study was to examine one student’s experience receiving feedback in a design studio environment. We found that Sasha viewed the relationship of trust and commitment formed between an instructor and student to be a critical component to effectively participate in a critique. This type of trusting relationship can be cultivated regardless of content area, but it need not look or perform in exactly the same way. She was able to see benefits from both formal and informal critiques and appreciated the balance instructors struck in providing useful feedback without being harsh or dismissive, but felt there were times when she would have benefitted from more direct and specific feedback. Additionally, she consciously and deliberately sought out feedback to prepare for her own professional life. Sasha described her experience positively overall. She learned to appreciate feedback in the context of an intentional and supportive mentoring relationship. While we recognize that studios vary across disciplines, her insights suggest several implications that other studio instructors can consider.

It is not possible to know exactly when and how Sasha’s views on critique changed, only that it was a gradual process over time and in response to different opportunities. What we do know is that it did change, quite drastically, in a way that she feels benefited her education and her future work prospects. And we believe this change illustrates the possibility that when instructors critique, they can be actively trying to encourage students’ development of dispositional growth in ways that may not be directly connected to the content of the discipline explicitly being taught. Sasha’s studio environment was conducive to developing such dispositions without sacrificing rigor in the amount of material taught or the level of proficiency students achieve. Her experience also illustrates that direct critiques can be offered without reverting to the callous critique that destroys student’s self-confidence. Sasha’s experience of receiving direct feedback in relationships where she felt valued indicates that instructors can be invested in students’ work and give direct feedback without being overly negative. Another implication is that supportive relationships in education are a two-way responsibility, where satisfaction depends on the mutual commitment from both parties (Poteat, Shockley, & Allen, 2009). While Sasha saw direct feedback as a sign of commitment from the instructors, she also had advice for what a student can do about fostering a productive feedback relationship. She recognized that “people want feedback, but they don’t necessarily want feedback, if that makes sense.” So her suggestion is that students

> Ask for a lot of feedback … Tell us what we did wrong, instead of presenting [feedback] in a way that's like, "Here's all the things you did right." … It makes the other person feel more comfortable about telling you what you did wrong, and then for you, you've kind of let down that barrier, like, "I'm not going to be upset by it or offended by it."

Second, we suggest that Sasha's experience with taking her idea to trade shows and industry experts illustrates that some students are motivated by the real-world possibilities of their ideas. Therefore, instructors can intentionally structure the experience of studio critiques by taking into account desired outcomes, student skill level, and incorporating their own knowledge of standards for success in their field, whatever that may be.

Third, we emphasize again the value that Sasha placed on the personal relationships with her instructors. Critiques were a unique opportunity to build a bond with instructors who model professionalism at a formative time, when she is building her own identity in preparation for stepping into the professional world. We recommend that instructors structure critiques in their courses in a way that opens the door for similar types of relationships.

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Chapter 17
Beyond Bricks and Mortar: Attributes of the School Environment That Teachers Relate to Creative Instruction

Jody Nyboer

Introduction

Evidence supports that creative instruction benefits learners *substantially* (Newton, 2013). Creative instruction has been shown to enhance learning (Reilly, Lilly, Bramwell, & Kronish, 2011; Rinkevich, 2011; Sawyer, 2011) and promote creativity among learners (Craft & Jeffrey, 2004; Horng, Hong, ChanLin, Chang, & Chu, 2005; Cheng et al., 2010; Nickerson, 2010). Given the role that it plays to supporting learning, it is essential to understand what contexts engage and foster creative instruction. However, few studies concerning creativity and the teaching environment are the focus of study. Knowledge concerning creativity and the instructional environment is generally "sparse" (Lilly & Bramwell-Rejskind, 2004, p. 4) and has been described by Beghetto as a "pitfall" of creativity research in education (2007, p. 102).

The goal of this investigation is to address these deficiencies in knowledge by looking beyond the school as an academy where only learner creativity is valued. This study focuses on instructor creativity and the environment by analyzing related literature, investigating the key attributes of the environment, and delineating the role of those attributes in mediating instructional creativity.

J. Nyboer (✉)
School of Design, Syracuse University, Syracuse, NY, USA
e-mail: jlnyboer@syr.edu

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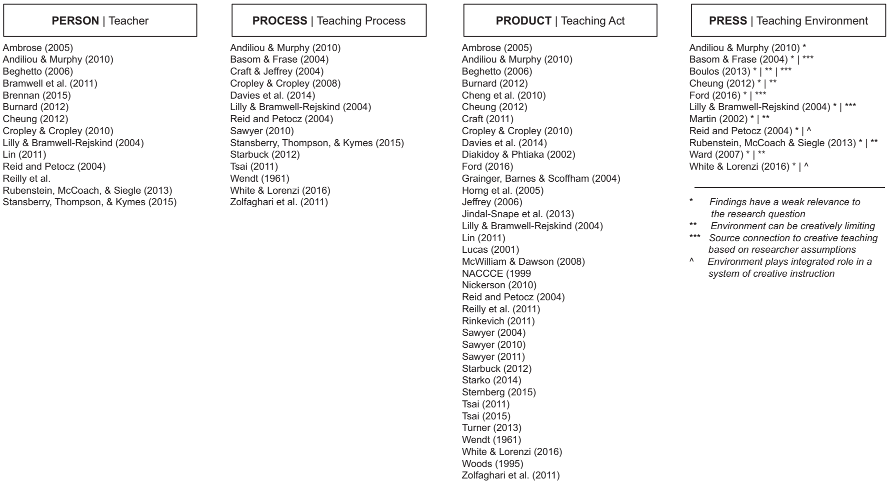

Fig. 17.1 Research indicating Four-Ps of teaching

Literature

The Four-P model (Rhodes, 1987) was used as a tool to analyze and organize literature related to the broad ecosystem of teaching and creativity. The Four-P model is widely adopted in creativity research because it is comprehensive, defining dimensions of creativity as person, process, product, and press (environment). Classifying the sources according to Rhodes' four dimensions reveals that contemporary literature emphasizes the environment the least and that constructs of environment are the least utilized to delineate creative instruction. This is illustrated in Fig. 17.1, a graphic representation of the contemporary research that indicates the Four-Ps of teaching. Classifying the sources also reveal that the bulk of research about teachers and creativity is coupled with research that concerns learners. This makes it challenging to discern how the Four-Ps distinctly relate to the teacher.

The literature review suggests that few contemporary studies address the teacher and the environment (Basom & Frase, 2004; Martin, 2002; Zane, 2015) and even fewer address teacher creativity and the environment (Cheung, 2012; Rubenstein, McCoach, & Siegle, 2013). Insight from contemporary research is lacking because studies about teachers are generally companioned by questions and outcomes concerning the learner (Henriksen & Mishra, 2015) and because there is a general failure in educational research to distinguish creative teaching from teaching *for* creativity (Futures, 1999). In summary, knowledge is deficient for answering the question addressed by this study: What attributes of the school environment enable and limit teacher creativity?

Prior to this study, process coding was used to analyze the related literature. Saldaña (2015) suggests that this method of coding is useful for mapping relationships, for linking data, and for developing models (p. 114). Qualitative analysis

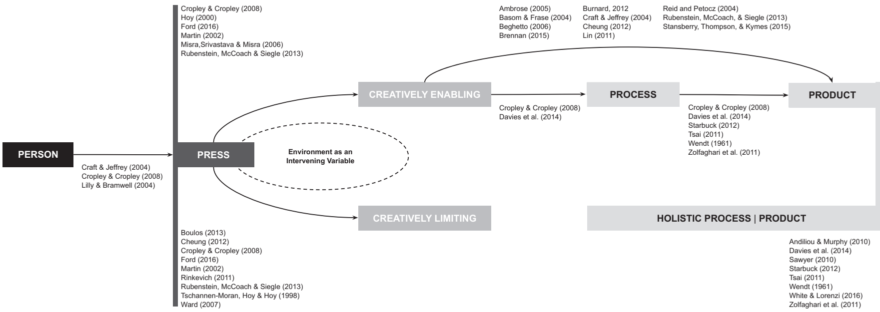

Fig. 17.2 Four-P Framework of Teaching

software (NVivo) facilitated the coding of each source and systematizing them into the Four-P Framework of Teaching (Fig. 17.2). The exercise of coding often require the researcher to interpret the relationships between instructional creativity and Rhodes' four dimensions of person, process, product, and press. Figure 17.2 suggests that there is a relationship between a creative person (teacher) and the teaching environment, which results in either enabling creative processes and outcomes or limiting them. This bids relevance to the Theory of Creative Affordances (Glăveanu, 2012). Glăveanu expanded Gibson's Theory of Affordances to reinforce that the physical or built environment is not a "stimulus." Rather, creative behavior can be "inspired" by perceived possibilities of the physical and material environment.

Research Design

The goal of this study is to discover what attributes of the environment enable or limit creative teaching. Kafashpour and Gharibpour (2016) suggest that "Those people who are working within an environment are the ones best able to identify factors that affect their work" (p. 106). The existing literature suggests that gathering insight directly from teachers is not an orthodox method of exploration within this area of research. However, the Four-P Framework of Teaching (Fig. 17.2) and Glăveanu's Theory of Creative Affordances suggest that we should.

The multiphase research design used in this study optimizes discovery by making creative teachers the unit of study (Table 17.1). The participants are full-time teachers from a private, urban elementary school located in the Midwest United States. The sample school was selected for its reputation as a creative academy characteristic of instructional excellence.

The initial phase of the study used quantitative methods and aimed to assess the creative ability of the participants for the purpose of selection. The Torrance Test of Creative Thinking (TTCT; Torrance, 1974) was used for this phase. The TTCT is the most widely used instrument for measuring creative thinking (Cropley, 2000;

Table 17.1 Overview of data collection methods

Approach	Method	Purpose
Quantitative	ATTA (Goff, 2002)	Identify participants with a high or substantial creative ability (a selection tool)
Qualitative	Interview (classroom)	Gather perceptions about creative teaching experiences
Qualitative	Interview (walking)	Gather perceptions about creative teaching experiences and the school environment

Kim, 2006; Starko, 2014) with high validity (Althuizen, Wierenga, & Rossiter, 2010; Cramond, Matthews-Morgan, Bandalos, & Zuo, 2005; Cropley, 2000; Kim, 2006; Starko, 2014). It is identified as a reliable assessment of creative ability for its predictive validity (Althuizen et al., 2010). The TTCT defines creative ability by primary dimensions of originality, fluency, flexibility, and elaboration.

Goff (2002) developed the Abbreviated Torrance Test for Adults (ATTA), a shortened version of the TTCT that can be administered to both children and adults. The ATTA was administered to the participants of this study. The ATTA is reliable (Auzmendi, Villa, & Abedi, 1996), valid (Althuizen et al., 2010), and an effective tool for screening creative ability (Cramond et al., 2005). The ATTA takes only 15 min to administer, including the verbal prompts, which is half the time required for the TTCT. The ATTA utilizes simplified versions of the figural and written/verbal of the TTCT. The Creative Index (CI) score of the ATTA is a combination of criterion-referenced measures that include provocative questions, internal perspectives, openness articulateness, and abstractness. The composite CI scores correspond to seven levels, defined by the distributive norms established by Goff (2002). The CI levels are defined as minimal, low, below average, average, above average, high, and substantial. Of 18 participants in this study, 9 scored a CI of >5 (high or substantial) and were selected to participate. Three participants piloted the interview protocols and six participated in formal data collection.

The second phase of this research used qualitative methods. Semi-structured interviews were conducted using two methods. The first involved interviewing each participant in their customary instructional spaces. During this session, participants were asked questions designed to learn about their creative experiences and importance of the environment in those experiences. Another method involved walking around the larger school environment with the participant. This method utilized the building as a primer, facilitating the generation of descriptive data through open-ended inquiries about the places in which participants experienced creative teaching or the opposite.

Random aliases (T01 through T06) were assigned to mask the identities of participants and track the source of the descriptive data. The data were interpreted and coded for contextual importance and for frequency and commonality. NVivo facilitated tracking and the process of performing an inductive analysis.

Table 17.2 Attributes of the environment that matter to creative teaching

Finding	Sub-category	Attributes
The physical environment relates to creative teaching	Furniture and interior finishes	Personalization Organization Flexibility Displayed thinking
	Building architecture	Proportions of space Connections outside of building
The socio-organizational environment relates to creative teaching	N/A	Meaningful interactions with colleagues Meaningful relationships with students Individual control over and ownership of space
Attributes of the environment that relate to creative teaching are interrelated	N/A	Vary and combine in unique ways

Discovery

Several findings emerged from this research that suggest that measurably creative teachers perceive strong associations between the environment and their creative agency as professionals. The following sections provide evidence that attributes of the physical environment and socio-organizational environment play a role in enabling and limiting instructional creativity (Table 17.2) and that the attributes are interrelated.

Finding 1: The Physical Environment Matters to Creative Instruction

All of the participants shared experiences that describe how the physical environment supports their creativity. Supportive context is multifaceted and includes attributes associated with furniture and interior finishes, and also building architecture.

Furniture and Interior Finishes

Personalization Creative instructors feel creatively enabled through personalization. T03 said that "without personalization," it would be difficult to do their job in a creative way. T06 identified a small space in their classroom as creatively inspiring to them because they had defined it with personal rugs, shelving, lighting, and other artifacts and said, "I'm always creating… I love just making everything for the classroom." They added:

> I think some teachers are happy kind of purchasing things from the teacher store and putting on the wall and calling it a day, and I like making my own… If you make it yourself, it's more personal… I think that when you care about what you made then that care radiates…Then the environment shows that to the kids and to anyone else that comes in….

Organization Creative instructors feel creatively enabled through organization. Several participants shared stories about how organization supports a "very creative and inviting space." T01 shared that when a space is "cluttered," it is "stressful." When asked to identify a space in the building that they felt creatively limited, they zeroed in on one for its "chaos" and "visual distractions." When asked to talk more, they shared:

> For me, [creativity is] very related. I feel like when my classroom is messy and there's just stuff all over the place […] It's harder for me to plan creatively because I'm distracted by all the mess… I can't get into a space where I can't be a creative teacher.

Flexibility Creative teachers feel enabled by reconfiguring things. When asked to share a creative aspect of their space, T05 blurted the single word, "Flexibility." T03 shared described their room as "very fluid" and "made to do big moving things" because its flexibility. T04 shared how "remodeling" their environment is creatively enabling because they simply like to "change it up." They shared:

> I feel like a creative environment has to be flexible… I might just come to school one day and say, "I want to set up [an activity] in the middle," and then I'd put all the tables kind of surrounding that. Or kids stand up, and I push all the tables so that everybody can be facing that way.

Displayed thinking Creative teachers feel enabled by exhibited work and ideas. When display surfaces are limited, they "Economize on the space that's available." (T04). Several participants identified gallery-like spaces on shelves and tables as creatively enabling. T03 identified a high ceiling with hanging visual. T02 talked about a repository of autonomous student works on a wall. In discussion they asked and answered the question, "Would the kids do this kind of writing if there wasn't a place to put it?… Maybe they wouldn't have done it if not for the space."

Building Architecture

Proportion of space Building architecture generally controls the size and height of interior rooms. Creative teachers associate proportions of space to creative instruction. T02 shared how a big space with windows "could always turn into a beautiful creative space for me." Similarly, T01 shared, "I feel like with all the open space, you have more room to be creative… it gives you the room to do whatever you want."

Connections outside the building Building architecture informs the location of exterior openings, natural light, and access to outside. When asked to share the most creatively inspirational space in the building, T05 identified one outside the building, emphasizing, "It's right next door to my classroom." Creative teachers feel creatively enabled by spaces with "lots of windows and wonderful sunshine" (T04). T02 shared how outside views and windows relate to their creativity, saying:

> Coming here, this room with windows on three sides and the sort of accessibility to nature, just seeing it. And we'll see hawks, and squirrels, and woodpeckers in our trees. And the changing of the seasons is so right there, the glow in the autumn when it's yellow right out our window. I mean, and the weather and the air. We open the windows, and just that— to me, that is really inspiring. And if you want to read, or write, or draw, or be creative, to have that just in your field of vision is so— I need that to be creative.

Finding 2: The Socio-organizational Environment Matters to Creative Instruction

All of the participants shared experiences that describe how the social and organizational environment supports their creativity. Supportive context is multifaceted and includes aspects of the environment that promote meaningful connections between colleagues and students and aspects of space ownership.

Meaningful interactions with colleagues Professional interactions are important to creative teaching. Colleagues are a soundboard for creative ideas, a source of feedback, and instrumental in actualizing creative ideas. T04 described exchanges with colleagues as an "important part of the whole experience" of creative teaching. T03 shared how colleagues help you, "think about things in different ways." Creative instructors are inspired just by seeing the creative activities of colleagues. T02 shared, "…I'll walk by the classroom next door and they'll be working on some creative project. I'll see something up on the screen…or I'll see something that's hanging on their walls… In a blip of time, you can get a feeling for that's something really creative and cool."

Meaningful relationships with learners Creative instructors feel creatively enabled by student-teacher relationships. T04 illustrated this by randomly remarking in interview, "What's interesting is we're talking about my creativity and part of it is student creativity and fostering that, and then part of it is my feeling that I'm being creative… I think there's a lot of cross-over." T02 shared, "I feel like so much of my creativity comes from the individual relationships and knowing your kids." They described how knowing their students made them feel like a "more authentic and more creative" teacher.

Individual control over and ownership of space Creative instructors often described how individual occupancy and control over spaces affect creative experiences. T02 described feeling creatively limited by a shared space that lacked this quality.

> … it doesn't feel like my space as much. It's not my classroom or my teaching partners'. It feels like a little bit like it belongs to another…. It doesn't really because it's sort of everyone's. It's shared. It's just sort of like a place you get in and get out. […] You just kind of don't want to spend a lot of time and it doesn't feel as inspiring and creative.

T04 also shared insight concerning similar limitations when visiting a space on the walking interview. They said, "I feel like this a great space, but I feel it could be more conducive to creative inspiration. More inspirational." When asked to talk more about their experience teaching in the space, they said, "Because other teachers used the space as well, I had to be pretty organized… I couldn't just take over… That would tend to put a little bit of [a] buffer on the creativity."

Finding 3: Attributes of the Environment That Matter to Creative Instruction Are Interrelated

All of the participants shared experiences that describe how several aspects of the physical and socio-organizational environment combine in ways that impact creative instruction.

The creative participants in this study rarely identified attributes of the environment that have an independent relationship to teaching. T04 illustrated this when they struggled to identify a creative aspect of their classroom, saying, "I can't just take any one thing out of this room and say it's the thing. It's the whole environment." Zeroing in on one attribute was mutually difficult among participants.

Displayed thinking encourages meaningful relationships and interactions and gives teachers instructional freedom. Exhibits in hallways result in praise and sometimes facilitate dialogue and the exchange of instructional ideas. T01 shared, "…when you do a lesson and you immediately put it up on your bulletin board [another] teacher will walk by and be like, 'That's really cool. Tell me more about that.' " T04 described how displayed thinking can span a network of connections and "just kind of [take] off."

Ownership and control over spaces spawn dynamic interactions between colleagues. T04 described how the overlap supports positive team-teaching experiences. However, T01 described how it can cause conflict over personalization of space. T05 illustrated how attributes of the environment are interrelated in complex ways. When asked what they need to work creativity, they shared:

> I like to work with people, but I like it quiet, too. So, there are rules of working together… You can have your earbuds in if you want, or whatever, doing the work, but having wide-open spaces with not too much clutter. I've tried to get rid of my desk, but I try to hide it… But then there's the teaching environment, and that's what it looks like, that's how you talk,

that's your management. And then there's routines, like how do you structure your day. There's just so many different parts of teaching… You're never done learning, and you're never done getting new ideas.

Discussion

This study was designed to learn how instructional creativity is enabled and limited by the environment. Several conclusions were reached as a result of the investigation.

The Environment has an important relationship with creative teaching Participants were asked to identify places in the building where they experienced feeling creatively inspired or limited. Creative instructors perceive personalizing, organizing, and reconfiguring as creatively enabling. Several sources support this finding; teachers use these strategies to support learner creativity (Martin, 2002), design and control their environment (Martin, 2002), and ultimately feel personally empowered by doing so (Ford, 2016). Altering the "nature of space" is described by Jeffrey (2006) as an instructionally creative use of space.

The importance that creative teachers place on displaying artifacts of thinking was surprising. Often, attributes were identified by the participants but not overtly talked about or identified; they were represented by omission. Participants identified surfaces that afford adhering, hanging, taping, tacking, etc. As an extreme example of this, one participant identified a creative moment where they allowed a visiting artist to paint directly on their classroom wall. Non-educational literature supports this finding; adaptable display surfaces support creative process (Kristensen, 2004; Martens, 2011), and the materiality of such surfaces can impact creative outcomes (Kafashpour & Gharibpour, 2016).

Creative teachers perceived large spaces with high ceilings and natural light as creatively enabling. Ample literature supports that *all* teachers desire large spaces with natural elements. These are common features in 21st-century school design (Ford, 2016; Lembo, Mecella, & Vacca, 2013). Research across domains supports a positive connection between creativity and nature (Plambech & Van Den Bosch, 2015).

Creative teachers emphasized the importance of people-connections to their creativity. This finding is supported in related literature. Lilly and Bramwell-Rejskind (2004) suggest that meaningful relationships are an integral aspect of fostering a "dynamic process of creative teaching" (p. 18). That process engages instructional reflection and self-awareness that leads to improving professional activity.

Space ownership and control can meddle with creative instruction. This is supported by Jeffrey (2006), who suggests that teaching innovations result when they are "owned" by the teacher… that the "teacher has a certain autonomy and control for the process" (p. 3). They emphasize "relevance, control, and innovation" as creative teaching contexts.

Creative Teaching is an environment-dependent system This study suggests that the attributes that enable and inspire instructional creativity are part of a complex system. The Environment Model of Creative Teaching (Fig. 17.3) illustrates

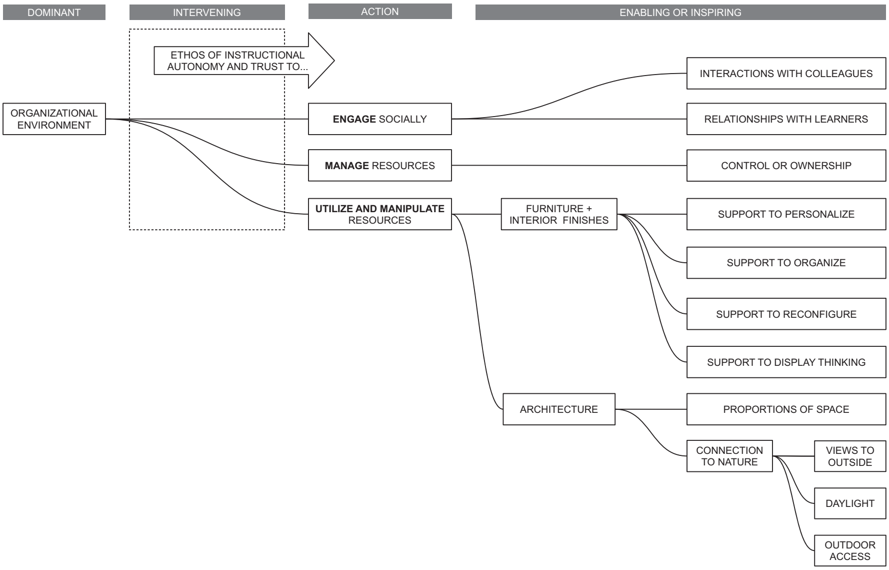

Fig. 17.3 Environment Model of Creative Teaching

that creative instruction is dependent on the environment and that the organizational environment plays a unique role. The model was developed by interpreting and synthesizing the findings of this study. The organization of Fig. 17.3 bears resemblance to the Four-P Framework of Teaching (Fig. 17.2) and suggests that the insight gained through this study is consistent with the analysis of related literature. In both models, the environment appears to play an intervening role, mediating actions (or behaviors) such as engaging socially, managing resources, and utilizing and manipulating resources. Creative teachers associate autonomy of these actions as creatively enabling, and management of them as creatively limiting.

The idea that an environment can block or negotiate creativity is not unique. Dul and Ceylan (2011) suggest that the impact of the physical workplace on creativity is small and "secondary" to the organizational environment. Dul (2009) found that the non-physical environment has a mediating impact on creative employees. Creative instructors experience the same pressures and do not respond creatively to an environment that prescribes controls.

Schools are workplaces that can affect creative teaching There are similarities between the attributes of the environment that emerged from this study and those from workplace creativity research. The similarities are rousing because they offer explanations that the related literature in education does not. McCoy and Evans (2002) found that spatial elements such as visual details, views to nature, and social interactions enhance the "creative potential" of a workplace space and predict creative performance. Kristensen (2004) found that non-fixed furnishings, large surfaces, collaborating, and an overall sense of adaptability are attributes that support a creative process. McCoy (2005) revealed that the proximity to resources, space planning and layout, circulation patterns, surfaces that allow for personalization and displayed thinking, sizeable work areas, adaptability of space, and visual access to others relate to creative production. Dul and Ceylan (2011) compiled a list of elements of the work environment that are "possibly" related to the workplace creativity and include teamwork, autonomy, furniture, privacy, views to nature, and daylight. Martens's (2011) investigation of the physical workplace concluded that open space, visual exhibits of work, and people interactions are important attributes of a creative workplace culture. The knowledge coincides with the findings of this study and supports that creative instructors are enabled and inspired by their environment in the same way other creative professionals are.

Recommendations

This study suggests that distinct attributes of the environment matter to creative instruction, but the work of investigating this is only just beginning. It is important to replicate the study to establish the reliability of the findings. School architecture and design has shifted dramatically in lieu of 21st-century century learning (Benade, 2017; Pearlman, 2010). Therefore, this study should also be replicated in a variety of school environments (old, new, and alternative) to understand how architectural and educational trends relate to the findings.

Some of the attributes of the physical environment that emerged as important to the teachers in this study also relate to *learner* creativity. Future studies might expand this work to include both user groups to understand the complexities of how they overlap and differ. Discerning the intersection of these attributes would be valuable knowledge for improving how we conceptualize and design schools. Similarly, the attributes of the physical and socio-organization environment that the teachers in this study identified as important have a strong resemblance to those that have emerged from workplace creativity. These parallels are exciting because they reveal a significant gap in knowledge, and suggest interdisciplinary trajectories for expanding this work that have not yet been explored.

Last, this is the only known study that has used teachers who have a high or substantial creative ability as the unit of study to explore the relationship of the environment to creative instruction. This is a unique aspect of the methodology of this work and it should be continued. Creative ability is a flexible skill that can be developed through practice. Thus, future studies might aim to understand how changes in the creative ability of teachers relate to their perception of the environment and their creative agency as professionals.

More research is needed to know what will support 21st-century *teaching* (Ford, 2016). This study provides evidence that school design is part of that narrative, but far beyond bricks and mortar. The findings presented in this research contribute important knowledge that can be used by architects, interior designers, facility planners, and administrators to conceptualize and design schools that enable the creativity of students and teachers alike.

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Chapter 18
What Else Did Pre-service Teachers Learn in a Maker Education Course in a Teacher Education Program Beyond Content?

Yi Jin

Introduction

The maker movement was originated from the Do it Yourself (DIY) culture and serves as a political response to industrialization (Dougherty, 2012). Deeply rooted in the participatory culture (Jenkins, Clinton, Purushotma, Robinson, & Weigel, 2006), *making* promotes "low barriers to expression and engagement, strong support for creating and sharing one's creations with others, and some type of informal mentorship whereby what is known by the most experienced is passed along to novices" (Fleming, 2015, p. 6). A makerspace is "a place where people come together to create and collaborate, to share resources, knowledge, and stuff" (Britton, 2012). The definition of a makerspace is broad and loose because no two makerspaces are the same. For example, academic makerspaces in schools and libraries bring unique opportunities for students and faculty, which could not be easily duplicated in a makerspace for entrepreneurs.

Making in education, which emphasizes the design process of creating artifacts, becomes a unique approach for students to explore, engage, and learn in formal and informal settings (Fleming, 2015). Maker education in schools is a combination of *making* and the integration of technology, which facilitates students to gain both competencies and confidence in the subject matter and the process of learning (Strycker, 2015). Furthermore, maker education helps students develop skills in Science, Technology, Engineering, the Arts, and Mathematics (STEAM) (Peppler, Maltese, Keune, Chang, & Regalla, 2014). Integrating *making* into education helps establish a maker culture in schools, which highlights informal, networked, peer-led, and shared learning motivated by fun and self-fulfillment, along with partnership, collaboration, and active community involvement (Sharples et al., 2014).

Y. Jin (✉)
Kennesaw State University, Georgia, GA, USA
e-mail: yjin8@kennesaw.edu

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Undoubtedly, educators are essential stakeholders in the maker movement who firmly believe that *making* could potentially transform education (Martinez & Stager, 2013). This strong belief facilitates the emergence of a large number of makerspaces in educational settings. Educators who support *making* are those who adopt a constructionist point of view toward learning, which posits that people learn through constructing meaning in their mind and making and creating artifacts using their hands (Harel & Papert, 1990). Building on constructivism (Piaget, 1971), Seymour Papert presented constructionism and proposed eight big ideas to guide constructionist teaching practices. These ideas are (1) learning by doing, (2) using technology as building materials, (3) hard "fun," (4) learning to learn, (5) taking the right and proper time for the job, (6) you cannot get it right without getting it wrong, (7) do unto ourselves what we do unto our students, and (8) entering and navigating the digital world (Martinez & Stager, 2013). Constructionism teachers follow these eight big ideas in their practice and focus on the "design and construction of personally meaningful projects determined by the learners and not pre-set by others" (Cavallo, Papert, & Stager, 2004, p. 120).

Three pedagogical strategies are commonly used in maker education, design thinking, problem-based learning, and project-based learning (Bell, 2010; Ellen, Donham, & Bernhardt, 2011; Rowe, 1991). Design thinking depicts how designers *see* and how they consequently *think* (Liu, 1996). This approach cultivates several competencies at various phases, which include the ability to understand and observe, synthesize, ideate, prototype, test, and iteration (Rowe, 1991).

Design thinking is unique in maker education because its core is to teach students to use design reasoning, which is fundamentally different from reasoning and problem-solving found in other domains (Dorst, 2011). Using this approach, students focus on the process of learning instead of the final product. Learners have an action-oriented, prototype-driven, and non-judgmental mindset during this creative process. In maker education, teachers teach design thinking as a combination of different kinds of thinking, which is generally composed of analytical reasoning (inductive and deductive reasoning), problem-solving, and design reasoning (Dorst, 2011). Moreover, teachers create learning experiences that foster students' characteristics as a design thinker (Razzouk & Shute, 2012). Using this approach empowers teachers to facilitate constructionist learning with the goal of fostering the "so-called twenty-first-century skills" that are consist of twelve skills: critical thinking, creativity, collaboration, communication, information literacy, media literacy, technology literacy, flexibility, leadership, initiative, productivity, and social skills (Partnership for 21st-Century Skills, n.d.; Scheer, Noweski, & Meinel, 2012).

Problem-based learning is a student-centered approach that initiates learning with a complex and realistic problem for students to solve. Facilitated by the teacher, students generate hypotheses and search for information. During this process, students form small groups and actively engaged in their own learning (Ellen et al., 2011). Problem-based learning is used in maker education to solve particular problems through the design process.

Project-based learning is a student-driven pedagogy, in which teachers become facilitators of students' learning. Guided by the teachers, learners ask questions of their curiosity and develop questions for their projects. Project-based learning helps teachers facilitate *making* projects initiated by students. All three pedagogies are commonly used in the maker education to facilitate interdisciplinary active learning. Each pedagogy has potentials to facilitate a *making* lesson or unit.

Researchers have been examining the impacts of *making* in education (Papavlasopoulou, Giannakos, & Jaccheri, 2017). Bennett and Monahan (2013) found that *making* motivated students to develop a deep relationship with learning during the process of completing their projects at hand. Moreover, researchers found that problem-solving through trials and errors led students to a rich learning experience (Petrich, Wilkinson, & Bevan, 2013). Furthermore, it is reported that *making* activities empowered students (Clapp, Ross, Ryan, & Tishman, 2016) and helped students develop a maker mindset (Dougherty, 2016). Nevertheless, few studies focused on how in-service and pre-service teachers were prepared for maker education. In a survey completed by 123 US teacher education programs, Cohen (2017) found that only half of the programs claimed that they offered some kind of preparation for maker education.

Nonetheless, for pre-service teachers to become active agents of this promising educational transformation, they need to be fully prepared. Thereby, the purpose of this study was to investigate what skills, belief, mindset, and practices pre-service teachers develop in a maker education course.

Method

Research Context and Participants

The current study was conducted in a maker education course at a teacher preparation program of a large US Midwestern land-grant university. This one-credit course is an elective of the Learning Technologies Minor program. Pre-service teachers who are enrolled in this minor are required to take 16 credits that focus on different aspects of technology integration in education. This course aims to provide pre-service teachers with the necessary knowledge on how to design learning experiences that involve *making* and technology. It is a 4-week course using the flipped classroom as its pedagogy (Velegol, Zappe, & Mahoney, 2015). Four major topics were covered: an introduction to makerspace, physical programming, 2D and 3D digital fabrication, and computer programming (coding). Pre-service teachers learned course content online and worked on hands-on projects in class every week. For example, students created windmill, robotics, and other machinery using circuits and various materials. Students created 2D paper projects and 3D sculptures using Cricut and Makerbot. Students also worked on coding robotics, such as Dash and Dot, Spheros, and Ozobots. After each project, they designed *making* lessons and posted it online for peer and instructor feedback. The major assignments are weekly discussion forum posts, hands-on projects, and a final reflection paper.

A total of 21 female pre-service teachers voluntarily participated in the study. These participants majored in early childhood education, elementary education, and secondary education. All pre-service teachers were enrolled in the Learning Technologies Minor and had finished the foundational educational technology course.

Data Collection and Analysis

Qualitative content analysis was used as the research design (Hsueh & Shannon, 2005). Pre-service teachers' final reflection papers were collected as the body of data. Directed content analysis approach was applied to data analysis, which retested existing categories, concepts, models, or theories (Krippendorff, 1980). Through the review of relevant literature emerged a pre-generated codebook with initial coding categories, such as skill, mindset, belief, and practices (Dougherty, 2016; Jones, Smith, & Cohen, 2017; Partnership for 21st-Century Skills, n.d.).

The researcher coded the first reflection paper to test the codebook. Afterward, minor changes were applied to the codebook. For example, brainstorming was merged into generating new ideas. Then, the researcher coded all 22 reflection papers. Later, the researcher combined the codes and categories into theme-related components and then themes.

To ensure validity, the following strategies were used (Johnson, 1997): (1) descriptive validity (using reflection papers as data ensured the factual accuracy of the accounts); (2) interpretive validity (member checking was used to get participant feedback (Lincoln & Cuba, 1985) and verbatim low inferences were reported); (3) theoretical validity (peer review strategy was used, and discussions were conducted with colleagues); (4) internal validity (data triangulation strategy was used and results found in this study were triangulated with data collected for another study, such as discussion posts, *making* projects, and lesson plan ideas).

Results

Developing Twenty-First-Century Skills for Learning and Teaching

Most pre-service teachers reported that they developed twenty-first-century skills after taking the course. They especially developed skills in technology literacy, social skills, critical thinking, creativity, communication, and collaboration. Moreover, they felt that they could help students gain twenty-first-century skills in their future classrooms.

Pre-service teachers commented that they felt more comfortable and confident in using emerging technologies after the course. They agreed that the emerging technologies used in the course were fundamentally different from the other computer technology they learned before in other courses, which were both beneficial and "opened the doors to a whole new side of technology." They also recognized the limitation of a 4-week course and were curious about other emerging digital tools. They appreciate the weekly discussion forums that gave everyone an opportunity to explore one more digital tool and share it with the whole class as a professional learning community. Collectively, they felt they gained technology literacy as a professional learning community (Lave & Wenger, 1991).

Pre-service teachers reported that they realized that for the hands-on projects they conducted in the course, there were many different strategies for *making* that were all viable throughout this process. They learned how to generate multiple new ideas for their *making* projects and critically think about how to execute each idea. For example, as stated by Lisa:

> With the LittleBits, we could have built our windmill in different ways; we could have had our windmill do more than just go in a circle going one way only. Same goes for the 3D and 2D printing. We chose to do manipulatives and name tags, but really there is an endless amount of things that could be done with the 3D printer and the Circuit machine. Then came the Spheros, just in our class there were many different projects going on. We had balloon popping, dancing, mazes, and more. The Spheros also have so many different things that can be done with them.

Pre-service teachers reported that they also learned how to generate new ideas to design engaging lessons because the course required them first to figure out how to use the technology from a student perspective and then to design *making* lessons as teachers. Furthermore, they stated that when incorporating technology into the classroom, they must critically think about the benefits and feasibility before the implementation using the four elements of critical thinking: (1) a critical thinking attitude, (2) the ability to use specific critical thinking skills, (3) the ability to apply those skills in new contexts, and (4) habits of reflection upon one's own thinking (Sweet & Michaelsen, 2012).

Pre-service teachers spoke highly of the course because they learned how to problem-solve and work in teams. All projects conducted in the course were complex and required a high level of skills. Sara illustrated her group's problem-solving process:

> One example … was the pinball machine that my group made with LittleBits. We had a tough time figuring out how we would get the flaps to work the way we wanted them too to push the ball back up into the air. We had to cut, switch out, measure, and redo those flaps many different times, but in the end, it worked.

Pre-service teachers also commented that when facing problems, they felt frustrated. They believed they should learn how to stay calm and patient to solve the problems. Moreover, they said that problem-solving and teamwork skills were essential for students to learn and "a good life teaching moment." These skills are crucial for pre-service teachers to develop because as future educators, they could pass down their learning experiences and nurture students' skills by integrating core subject mastery and contemporary, interdisciplinary themes.

Cultivating a Maker Mindset

All pre-service teachers coming into the course had minimum experiences with *making*, reflected in their belief that they were not makers. However, at the end of the course, most commented that they cultivated a maker mindset. They also said that they developed skills in design thinking and creativity both in *making* and learning and teaching.

Pre-service teachers spent much time designing and redesigning their project. Olivia said,

> I have also learned a lot about how to plan a design for technological tools; when we worked with LittleBits, my group struggled with the design aspect. We had to try and figure out how to make the circuit for a robot, but we also had to design our robot to hold our circuit. After this struggle, I learned a lot about planning a design before executing it.

Some of them believed that adapting their design process was the most beneficial part for them as future teachers.

Pre-service teachers believed the *making* experiences helped them to expand their creativity. Mary commented:

> One of the hardest things to do in this class was to decide what to make out of the technology we were using. For example, when we were using the 2D and 3D printers, we had a lot of freedom of what to create. Through this process, my creative thinking skills have strengthened because of this freedom I saw throughout the course. After deciding what to make, I once again had to use my creative thinking skills to design it into a lesson that will be beneficial to teach students.

Meanwhile, they developed a habit of using design thinking and creativity in their lesson planning. Ava commented:

> Before the course, I would look at educational technology tools as is. For example, looking at just the surface of Spheros capabilities and saying students can race them. Instead of breaking down what their potential of programming or designing features that can relate to any subject matter. This experience has taught me to explore the possibilities of the tools provided.

Pre-service teachers agreed that design thinking, problem-solving, curiosity, creativity, collaboration, and innovation were essential components of a maker mindset, which they believed they developed in the course. They also commented that there were no limits to the *making* projects. Mistakes and failure, productive struggle, patience, and never giving up were essential. They began to think about how to develop students' maker mindset as teachers. Erin said:

> I believe that the course has made a lasting impact on me as a maker because I will want to be thinking of new and creative ways to get students engaged in building, making, and learning all while doing projects that they are interested in. That is what I have found to be a key factor in Makerspace because once a student has an interest in what they are doing, they will want to keep learning!

Changing Perceptions and Practice of Learning and Teaching

Most pre-service teachers appreciated that they got the chances to work on the projects instead of just learning about them. Working on hands-on projects was rated highly. They believed this enjoyment would be shared by their future students. Emma wrote:

> I believe that if the kids are interested in what they are doing, they will learn more. I know kids these days are so in love with technology that they would love these hands-on activities that we could do. If my students are more involved with what we are doing, they are going to learn more and be interested in what we are learning about.

In general, all pre-service teachers wrote about the changes in their teaching beliefs. Lily reflected on her change:

> Before, I never really knew what a makerspace had to do with a classroom and how that it could be relevant even when the students are simply exploring on their own. Now I understand that if I have a makerspace environment in my classroom, it will allow students to take what they have learned and apply it in different ways. The limit would only be their imagination, and this would allow them to gain skills that no one could simply teach. A makerspace changes the game of learning, allowing the students to explore what interests them or what they struggle with on their own, in their own unique way, all in one space. I cannot wait to provide a makerspace and creative environment in my classroom for students to explore.

Pre-service teachers commented that they believed in the power of hands-on activities, active learning, and technology integration, which "allows students to go above and beyond the content, they are learning in the classroom because makerspace allows students to expand their knowledge on their own terms." Moreover, they believed in the potentials of *making* in helping cultivate students' maker mindset, develop a deeper understanding of subject areas, and gain crucial twenty-first-century skills. Furthermore, they kept emphasizing that the maker mindset and twenty-first-century skills were the keys for students to succeed in the future. They also became more confident and developed self-efficacy. Emily said:

> While I felt challenged while completing the course, I discovered that I am capable of doing phenomenal things using technology and makerspaces. Furthermore, I found that I can create a lesson plan that fits numerous Common Core standards using different means of technology in a makerspace.

All pre-service teachers mentioned that they could use the ideas and projects in their curricula with some adaption and differentiation to grade levels. Pre-service teachers enjoyed the opportunities to create lesson plans to teach Common Core Standards by integrating *making* and technology. They wrote about their creative lesson plan ideas and expressed excitement in teaching those lessons. Most of them also set up detailed plans for building up a makerspace for their future schools.

Additionally, they began to think about how to strengthen their leadership and teamwork skills and ask questions as teacher leaders. Ella questioned herself:

> How will I go about making it school-wide, which would be the most beneficial for everyone? How will I get the other teachers on board if they don't know what a makerspace is? If my school already has a makerspace, what are some things that I can do to become involved or to improve the makerspace?

Discussion

The results showed that pre-service teachers gained twenty-first-century skills, changed their teaching beliefs, and cultivated a maker mindset. These findings are encouraging because the skills, belief, and mindset are as necessary as the content. The implications of the study are promising, as pre-service teachers potentially will infuse what they learned into their instruction and promote students' skills and maker mindset.

Among these results, cultivating a maker mindset is the most important because the maker mindset is a representation of the growth mindset that leads to creation and innovation (Dougherty, 2016). It is essential for educators to help PK-12 students learn that people need to be engaged in what they are doing, they need to do something that they *love* to do and learn through the process, and they need to believe in what they are doing is worth sharing. Cultivating this maker mindset, which is composed of purpose, joy, engagement, focus, flow, persistence, and resilience, is necessary (Dougherty, 2016). Once students cultivated a maker mindset, they will strive to learn the content and be engaged in the learning process. Moreover, the maker mindset is what students will need in their life to become life-long learners and makers.

Another vital part of the maker mindset that teachers should develop in their students is jumping in and enjoy the learning experiences. Learning is fun, highly engaging, and motivating. Different from the traditional teaching method, *making* that cultivates a maker mindset provide playful experiences for students, which all teachers should strive to provide.

Overall, maker mindset incorporates six traits: a sense of curiosity, an interdisciplinary approach to challenges, social-emotional competence through play, a disposition to share and collaborate, a growth mindset, and resilience in the face of frustration (Regalla, 2016). All six are beyond content and should be integrated into the curricula that prepare students for their lives.

Beyond content, teachers should cultivate students' maker mindset, a can-do attitude. Fostering this mindset is a human project focusing on developing students physically, mentally, and emotionally (Dougherty, 2013). Furthermore, maker-centered learning helps the student develop agency around making stuff and community, as well as building character such as building competence and confidence and forming identities. Researchers reported that students developed a set of non-cognitive skills in the *making* projects, among which "were inspiration, collaboration, a growth mindset, motivation, and development of a failure-positive outlook on the world" (Clapp et al., 2016, p. 29). The results of this study found that pre-service teachers also developed noncognitive skills, such as collaboration, a maker mindset, and so on. Thus, it is crucial to prepare pre-service teachers for maker education. However, rarely teacher education programs provide such preparation (Cohen, 2017). A one-credit course is not enough to prepare pre-service teachers to fulfill all the potentials maker education brings. Considering the outcomes and benefits of *making*, teacher educators should offer more preparation of maker education throughout the program. Design-based research is needed to examine the design and best practices of such preparation. Meanwhile, empirical studies are needed to explore what learning outcomes (technological pedagogical content knowledge, maker mindset, noncognitive skills, etc.) could be achieved after such preparation.

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Chapter 19
Training Motivational Regulation Skills Through Virtual Avatars in Online Learning

Sanghoon Park and Jung Lim

Introduction

Motivation plays a crucial role in supporting students' persistence, retention, achievement, and satisfaction in online learning environments, given the independent nature of the learning context (Artino, 2008; Keller, 2008). The motivational regulation model has been suggested as a mechanism to support students' autonomous practice of motivational regulation strategies (MRS) that help purposefully initiate, direct, and manage motivation in the course of learning (Schwinger & Stiensmeier-Pelster, 2012). In online learning environments, it is critical for online learners to acquire self-initiated motivational regulation skills so that they can overcome various motivational challenges that they encounter while performing online learning tasks. The benefits of practicing MRSs in learning have been reported in many previous studies (i.e., Schwinger, Steinmayr, & Spinath, 2009, 2012; Schwinger & Stiensmeier-Pelster, 2012; Wolters, 2003; Wolters & Mueller, 2010). Especially in online learning settings, Park and Yun (2017, 2018) reported that MRSs can help improve two categories of cognitive learning strategies (i.e., surface level strategies and deep processing-level strategies) and promote cognitive and

S. Park (✉)
Department of Educational and Psychological Studies, University of South Florida,
Tampa, FL, USA

Instructional Technology Program, EDU302K, College of Education, University of South Florida, Tampa, FL, USA
e-mail: Park2@usf.edu

J. Lim
Educational Technology and Assessment (ETA), College of Public Health,
University of South Florida, Tampa, FL, USA
e-mail: junglim@usf.edu

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emotional learning engagement, which are essential for successful online learning experiences.

In this chapter, we introduce the motivational regulation model as a viable model to create a virtual avatar-delivered motivational regulation strategy (VA-MRS) training module that can be integrated in online courses. The main goal of the VA-MRS training is to help online learners acquire the necessary motivational regulation skills through the repeated interactions with a virtual avatar. The motivational regulation model offers the process of initiation, consultation, and application phases that are essential to create theory-based motivational training experiences for online learners. First, we introduce motivational regulation as a key aspect of self-regulation. Second, we present previous studies on how motivational regulation influences online students' learning experiences, focusing on cognitive learning and engagement. Lastly, we share a case of VA-MRS training module with descriptions of module structure, avatar design, and motivational message design.

Motivational Regulation Model and MRSs

Motivation has been consistently identified as a necessary factor to achieve successful learning experience (Lim, 2004). Since online learning typically involves more autonomy and self-regulation (Artino & Stephens, 2009) than traditional classroom learnings, there is an increasing need for online students to learn how to initiate their motivational efforts and find proper solutions to challenging motivational problems.

According to Wolters and Mueller (2010), MRSs are defined as a set of "thoughts and behaviors through which students act to initiate, maintain, or supplement their willingness to start or to provide efforts toward completing academic activities" (p. 218). Schwinger and Stiensmeier-Pelster (2012) presented a MRS model consisting of three self-motivation phases (Fig. 19.1). The first phase of the MRS model suggests the importance of awareness of low motivation from the student side. In other words, a student needs to recognize the need for higher motivation before performing a learning task and should be willing to make an effort to promote motivation. If a student does not perceive low motivation or is already highly motivated, motivational regulation is not necessary. In the second phase, once the student feels need for higher motivation, she or he needs to identify the reasons why her/his current motivation is low. According to Schwinger and Stiensmeier-Pelster's motivational regulation model (2012), the reasons are categorized into contextual categories (i.e., task characteristics and learning setting) or individual categories (i.e., prior knowledge, intelligence and motivational dispositions, such as interest and goal orientations). In the third phase, once the causes of the low motivation are identified, the student can further try to regulate his or her interest orientation, goal setting, or behavior by practicing self-initiated MRSs. In short, the successful utilization of motivational regulation requires students to understand the three motivational regulation phases and the context of using their selected MRSs to increase motivation and further achievement. Regarding specific MRSs, Wolter's work (2003) introduced six strategies, which was later expanded to include eight MRSs by Schwinger and Stiensmeier-Pelster (2012) (Table 19.1).

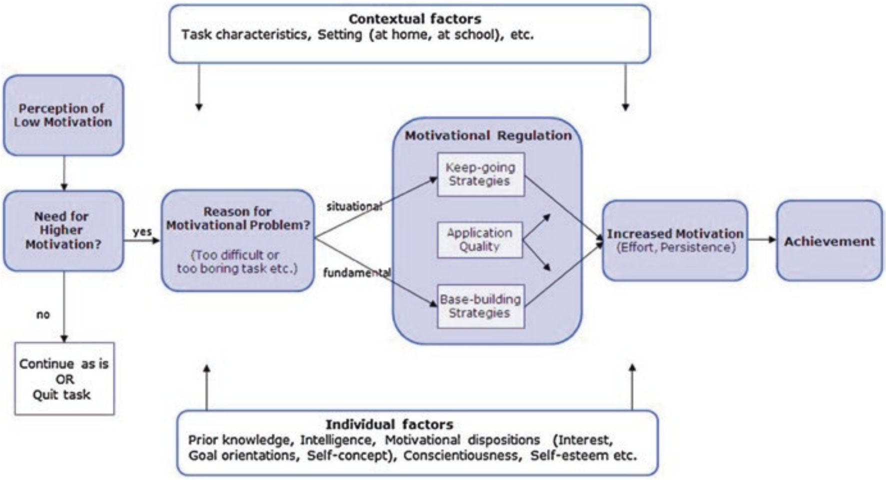


Fig. 19.1 Motivational regulation model. (Reprinted from Schwinger & Stiensmeier-Pelster, 2012, p. 38, with permission from Elsevier)

Table 19.1 Motivational regulation strategies (Schwinger et al., 2012)

Type of MRS	Description
1. Enhancement of situational interest	Turning a relatively tedious task into a more fascinating one through imaginative modification
2. Enhancement of personal significance	Establishing a connection between the task and one's own personal interests and preferences
3. Mastery self-talk	Highlighting the goal to enlarge one's competence and master challenging tasks
4. Performance approach self-talk	Earning a higher exam grade than one's classmates
5. Performance-avoidance self-talk	Avoiding others who make fun of one's poor performance
6. Environmental control	Intentionally eliminating possible distractions
7. Self-consequating	Self-administered gratification for achieving a certain goal
8. Proximal goal setting	Dividing learning materials into small and manageable pieces to experience success more quickly and frequently

Motivational Regulation, Cognitive Learning, and Engagement

Understanding when and how to use MRSs is important for online learners because MRSs can improve students' efforts to regulate their own motivation in learning (Smit, De Brabander, Boekaerts, & Martens, 2017). Representing a vital facet of self-regulation, recent studies show that MRSs positively influence the use of cognitive learning strategies and learning engagement. For example, Park and Yun (2017) examined the relationships between online students' use of MRSs and cognitive learning strategies. The findings of hierarchical regression analyses using two dependent variables (i.e., surface level learning strategy and deep processing-level learning strategy) indicate that surface-level learning strategies (i.e., rehearsal) and deep processing-level strategies (i.e., elaboration, organization, and critical thinking) are predicted by different sets of MRSs after controlling for students' academic levels and age. For example, three MRSs were significant for the rehearsal strategy: the enhancement of situational interest strategy (turning a relatively tedious task into a more fascinating one through imaginative modification), $\beta = 0.304$, $p < 0.001$; the mastery self-talk strategy (highlighting the goal to enlarge one's competence and master challenging tasks), $\beta = 0.398$, $p < 0.001$; and the performance avoidance self-talk strategy (avoiding others who make fun of one's poor performance), $\beta = 0.166$, $p < 0.05$. In addition, three MRSs were significant for the elaboration strategy: the enhancement of situational interest strategy (turning a relatively tedious task into a more fascinating one through imaginative modification), $\beta = 0.316$, $p < 0.001$; the enhancement of personal significance strategy (establishing a connection between the task and one's own personal interests and preferences), $\beta = 0.291$, $p < 0.001$; and the mastery self-talk strategy (highlighting the goal to enlarge one's competence and master challenging tasks), $\beta = 0.303$, $p < 0.001$. Specifically, both the enhancement of situational interest strategy and the mastery self-talk strategy most strongly correlated with surface level and deep processing-level learning strategies.

Park and Yun (2018) also examined how online students' academic level and their uses of eight MRSs influence behavioral engagement, emotional engagement, and cognitive engagement. A series of hierarchical regression analyses revealed that behavioral engagement, emotional engagement, and cognitive engagement are predicted by different MRSs after controlling for the academic level (i.e., graduate and undergraduate). For example, the performance-avoidance self-talk strategy (avoiding others who make fun of one's poor performance), $\beta = -0.364$, $p < 0.01$, and the environmental control strategy (intentionally eliminating possible distractions), $\beta = 0.283$, $p < 0.05$, were two significant MRSs of behavioral engagement. The mastery self-talk strategy (highlighting the goal to enlarge one's competence and master challenging tasks) was significant for emotional engagement, $\beta = 0.400$, $p < 0.05$. Lastly, the enhancement of personal significance strategy (establishing a connection between the task and one's own personal interests and preferences), $\beta = 0.367$, $p < 0.001$, and the performance-avoidance self-talk strategy (avoiding others who make fun of one's poor performance), $\beta = 0.225$, $p < 0.01$, were two significant MRSs for cognitive engagement.

Therefore, MRSs are a set of skills that online learners need to develop to utilize their cognitive learning strategies and further improve learning engagement. However, simply presenting a set of strategies to online learners will not help them effectively internalize the motivational regulation. To help online students understand the motivational regulation process and support their identification of proper MRSs, we need to provide more interactive and engaging training. In the following section, we describe an example of the VA-MRS training module that incorporates a virtual avatar as a training agent.

Rationales and an Example of the VA-MRS Training Module

Why to Use the Motivational Regulation Model?

Motivational support has been widely regarded as a way to increase learning motivation through the motivational design process. For example, one of the most well-known motivational design models, Keller's ARCS model with four motivational design components such as attention, relevance, confidence, and satisfaction has been studied in various learning settings as a guideline to create motivationally enhanced learning environments. Based on the four components, Keller (2010) presented how the four motivational components can be used to create motivational tactics and strategies to promote each component of the ARCS. Hartnett (2016) also suggested a motivational design framework based on three levels of support (i.e., autonomy, competence, and relatedness) with three types of stakeholders (i.e., teachers, designers, and learners). Yet, due to the numerous contextual and individual factors associated with motivation, supporting each learner's internalized motivational regulation is equally important. Keller's recent addition of a "V-Volition" component to his ARCS model shows the importance of combining external motivational design and internal motivational regulation (Keller, 2010).

As described in the previous section, for online learners to effectively utilize MRSs, they must have the following knowledge and beliefs (Wolters & Mueller, 2010): (1) awareness of MRSs as potential motivation strategies, (2) ability to identify and execute proper MRSs, and (3) belief that using the MRSs will positively influence their motivation. Research conducted within a self-determination framework posits that external supports are necessary in order for students (especially in online learning) to internalize the value of engaging in activities that are not particularly compelling or intrinsically interesting (Deci & Ryan, 1985; Reeve, Jang, Hardre, & Omura, 2002; Ryan & Deci, 2000). Especially in online classes, students are required to maintain high level of autonomy and self-regulation due to the nature of course delivery, which does not always provide synchronous support (Dabbagh & Kitsantas, 2004; Hartley & Bendixen, 2001). Hence, there is a strong need to encourage online students to initiate and persist in utilizing MRSs.

Why to Use Virtual Avatars?

According to Park (2015a), a virtual avatar-provided scaffolding can be a useful intervention to teach online students about self-initiated motivational regulation as well as specific types of MRSs. Virtual avatars (i.e., pedagogical agents) have been studied as an intervention to influence students' learning (e.g., Atkinson, 2002; Baylor, 2002; Baylor & Plant, 2005; Moreno, Mayer, Spires, & Lester, 2001). Yet, their primary value is for motivation-related outcomes (Baylor & Kim, 2004). Virtual avatars can facilitate the learner–agent relationship and help motivate a learner to be involved in learning tasks by forming a viable relationship with him or her. They also serve as a pedagogical mentor that delivers learning content with motivational messages. Furthermore, the race and gender of virtual avatars influence the effectiveness of their implementation. Research shows that students who interacted with a virtual avatar matching their race responded more positively to the learning content than those who interacted with an agent of a different race (Rosenberg-Kima, Plant, Doerr, & Baylor, 2010). Media features such as voice, emotional expression, gesture, image, and animation are critical for constructing an effective agent persona (Clark & Mayer, 2011; Park, 2015b).

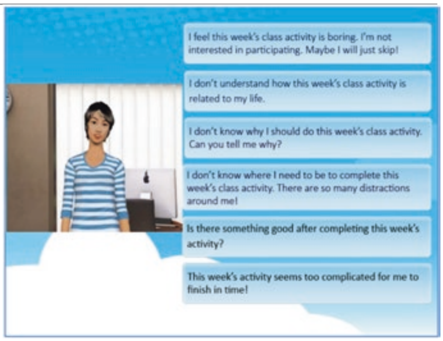
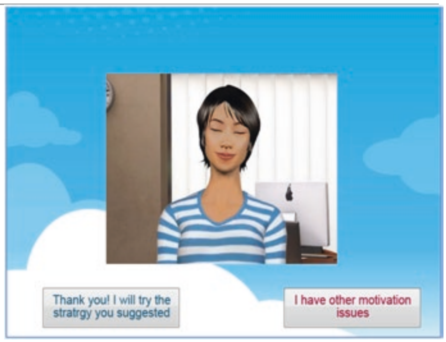
As an approach to help students learn MRSs while working on learning tasks in online courses, we created the VA-MRS training module in which animated virtual avatars can guide students in initiating their motivational needs and using proper MRSs for different motivational challenges. The VA-MRS module can be accessed based on each student's motivational needs; thus it does not provide MRSs based on the results of learner analysis. Rather, it is an open module that provides possible motivational strategies for students who do not feel motivated yet are willing to seek possible ways to improve their own motivation. Virtual avatars were developed using the Living Actor platform program to create agents' appearance. The Living Actor presenter program was used to generate video animations from an audio or text file that can automatically animate a high-quality 3D avatar over any background. We used Adobe Captivate 9 to create a training module that can be easily embedded in any learning management systems.

The following section provides the details of the VA-MRS training module in three aspects: module structure, virtual avatars, and motivational regulation messages.

Module Structure

The VA-MRS training module consists of three parts: initiation, consultation, and application, which are based on the three phases of the motivational regulation model (Fig. 19.1). The initiation part begins with a student's awareness of low motivation and need for higher. If the student does not perceive the need for higher motivation, the VA-MRS training is not needed. Once the need for higher motivation is realized, the student is guided to identify reason(s) for motivational problems. The consultation part covers the probable reason(s) for motivational problems and delivers a virtual avatar message explaining why the student is experiencing the particular type of motivational problem and how he or she can solve it by using one or more MRSs. In the last application part, the student is encouraged to use the advised MRS(s) when working on given online learning tasks. The sequence of module structure is presented in Table 19.2. The module structure map is presented in Fig. 19.2.

Table 19.2 VA-MRS module sequence based on the motivational regulation model

VA-MRS sequence	Motivational regulation model	VA-MRS screens
Initiation to increase the awareness of MRSs as potential motivation strategies	Awareness of low motivation	
Consultation to promote the ability to execute the strategies properly	Identification of the reason(s) of the low motivation (contextual categories and/or individual categories)	
Application to improve belief that using the strategy will be effective in increasing motivation	Practice of self-initiated MRSs	

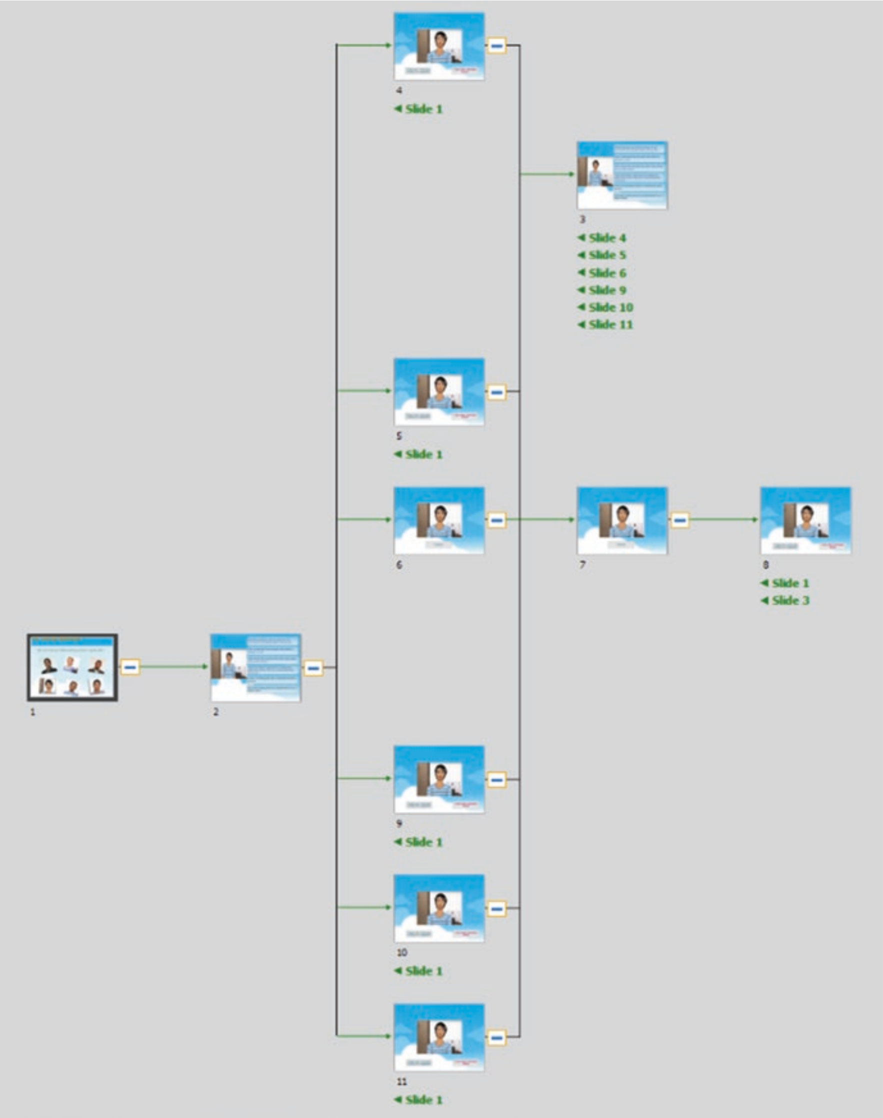


Fig. 19.2 Module structure map

Virtual Avatars

A virtual avatar interacts with learners via verbal and nonverbal forms of communication, which determine the role of the virtual avatar. The appearance and voice of a virtual avatar also can be customized by gender, ethnicity, and age. According to Baylor (2011), factors such as gender, ethnicity, attractiveness, and coolness can be considered in the design of virtual avatars. Among those factors, we considered gender and ethnicity as two key design factors because learners are often more influenced by a virtual avatar of the same gender and ethnicity (Baylor, 2009). For this VA-MRS module example, we used three most representative ethnicities (African American, Asian, and Caucasian) for each gender (male and female) and designed six different virtual avatars (Fig. 19.3). All virtual avatars provide motivational guidance and messages in the same way regardless of the different gender or ethnicity in their appearance.

A selected virtual avatar interacts with an online student as a consultant and guide them through menu selections and persuasive MRS messages. A student who perceives low motivation and wants to promote higher motivation joins the training session voluntarily. And the student is guided to the first screen where he or she can select a virtual avatar from six available ones. This allows the student to connect with a virtual avatar that he or she trusts and feels most comfortable with.

Motivational Regulation Messages

Once a virtual avatar is selected, the student can initiate MRS training by selecting one of the six motivational challenges presented on the screen. The six motivational challenges are associated with eight types of MRSs. For example, the motivational challenge "I feel this week's class activity is boring. I'm not interested in participating. Maybe I will just skip!" is associated with the first MRS (enhancement of situ-

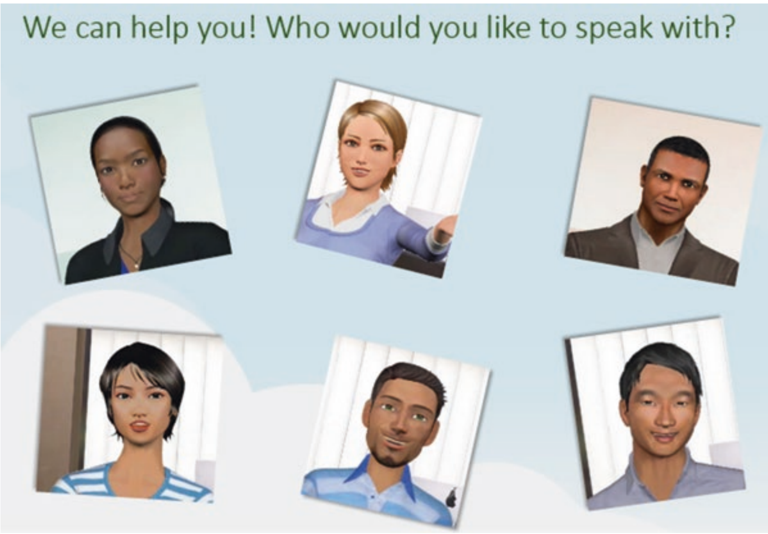


Fig. 19.3 Six virtual avatars (2 gender × 3 ethnicity)

ational interest). If the student selects this motivational challenge, it indicates that he or she is struggling with the “low interest” type of motivational issues.

Based on motivational problems identified, the selected virtual avatar provides voice-narrated MRS messages that recapture the identified motivational challenge and further suggest corresponding MRS(s) to overcome the problems (Table 19.3). The student is then encouraged to try the MRS(s). If there are more than one identified motivational challenges, the student can navigate back to the main screen and repeat the process until all motivational issues are resolved. Students are allowed to continue the process until they acquire all the necessary motivational regulation skills in a given learning context so that MRSs can be internalized and ready to be used.

We created MRS messages based on both conceptual definition of each MRS (Table 19.1) and statements used in the MRS questionnaire (Schwinger et al., 2009) to ensure that the messages are valid to address each MRS. For example, we began with the definition of “situational interest” (Renninger & Hidi, 2011) and also of the MRS, which is “turning a relatively tedious task into a more fascinating one through imaginative modification” (Table 19.1). Understanding the meaning of the first MRS, we used corresponding five MRS questionnaire statements to create MRS messages (i.e., I made learning more pleasant for me by trying to arrange it playfully). The MRS messages were then revised repeatedly until all researchers reach to an agreement on the message content. The final version of the MRS messages were reviewed again by two English speaking native speakers to make sure all the messages sound natural.

LMS Integration

The VA-MRS training module can be embedded into a learning management system (LMS) either in the form of an external link or as a supplementary course activity. An example of the VA-MRS module in the CANVAS LMS is presented in Fig. 19.4. The image opens a link to a pop-up window presenting the VA-MRS training module.

Future Study

In this paper, we introduced the motivational regulation model and described how the model can be used to create the VA-MRS training module for online learners. To further evaluate the VA-MRS in online learning, future studies will be needed. First, an experimental study will be needed to examine the effectiveness of the VA-MRS training module by comparing students’ MRS usage between the group employing

Table 19.3 Virtual avatar delivered MRS messages

MRSs		Persuasive MRS messages from VA
Enhancement of situational interest (SI)		*[Motivational challenge]* I feel this week's class activity is boring. I'm not interested in participating. Maybe I will just skip! *[MRS message]* Hi there, so you feel like you are not interested in doing this upcoming activity at all? Well, let me tell you this. Not all class activities necessarily have to be boring, and even if you feel that way, you can still make a boring task into something fun and interesting! I am not kidding. You are the boss of your learning, and you can make it happen! Maybe you feel a little interested now? You can make your learning task more pleasant by trying to arrange it playfully. Or you can invent a corresponding game, if that is what you really have to do to add some fun. Also, think about the features that are fun in this learning task and find a way to enjoy working on it. Remember, you can make work entertaining for yourself more than anybody else!
Enhancement of personal significance (PS)		*[Motivational challenge]* I don't understand how this week's class activity is related to my life. *[MRS message]* So, I see that you are having a problem with this week's class activity. You have checked the course activities and still do not see how the activities are related to what you do in your life, right? Well, think about something that you have done before and use your previous experience to make a connection to the activities. There will definitely be some experience that you can relate the learning material. Maybe you will find things that are related to your work and your personal interests. Look for them!
Goal of the learning process	*Mastery self-talk (MST)*	*[Motivational challenge]* I don't know why I should do this week's class activity. Can you tell me why? *[MRS message]* Well, think about the most obvious reason first. We all work intensely because we want to learn something new! I am sure that is why you are sitting right there. To learn more! So, let's keep it that way. I understand you are not sure why you should do this week's classwork, but think about the time when you first learned something new and how excited you were only because you found out how much you could possibly learn! Maybe you can take this opportunity to challenge yourself to finish the task and learn a lot for you personally. So, keep on learning! Try the class activities and learn as much as possible for you!
	Performance-approach self-talk (PST)	*[MRS message]* There is one obvious reason why you need to do the class activities, and why you need to do them so well. That's right! When you do well, you can obtain good grades! All the time and effort you spent on the course activities will bring you a good course grade, and you will successfully complete the course! So, complete all the course activities in time! Prepare yourself for the tests and exams and earn good scores. You just have to keep on learning to do well on an exam, and that is all you need to think about. What if you don't keep learning? Well, I think you know the answer. Your grade will worsen, and you will fail the class! So, complete all the course activities in time to earn good grades!

(continued)

Table 19.3 (continued)

MRSs		Persuasive MRS messages from VA
	Performance-avoidance self-talk (PAST)	*[MRS message]* If you don't do the class activities, you will not receive any points, and eventually you will make a fool of yourself! If you do not want to make a fool of yourself, what do you think you need to do? That's right! You have to push yourself more to keep on learning! Can you imagine your classmates making fun of your poor performance or missing assignments? I know it is very unpleasant for me when I perform worse than others. I am sure you feel the same way! So, do your best and keep on learning!
Environmental control (EC)		*[Motivational challenge]* I don't know where I need to be to complete this week's class activity. There are so many distractions around me! *[MRS message]* In the normal course of life, a certain number of distractions are bound to affect each one of us. It is just inevitable. But here, let me share some tips with you. First, remember that you have choices. You can choose to learn at times when you can concentrate particularly well. Also, prior to beginning with the course, try to eliminate all possible distractions so that you can concentrate on your course activities. I know you cannot eliminate all of them at once, but if you try to keep all possible distractions to a minimum, you will soon find that distractions seldom occur while you are working on the course activities. Give it a try!
Self-consequating (SC)		*[Motivational challenge]* Is there something good after completing this week's activity? *[MRS message]* What is your hobby that you enjoy doing the most? Whenever you feel unmotivated to do any class activities, think about something nice that you can do after completing the classwork. You will have to keep on learning and make a deal with yourself, saying that you will do something pleasant after you finish work. This is a promise that you make to yourself, and you have to keep it in order to do something that you like later.
Proximal goal setting (PGS)		*[Motivational challenge]* This week's activity seems too complicated for me to finish in time! *[MRS message]* I understand. Class activities are not always easy. If you feel the task is too much for you, there are several things you can try. First, see if you can break down the workload into small segments so you feel like you can handle it more easily. Obviously small tasks are a lot easier to complete than doing a whole task at once. Then try to approach the coursework step by step. This will help you feel as though you are making good progress. Lastly, keep telling yourself that you can master the tasks if you set yourself sub goals. So, plan ahead and see if you can break down your classwork into small steps! I am sure you will find it very doable.

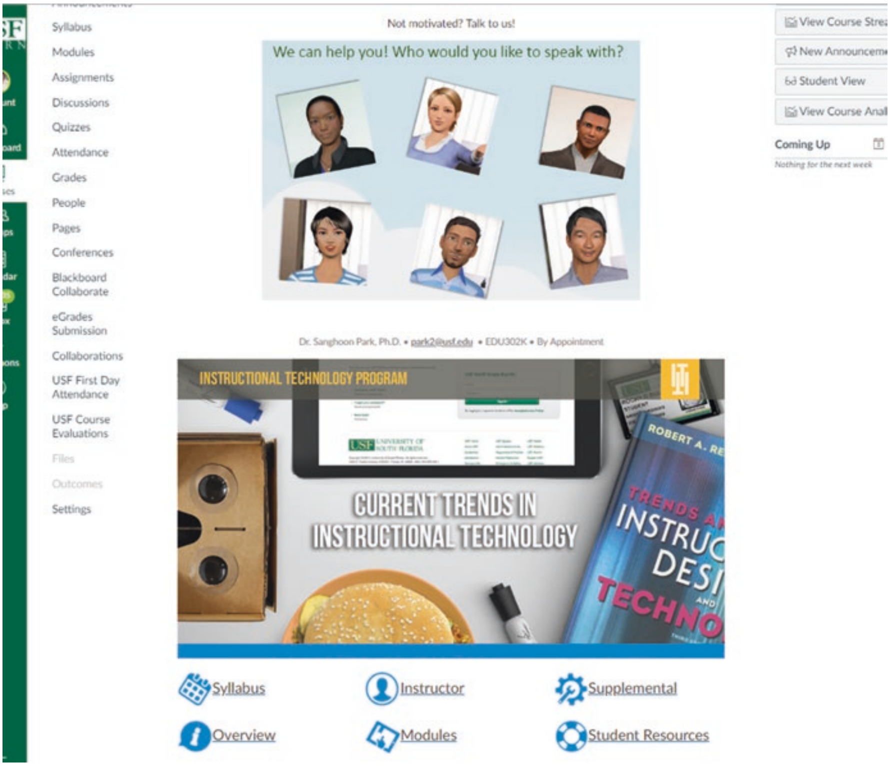


Fig. 19.4 VT-MRS integration into CANVAS LMS

the VA-MRS training module and the group not employing the VA-MRS training module. Also, the type of motivational challenges students mostly experience while taking online courses can be further analyzed to strengthen the MRS messages in the training module. In addition, a study can be conducted to examine online students' different motivational experiences between the external motivational design condition (i.e., using the ARCS design model), the internal motivational regulation condition (using the VA-MRS module), and the combined condition (using both the ARCS design model and the VA-MRS module). Lastly, to examine the value of including a virtual avatar in VA-MRS training, a study will be needed to separately examine the effectiveness of MRS messages with the presence of a virtual avatar and without it.

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Sanghoon Park is an associate professor in the Instructional Technology program at the University of South Florida. His research focuses on multimedia design principles with emerging technologies, motivational and emotional experiences in online distance education, and the design and development of augmented reality-based mobile learning

Chapter 20
The Effects of Wearables on Performance in Education: Serving the Whole Student with Directed Attention on Health and Wellness

Suzanne Ensmann

Introduction

Students often enter education in the survival mode (packing more sand into that already overflowing bucket), memorizing content and checking off boxes as opposed to being ready to engage in higher-order thinking skills. Before we inundate learners with more content, we must consider first addressing the student as a whole-being. Instructional design models, such as the First Principles of Instruction (Merrill, 2007a, 2007b, 2009a, 2009b), offer student-centered learning solutions for instruction. When developing instruction, the first step is to analyze and identify the problem. This systematic process leads learners to activate, demonstrate, apply, and integrate a solution to promote real-world relevance. Now, consider having learners apply that same systematic process to identify their barriers to learning. Learners may walk into a room and be bodily present, but cluttered minds are different than minds being present. Consider the mind on autopilot (Germer, 2004) similar to walking into a room and forgetting why. Research reflects that increasing mindfulness has positive impacts on mood and stress (Brown & Ryan, 2003; Germer, 2004). Offering learners guided time to direct attention to what they think, feel, and experience provides them with an opportunity to focus and bring them into the present. Consider the possibilities if learners are directed to set intentional health, wellness, and performance goals while encouraged to monitor those goals with wearable devices, also called wearables, to improve outcomes.

The prompting of this study arose out of the author's personal experience with using wearables to monitor health and wellness, specifically running marathons to improve energy and focus in order to achieve performance goals of obtaining graduate degrees. These personal merits expanded into a small study of secondary students' use of Fitbits to improve persistence in the classroom. The researcher

S. Ensmann (✉)
The University of Tampa, Tampa, FL, USA

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purchased Fitbits through a grant at Indian River State College in 2014, which the participants used. Overwhelmingly, all nine participants agreed that the wearables supported their persistence to the end of class, noting improved health and wellness from water consumption to sleep activity and physical fitness. Now teaching graduate-level students, the researcher wanted to explore what wearables these students owned and their effect on health, wellness, and classroom performance. The study began with a review of the literature on neuroscience related to performance and the study of physiolitics as tracked by wearables.

Literature Review

To explain the science behind the experience, the researcher began by examining the literature for the correlation between physical activity and improved focus, cognition, and attitude. Health and wellness have been found to be directly correlated with improved cognitive functions and learning gains (Ratey & Hagerman, 2008; Calestine, Bopp, Bopp, & Papalia, 2017). Specifically, neuroscience studies suggest that vigorous movement can actually stimulate brain activity, producing new brain cells in the hippocampus (Ratey & Hagereman, 2008; Cotman, Berchtold, & Christie, 2007; Basso & Suzuki, 2017). Feelings of wellness, energy, motivation, impulse control, self-esteem, and focus are also byproducts due to elevated endorphin, norepinephrine, dopamine, and serotonin levels after exercise (Ratey & Hagerman, 2008). A deeper look into neuroscience provides scientific evidence that neurotransmitter levels change after exercise, affecting cognition and mood (Basso & Suzuki, 2017; Ratey & Hagerman, 2008). These neurotransmitters are chemicals released across the synapses (nerve endings) in the brain. Chemical elements include dopamine, serotonin, epinephrine, acetylcholine, glutamate, and GABA. Increased levels of dopamine may reduce the fear response, reducing anxiety; serotonin offers antidepressant benefits (Basso & Suzuki, 2017); epinephrine offers improved mental performance capabilities (Peyrin, Pequignot, Lacour, & Fourcade, 1987); acetylcholine involved "cognitive process such as memory" (Basso & Suzuki, 2017, p. 141); and glutamate and GABA have been shown to impact excitement and disinhibition (Basso & Suzuki, 2017).

To monitor and measure these physical activities, this study then looked at the literature involving wearables. According to the *Rhetoric Society Quarterly*, wearables have been defined as "those technologies, electronic or otherwise, whose primary functionality requires that they be connected to bodies" (Gouge & Jones, 2016, p. 201). The *World of Wearables* elaborates upon this, suggesting the microchips in these devices can sense, process, transmit, utilize, and store data integrating cohesively with digital applications (Park, Chung, & Jayaraman, 2015). For the purposes of this study, wearables will be defined as *computerized devices designed to be worn or attached to the body to communicate information back to the wearer.*

The health industry clearly reflects ample research to attest to the benefits of using the data derived from wearables to improve health and wellness (Fazana et al., 2017; Klasnja, Consolvo, McDonald, Landay, & Pratt, 2009). The sports industry reflects research of wearables being used to improve physical performance (Bunn, Navalta, Fountaine, & Reece, 2018); however, empirical studies are lacking in the education realm to use the technology we see in other arenas for the betterment of classroom performance. With high-speed Internet access exponentially adding to a fast paced, driven, and competitive society, college students' concerns range from financial to domestic to worldwide crises spanning politics to natural disasters. If stress is not enough to cause serious distractions and health related issues, coping mechanisms such as over-indulging have profound effects on energy levels and cognition. Obesity alone accounted for $315.8 billion dollars in the United States in 2010 (Biener, Cawley, & Meyerhoefer, 2017). Compound this with the fear of missing out (FoMo) (Rosen et al., 2018), which influences additional smartphone usage. For authentic learning to take place, educators must address the whole student: mind, body, emotional, and social well-being.

Integrating Wearables with Intentionality

The integration of technology to improve performance in education often lags behind adoption in the public market and the workforce. Ubiquitous computing is common in work environments, but is often not even recognized upon entering the educational realm. Consider wearables in this context, for example. Google Glasses and smartwatches have evolved to seamless extensions of the human body, incorporating gestures to operate this technology (Reyes et al., 2018). The accessibility opportunities provide additional avenues for those in need. Athletes train with wearable clothing and analyze the data captured to improve performance. Wilson coined this as the study of *physiolytics*, "the practice of linking wearable computing devices with data analysis and quantified feedback to improve performance" (2013, p. 1). The design of wearables, such as heart monitors or brain readers, is to detect bodily functionality and offer data for the users to improve performance. Likewise, smartwatches inherently promote movement.

The number of wearables and the evolution of their functionality to become more than a novelty has expanded their usage to be worn as common nature by owners today.

With a study on wearables in the workforce, Dr. Öste paved the way for studies to be conducted in the educational setting (2016). Thus, the question becomes:

> *If students are directed to use wearables to intentionally set goals and monitor their health and wellness (physical, mental, emotional, and social wellness), could they improve their performance in the classroom?*

It is hypothesized that learning performance will improve if educators support the whole student by guiding them to:

- Set intentional goals for their health and wellness, *physiological, mental, emotional, and social*, and
- Measure these goals with wearables.

Method

Data collection began with a preliminary survey to determine what wearables are being used by consumers today to improve personal performance. This survey determined which devices are most commonly being worn among respondents and the most common intent for using the wearables in the following health and wellness areas: (1) Physical: fitness, posture, water intake, sleep performance; (2) mental focus; (3) emotional: stress, mood; and (4) social. This survey also recruited participants to take part in a *Get-Fit-to-Persist* study to examine the effects of wearables when learners use intentionality to set goals to improve their classroom performance. Demographic questions were included to assure that no assumptions were made about participants and diversity could be examined to see if any correlations existed.

To determine *if students could improve their performance in the classroom when directed to use wearables to intentionally set goals and monitor health and wellness*, this study sought to answer these questions:

1. What wearables are students using?
2. What intentional goals are students measuring with wearables?
   In terms of:
   (a) Health and wellness (physical, mental, emotional, and social)
   (b) Classroom performance
3. And, do students improve classroom performance by setting these intentional goals and monitoring them with wearables?

Participants

To gather a broad pool of graduate-level participants and those who might use wearables with the intended purpose of improving performance, the preliminary survey was sent to members of the following organizations: Association for Educational Technology and Communications (AECT), the International Society for Technology in Education (ISTE), and faculty members at The University of Tampa in both the Health department and the Instructional Design and Technology (IDT) graduate program. The study encompassed the latter convenience sample due to a low response of participants in the preliminary survey calling for volunteers. An International Review Board application (IRB) was prepared and approved to adhere to ethical practices included in procedures of administering all data collection. Participants were required to meet the following qualifications:

- Eighteen-years of age or older;
- Enrolled in a college course or taking a fitness class in the United States.

Procedure

- The preliminary survey was digitally delivered to participants.
- For the pilot-study, the digital pre- and post-surveys were introduced by the researcher in a summer graduate level class and completed electronically.
- The following was included with the surveys:
  - Research reflecting the correlation between health, wellness, and performance to be transparent about the purpose of the study.
  - Notice that participants opting into the study would need to participate in two brief assessments; before and after this study to be delivered over 2 weeks during the first summer term or 4 weeks during the fall term and:
    1. Select a wearable to use in order to monitor their progress. (Wearables were not provided as part of this pilot.)
    2. Set intentional goals for themselves to maintain or improve their:
       (a) Health and wellness and
       (b) Classroom performance.

Instruments and Timeline

As previously mentioned, the preliminary survey was the first phase to determine what devices and intentions were currently being used by a graduate population in the fields of instructional design and educational technology. All participants agreed to an informed consent and freely volunteered. This survey also served as a recruitment tool with a question at the end offering participants the opportunity to sign-up for the study.

The pre- and post-surveys were then developed in the Qualtrics® platform to quantitatively measure the learners self-determined performance goals for both health and wellness and classroom performance. The participants of the study set their goals in the beginning of the term and measured completion of their health and wellness goals based upon data tracked by their wearables. They self-reported their performance goals and outcomes.

To assure validity of this instrument, 10 graduate students in a program effectiveness course participated in a sample study using a checklist to evaluate each question on the survey. The Department of Health and Human Services, Center for Disease Control (2008), designed and developed the Quality Appraisal System (QAS-99) *Checklist to Evaluate the Quality of Questions* used to rate each question in the instrument for accuracy, usability, and clarity. Based upon the feedback from this test, revisions were made to reduce technical challenges with the instrument, simplify and clarify the context of the questions. For example, text boxes were initially provided to gather input of wearable brands but testers expressed that it was not apparent what the text boxes were for so they were eliminated; likewise, a question that asked for participants to list their wearables and brands was revised to eliminate the double-barreled question. Qualitatively, an open-ended question was also added to afford participants the opportunity to elaborate upon their perspectives.

Results

Demographics

The preliminary survey used to determine what wearables students were using to improve health, wellness, and performance reflected that some students are indeed using wearables. Based upon 30 participants, 23 stated they engage in fitness classes, while 11 stated they are college students attending universities within Tennessee, Virginia, Florida, and online. They listed majors of instructional design and technology, music, and math fields. Ninety-one percent of participants were graduate-level students and about half were from the Southeast portion of the United States. Approximately half received instruction through hybrid delivery, while the rest were fairly divided between receiving online and face-to-face delivery methods.

The age of those using wearables was primarily the established Generation X, from 38 to 53 years old. The generation classification was based upon the Pew Research guidelines (Fry, 2015), which categorizes Early Baby Boomers prior to 1955; Baby Boomers from 1955 to 1964; Generation X from 1965 to 1980; Generation Y from 1981 to 1992; and the Millennials after 1992. Females participants outweighed the male population from 70% to 30%. Regarding the socioeconomic levels, this study used the Pew Research Center (2016) classification of family household income brackets to determine if affordability impacted ownership of wearables. The breakdown was as follows: Lower = below $42,000; middle = $42,000 to $125,000; and, upper = above $125,000. Eighty-two percent attested to falling into the middle and upper socioeconomic bracket. The majority of respondents view themselves as above average achievers.

Pre-study Survey While the preliminary survey offered a question to recruit volunteers for the study, this option did not return many participants for the pilot; the study was thus extended to an IDT class for the two- and four-week studies. Out of the 21 participants in the two-week study, 18 attested to being college students receiving instruction in a hybrid format. Seventeen participants completed the post-survey.

Three IDT students participated in the four-week pilot study. Due to low participation, the researcher recognized that the majority of the class had taken the summer pilot. The quantitative demographic data was removed from this report as not to divulge the identity of the participants. Majority of participants were distributed evenly among Generation X and Y. The genders participating were again primarily female. The majority of participants had spent most of their lives in the southeast or out of the states. Participants self-identified dispersed socio-economic levels as categorized by the Pew Research Center (2016). Lastly, just as in the preliminary survey, the majority of participants purported to be above average achievers. See Table 20.1.

1. *Wearables Participants Are Using*

Preliminary Survey Participants selected wearables they used as primarily smartwatches and Fitbits. Heart monitors were the next device most commonly worn.

Pre-study Survey Participants identified 35 different wearables they would use during this study. Despite wearables being defined for participants as *computerized devices designed to be worn or attached to the body to communicate information back to the wearer*, six participants listed cell phones. Anecdotal feedback from participants arguably defended cell phones as wearables since they wear them on their bodies; specifically, using an “arm band” and wearing “on self” to track and measure health and wellness. Apps participants reported to use with their wearables:

- MyPlate
- Fitbit App, My Fitness Pal
- Activity App
- Calm App, Sleep Tracker
- Health app on iPhone and Runkeeper app for running
- Samsung fit
- Raly
- Samsung Health
- iPhone Health App
- Activity, Noom Coach

Post-study Survey Fourteen out of the initial 21 participants completed the study, but used the majority of more common wearables when compared with all the selections originally selected in the Pre-Study Survey. See Table 20.2. Apps participants reported to use with their wearables included the following:

- Health (iPhone App).
- Fitbit
- MyPlate
- Rally
- Activity App
- Runkeeper
- Noom Coach and Activity
- Calm app (meditation & sleep stories)

Table 20.1 Get-fit-to-persist demographics

	Preliminary survey		Pilot-study survey	
Variable	%	*n*	%	*n*
Generation				
Millennials	0.13	4	0.14	3
Generation Y	0.20	6	0.38	8
Generation X	0.43	13	0.38	8
Baby Boomers	0.17	5	0.10	2
Early Baby Boomers	0.07	2	0.00	0
Total	1.00	30	1.00	21
Gender				
Male	0.30	9	0.25	5
Female	0.70	21	0.70	14
Not Listed	0.00	0	0.05	1
Total	1.00	30	1.00	20
Location				
Southeast	0.53	16	0.43	9
Northeast	0.07	2	0.14	3
Southwest	0.10	3	0.00	0
Northwest	0.00	0	0.00	0
Midwest	0.13	4	0.10	2
Country Other Than USA	0.17	5	0.33	7
Total	1.00	30	1.00	21
Socio-Economic levels				
Lower	0.18	5	0.35	7
Middle	0.36	10	0.45	9
Upper	0.46	13	0.20	4
Total	1.00	28	1.00	20
Self-Described Achiever levels				
1. Complacent	0.00	0	0.00	0
2.	0.03	1	0.00	0
3.	0.10	3	0.24	5
4.	0.43	13	0.43	9
5. High Achiever	0.43	13	0.33	7
Total	1.00	30	1.00	21

2. *Intentional goals* participants measured with wearables in terms of the following:

   (a) Health and wellness

Preliminary Survey Most focused on physical well-being. Notably, the 30 participants selected 55 intentions they use wearables for to track numerous health and wellness aspects, including emotional, social, and mental well-being. Fitness was the greatest intended use among participants.

Table 20.2 Wearables used

	Preliminary survey		Pre-study survey		Post-study survey	
Variable	%	*n*	%	*n*	%	*n*
Accessories						
Smartwatch	0.37	10	0.23	8	0.16	5
Fitbit	0.37	10	0.17	6	0.16	5
Smart glasses	0.00	0	0.03	1	0.00	0
Smart jewelry	0.04	1	0.03	1	0.00	0
Other	0.04	1	0.17	6	0.23	7
Subtotal	0.81	22	0.63	22	0.55	17
Adheres to body						
Heart monitor	0.15	4	0.06	2	0.10	3
Upright device for posture	0.00	0	0.03	1	0.06	2
Smart contact lenses	0.00	0	0.06	2	0.00	0
Other	0.00	0	0.03	1	0.10	3
Subtotal	0.15	4	0.17	6	0.26	8
Clothing/Textiles						
Smart insoles	0.04	1	0.00	0	0.00	0
Smart shoes	0.00	0	0.09	3	0.06	2
Smart socks	0.00	0	0.00	0	0.03	1
Other	0.00	0	0.09	3	0.06	2
Subtotal	0.04	1	0.17	6	0.16	5
Unidentified						
Other	0.00	0	0.03	1	0.03	1
Subtotal	0.00	0	0.03	1	0.03	1
Total	1.00	27	1.00	35	1.00	31

Pre-survey Participants, again, listed intentions distributed over all four categories, with the majority of focus on tracking physical well-being. Participants ambitiously stated they would use their wearables to track 85 uses.

Post-survey Although participants did not use all initial intentions for their wearables, the majority focused on physical well-being, with several still dispersed among other aspects of health and wellness. See Table 20.3.

(b) *Classroom goals*. When students were asked to identify goals they would set for themselves over this study, all listed at least one goal, with some setting multiple.

Pre-survey The greatest classroom goals were producing professional work and keeping up with assignment due dates. See Table 20.4.

3. *Determine if classroom performance improved*

Table 20.3 Intended use

	Preliminary survey		Pre-study survey		Post-study survey	
Variables	%	*n*	%	*n*	%	*n*
Physical						
Fitness	0.31	17	0.20	17	0.29	15
Posture	0.00	0	0.02	2	0.00	0
Sleep	0.11	6	0.07	6	0.06	3
Pain	0.00	0	0.01	1	0.00	0
Nutrition	0.09	5	0.14	12	0.12	6
Water	0.11	6	0.12	10	0.08	4
Other	0.02	1	0.02	2	0.04	2
Subtotal	0.64	35	0.59	50	0.59	30
Mental						
Mental focus	0.07	4	0.13	11	0.10	5
Other	0.00	0	0.01	1	0.02	1
Subtotal	0.07	4	0.14	12	0.12	6
Emotional						
Stress	0.11	6	0.15	13	0.16	8
Mood	0.05	3	0.04	3	0.04	2
Subtotal	0.16	9	0.19	16	0.20	10
Social						
Interaction with others	0.13	7	0.08	7	0.08	4
Subtotal	0.13	7	0.08	7	0.08	4
Others						
Unspecified					0.02	1
Subtotal					0.02	1
Total	1.00	55	1.00	85	1.00	51

Post-survey Seventeen students completed the post-survey. Fourteen stated they used the wearable to measure their performance. Out of those 14, all stated they achieved their classrooms goals. See Table 20.5.

In summary, the data, although not to be generalized, returned that the 30 participants who responded to the preliminary study use wearables to monitor health and wellness. Of the original 21 volunteers who completed the study, 17 completed the post-survey. Three noted they did not use the wearable to track their performance, while 14 noted achieving their goals.

Discussion

This study set out to determine if students are directed to use wearables to intentionally set goals and monitor their health and wellness, could they improve classroom performance? The responses sparked a few thoughts. First, the overall number of

Table 20.4 Pre-survey: classroom goals

Variable	%	*n*
Keep up with assignment due dates	0.41	11
Produce professional work	0.52	14
Other		
Achieve personal goals	0.04	1
Work/School/Life Balance	0.04	1
Total	1.00	27

Table 20.5 Post-survey: classroom goal performance outcomes

Variable	%	*n*
Not at all = Scale point 1	0.00	0
Somewhat = Scale point 2	0.71	12
Met my goals = Scale point 3	0.24	4
Surpassed my goals = Scale point 4	0.06	11
Total	1.00	17

participants in the survey sent out nationally appeared low. This may be because volunteers were required to have an interest in wearables and incorporate them into their everyday lives. Volunteers participating in the actual study were also nominal, causing the researcher to extend the study to a convenience sample. Time of year may have also influenced this as elaborated upon under the Limitations section.

Second, almost all categories of wearables were selected by participants in the study's pre-survey. This seemed surprising to the researcher because most of these had not come up in conversation among the student population. The post-survey results reflected that the most common wearables, the smartwatches and Fitbits, were actually used. Two inferences may be derived from this: (1) Participants have an array of wearables that cannot be visibly detected and did not use them for the pilot or (2) Despite wearables being defined, participants skipped over the instructions in the pre-survey and better understood the context once required to apply the use of wearables to an intent.

Lastly, 76% of the participants who attested to using wearables for monitoring and improving health and wellness were generations X and Y. This generation may actually have the most on their plate with responsibilities expanding beyond classes into families and careers. This may suggest that those who have the least time to spare are actually finding the most value in the benefits of wearables to incorporate them into their daily lives. Likewise, their socio-economic level could also explain how these participants could afford wearables.

Limitations of the Study

Demographics Despite efforts to distribute the preliminary survey nationwide to recruit for this study, the largest pool of participants came from the graduate program where the researcher teaches about the positive impacts of health and wellness on performance. This provides clear directive to foster students' intentionality of goal setting using wearables but also lends itself to a bias sample population; thus, the results are only intended as a pilot study to be considered for future expansion to other populations.

Time Initially, it was intended for this study to be completed in the spring term, inclusive of pre- and post-surveys and the Mindfulness Attention and Awareness Scale (MAAS) questionnaire. The MAAS validated questionnaire approved by Brown and Ryan (2003) to be used with this pilot was intended to quantitatively assess the learner's presence of mind (mindfulness) throughout the study. The intention was to be able to triangulate the data analysis.

The results of the preliminary survey were delayed, moving the pilot into summer and fall sessions. Since the summer sessions were condensed, it was determined that the MAAS instrument would not be administered. The researcher did not want to inadvertently add stress to students, contradicting the concept of mindfulness and invalidating the results.

Conclusions and Future Studies

This investigation aimed to explore the effects of wearables on performance when used with intentionality. Specifically, the goal was to determine *if students are directed to use wearables to intentionally set goals and monitor health and wellness (physical, mental, emotional, and social) could they improve their performance in the classroom?*

It was hypothesized that learners' presence-of-mind and well-being to cognitively process learning would improve if educators support the whole student by guiding them to:

- Set intentional goals for their health and wellness and
- Measure these goals with wearables.

Out of the 21 students who took the pre-survey, 14 completed the study and were able to make the connection between health and wellness and educational performance. They accomplished this by setting intentions, monitoring their progress with their wearables, and attesting to making some progress with the classroom goals they set. This study represents the demographics of those who participated, which was heavily weighted with generations X and Y, middle and upper socio-economic graduate level students. This population's motivational level may be unique due to this demographic and is not intended to be used as a generalization.

"Cura personalis" is the Latin term for caring for the whole student. This pilot is the first step in recommending that we do exactly that when students step into a classroom. It is not enough that we attempt to pack more knowledge in without first guiding them to make the connection between health, wellness, and their ability to process new knowledge. Students in the preliminary survey used wearables with many intentions to improve health and wellness (physical, mental, emotional, and social well-being). From this we may infer that there is a growing interest to improve performance with these data tracking devices. This study touches the tip of what the students have already started exploring on their own. The health industry uses wearables to improve health and wellness (Fazana et al., 2017; Klasnja et al., 2009). The sports industry uses them to improve physical performance (Bunn et al., 2018). The field of education could benefit from pursued research to examine the use of wearables with intentionality to improve cognition.

Further studies might include expanding this pilot to study specific wearables; accuracy of specific wearables; why they work for some and not others; specific intentions; data collection of the wearables and educational gains to determine not just self-reported outcomes but actual data driven performance. Next steps should include expansion to integrate this study across disciplines to examine the effects of performance on a broader population. From a pragmatic standpoint, there is no reason a teacher cannot implement basic strategies in their own classroom now. Students may be encouraged to use wearables they already own to improve performance now. Offering learners guided time to direct their attention to what they are thinking, feeling, and experiencing provides opportunity to increase mindfulness. Consider the possibilities if learners are guided to set intentional health, wellness, and performance goals and then encouraged to monitor those goals with wearables to maintain and improve intended outcomes. Some simple steps may include:

1. Planting the seed of awareness by providing research reflecting the correlation between health, wellness, and improved performance.
2. Directing students to:
   (a) Set intentional goals for themselves to monitor mind, body, emotional, or physical performance with wearables (i.e., have learners brainstorm on the possibilities: wearables vibrate to encourage breathing and movement; the Headspace app offers guided meditation; most apps can track and trigger water consumption to improve performance).
   (b) Set personal class goals.
   (c) Reflect upon their success and make the correlation based upon the data analysis (Lee, 2013).

Unanticipated secondary outcomes from this study included (a) IDT students developing instructional design projects and (b) discussions focused on and around health and wellness after awareness was raised from this pilot. This study also blossomed into another special project awarded by The University of Tampa to drive performance. The directive for students to set performance improvement goals culminated with reports of students monitoring their health and wellness in an Inquiry and Measurement class. To incorporate this initiative into the curriculum, students were charged with personalizing their inquiry studies and using the emerging technology to experience automated data collection. The value of studying wearables in education may expand the cura personalis concept to improve overall performance, one student at a time.

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Chapter 21
Business Students Meet the Real World: Creative Problem-Solving via a Complex Role-Playing Simulation

Dennis W. Cheek and Kim A. Cheek

Instructional design that immerses students in complex, real-world problem-solving is essential to the cultivation and refinement of twenty-first-century skills. We describe a specially designed simulation that engages business school students in the resolution of an environmental crisis associated with acid mine drainage (AMD) involving a national mining industry, the geosciences, budgetary restraints, severe competing funding priorities for education, healthcare, etc.

The Witwatersrand Basin in the Republic of South Africa (RSA) is the largest gold-producing region in the world. Over 40,000 metric tons of gold have been extracted (Pratt, 2011). Mines are as deep as 4 km below the surface with an average gold mine comprised of a total of 362 km (225 miles) of tunnels. Some 5000 scattered and abandoned mines have filled up with water, become highly acidic, and dissolved a multitude of toxic metals. Recurring outflows of this toxic water from the mines (AMD) pose threats to flora, fauna, agriculture, and human settlements. Underground the mines continuously expand as acid eats through rock layers horizontally and vertically.

The simulation was developed for and used in two business school courses on "business with a social conscience" and "creativity management." This chapter highlights important aspects of the design of the simulation. It then describes a wide array of events that occur during the simulation that lead to divergent and potent learner outcomes. We highlight along the way a series of student comments about the design aspects of the simulation and their insights regarding how the course's

D. W. Cheek (✉) · K. A. Cheek
IÉSEG School of Management, Socle de la Grande Arche, Paris, France

METIL, IST, University of Central Florida, Orlando, FL, USA

College of Education and Human Services, University of North Florida, Jacksonville, FL, USA
e-mail: dcheek@ist.ucf.edu; d.cheek@ieseg.fr; k.cheek@unf.edu

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design features promote student engagement, motivation, persistence, out-of-the-box thinking, and critical decision-making.

Evolution of the Simulation

This simulation arose from an article on AMD in RSA in *Earth,* a magazine of the American Geosciences Institute (Pratt, 2011). Simulations immerse learners in a teacher-designed "world" in which they must navigate a contrived situation with associated ambiguities. The outcomes of a simulation are greatly influenced by the inherent design of the simulation and by learners' creative responses in role-playing, problem-solving, and decision-making. The simulation was first used in a very simple format involving dyads of students with assigned roles in a "simulated public hearing" as a component of a semester long BBA course with about 60 students at the National University of Singapore Business School in 2011. Results seen in students' growth in understanding of themselves in such a situation as well as their acquisition of knowledge about AMD were encouraging.

An opportunity arose in 2013 to take over an existing MSc course on "Creativity Management" at IÉSEG School of Management (IÉSEG) in France and teach a 1-week, English-language-only, intensive module at both their Paris and Lille campuses. The course was an elective within the Innovation and Entrepreneurship track and open to MSc in Management, Master of International Business (MIB), and undergraduate (foreign only) BBA students. In 2017–2018, IÉSEG reported 5150 students, including 2270 international exchange students from 69 nations. The course has been completed by 543 students in 10 cohorts in Paris and Lille (2013, 2015–2018).

The decision was made to focus the course on student use and further development of a blend of cognitive and non-cognitive (CNC) skills through a specially designed, complex 4-day simulation experience. The need for attention to a mix of CNC skills in business schools and throughout formal education goes back to at least the 1991 release of the US Department of Education *Secretary's Commission on Achieving Necessary Skills* (SCANS) report which used data across 50 occupations to identify what a useful mix might entail (Kautz, Heckman, Diris, Ter Weel, & Borghans, 2014). Recent studies converge around the importance of three dimensions to such skills: (1) information, (2) communication, and (3) ethics and social impact as delineated by Ananiadou and Claro (2009). Skills would include those essential for research endeavors, problem-solving, decision-making, creativity and innovation, critical thinking, responsibility, collaboration, persistence, motivation, and learning to learn (cf. Kautz et al., 2014; Pellegrino & Hilton, 2012). The design of this course is well aligned with the goals of the newest IÉSEG strategic plan and its efforts on improving teaching and learning (Ammeux & Roussel, 2016; IÉSEG School of Management, 2016). The importance of diverse CNC skills has even more recently been underscored by CEOs of global companies (PWC, 2018) with

77% of them saying "the availability of key skills is the biggest threat to their businesses" and that they are struggling to "find the creativity and innovation skills they need."

Design of the Simulation

Three distinct sets of information were created to engage and support students in activating and improving CNC skills. Sufficient but by no means exhaustive content to allow for ample student imagination, discernment, and meaning-making were provided concerning:

1. Detailed information about 60+ creativity techniques for different identified purposes
2. Information on the various assigned "roles" within the simulation and information on RSA economy, education, employment, geography, history, national budgets, and politics
3. Information on select geosciences and sociotechnical aspects of AMD in RSA.

The guiding principles for selected materials included: (1) English language only, (2) sources ranging from semi-popular sources to technical ones, (3) some disagreements among the various sources as to certain facts or the importance of them, (4) relevance to AMD issues in RSA with some external examples to act as provocations or prompts for student ideas, and (5) a sufficient array of diverse creativity techniques that students could use to stimulate their own ideation, analysis, refinement, and promotion of possible solutions.

Materials were organized into labeled folders on the institution's online learning system as both individual files and zip folders for rapid download. Students accessed the folders and two external websites (both of which dealt with creativity techniques—one in French and one in English). Access or use of other knowledge from the Internet, newspapers or other print materials, friends or family, or social media was not allowed as part of the "game rules" for the simulation. This rule was for two reasons: (1) to maintain almost total information symmetry across the teams and (2) to bound the complexity of the simulation to help ensure students' success at the challenging requirement to find one or more potentially viable solutions to AMD in RSA within just 4 days. Students were permitted to use information already known to them at the start of the course. There has yet to be a student specifically familiar with AMD and exceedingly few were familiar with either the mining industry (even in home nations) or RSA.

Materials given to students regarding AMD matters have varied over time as some items were withdrawn and new ones added. These changes included updates to existing documents and new materials to respectively increase or limit complexities within the simulation. The annual package included several thousand pages of materials organized into two AMD folders: One labeled "Essential Readings" and the other "Optional Readings." The items cover topics such as: (1) annual reports of select mining companies operating in RSA, (2) annual RSA national budget summaries as well as the most recent full budget—a 400+ page document which the National Treasury has to master (other teams need to become aware of its main features for their respective roles), (3) position papers issued by various nonprofits, (4) scholarly papers and international documents related to AMD issues, (5) geochemical information related to AMD, (6) economic and labor information, (7) overviews of RSA mining industry, (8) overviews of relevant RSA laws and regulations, and (9) large-scale maps of the mining areas. In addition, there is information on pressing national issues, for example, health and safety, fresh water, and droughts (e.g., there has been a 3-year intense drought in western RSA since 2014). The overarching national issue is government corruption at the national, state, and local levels—a key element that will affect many aspects of the simulation over the 4 days.

The professor delivers a 1-hour opening lecture. It highlights the nature of the course and the designed experience students will soon be enmeshed within, expectations regarding their performance, demands that the course imposes on individuals, teams, and the entire class, the 360° grading process that will be used, and the interrelationships among the simulation, imagination and creativity, and business knowledge. Students are urged to take risks in this "safe" environment and to step out of their own cultural norms and usual ways of conducting themselves. The importance of student risk taking (experimentation) while playing their assigned roles as its critical role as a contributor to student, team, and class success is underscored. Consequently, students are told that student efforts, even if not as successful as they wish them to be, will not be counted against them, and often will count for them. The most obvious example is that non-native English speakers must exercise both oral and written English-language skills no matter what their current state of proficiency to participate and seek to make their ideas known. Even native English speakers learn new things, as one such student volunteered that "… I had to place myself in my teammates' positions so that my speaking would be clear and understandable … to practice patience as sometimes teammates that were not as fluent in English took longer to understand the given concept or point of discussion. Once everyone understood the topic, it was amazing to see how our various experiences and cultures combined offering incredible brainstorming."

Since students are from a wide variety of places around the globe, a second example explicitly mentioned is that students with certain characteristics (e.g., race, gender, ethnicity, age, social background) may not be allowed to speak publicly or exercise leadership roles in their homeland. They are reminded that this is the time, place, and supportive learning environment where such rules from "home" do not apply and, thus, the perfect opportunity to challenge themselves, experience new things, and grow in certain dimensions as a prospective business employee working internationally.

The lecture also emphasizes the need to challenge each other and to draw the very best out of every member of their team and other teams across the class. Finally, students are encouraged to "have (serious) fun." A break is then taken. During the break, students who wish to volunteer to be considered for the important and challenging role of the International Consulting Group (ICG) are briefly interviewed by

Table 21.1 Teams for the simulation

International Consulting Group (ICG—the class leader)	Federation for a Sustainable Environment (NGO)
Mining Communities Federation (NGO)	Office of the RSA President
Cape Town Chamber of Commerce (Business Federation NGO)	National Treasury of RSA
Congress of South African Trade Unions (NGO)	Committee on AMD, RSA Parliament
National Union of Mine Workers (NGO)	RSA Department of Water and Sanitation
Johannesburg Chamber of Commerce (Business Federation NGO)	RSA Department of Health
Government of Johannesburg (largest city in RSA)	South African Democratic Alliance (largest opposition party in RSA)
Chamber of Mines (mining industry NGO)	

the professor and the team is constituted. All who volunteer and are not chosen are placed on other teams where their background and talents will likely prove useful. The ICG receives some very quick suggestions from the professor and then is sent off to a separate room to plan, knowing they must provide initial instructions to the entire set of teams within 10–12 minutes.

Upon their return from the break, all other students are randomly assigned to one of 14 teams by the professor (see Table 21.1), making 15 teams in all counting the ICG. All but the ICG correspond to actual RSA organizations. The presence and prominence of the ICG over the 4 days remind students that there are many international consulting companies for whom some of them may work after graduation or as part of their formal internship experiences. It also highlights that business consultants often assist governments and other public and private sector actors to solve pressing real-world problems and they are compensated accordingly.

The number of teams in the simulation is determined by considering a variety of factors including: (1) sufficient differences of values and goals across the teams to make for disputes, resistance, informal alliances, and differing views of AMD and its importance sufficient to generate tensions, challenges, and possibilities for resolution in the allotted time, (2) the large size of the class (usually 90–110 students; in smaller classes 1–2 teams are eliminated from those within the same societal sector with a minimal team comprised of three members), and (3) the management tasks that the ICG would need to undertake to track and interact with all the various subtasks and smaller groupings that inevitably occur once the simulation commences. Random team assignments ensure that students work across cultures and among people with varied life experiences, first languages, and educational backgrounds while using English as the required *lingua franca*. It also means they must adjust to representing well a role and position that may not correspond to their personal views. This helps foster perception and understanding of the "other," an important life skill. One student reflected that "to be able to interact and work with all these ethnicities and trying to come up with valid compromises and solutions was challenging. Language, difference in opinions, different views of the world due to upbringing were small barriers …. But I learnt how to deal with these issues through the simulation."

The simulation's content and processes are bounded by the following parameters: (1) nearly complete symmetry of information across all teams to eliminate undue advantage, (2) each team plays an assigned role as they believe their real-world counterparts would, and (3) the primary task is to collaboratively and mutually decide on a suitable course of action to address AMD across RSA.

After all students are assigned, the simulation commences under the direction of the ICG. The professor now assumes the role within the simulation of an international expert on AMD who has been contracted by the RSA President's office to provide only scientific and technical information about AMD upon demand of the various teams throughout the 4 days. All process and procedural questions are directed to the ICG. One student described the course as "… unexpected, exhausting, realistic, and full of surprise … unexpected because after a short introduction, we needed to face the entire project on our own. The role of the professor was only the one to provide technical info about some aspects without helping in other fields."

The first step is for all teams to meet independently, get to know one another, and together read and briefly discuss the Pratt article. A mini-tutorial in private is given by the Professor to the Office of the President team during this time because their role is critical to the entire tenor of the simulation. They are reminded about the sample types of relationships they would be likely to have with every single team in the room. They are informed about their power and the freedom of movement and direction that they alone enjoy throughout the simulation since this is their forum to which the others have been invited as participants, including the ICG. At the same time, they are reminded that there are always reporters and TV cameras in the room and daily reports have been issued before and will be issued during the 4-day meeting.

Then the RSA President (decided by that team) greets the attendees of this important "National Consultation on AMD in RSA" to which all organizations (teams) have been summoned to aid their country. The last 15 minutes of each class is given over to the professor providing a high-level view of key insights as to how teams are doing and process reflections. All other class directions, work flows, assigned tasks, etc., are mediated by the ICG. The professor meets daily with the ICG to debrief and assist them (but not overly so) in their assigned role as well as responding outside of class to their email communications. Figure 21.1 shows the overall process flow across the 4 days of the simulation as it has organically developed from the first to the tenth cohort. This general schema has naturally emerged each time with just slight variations (this flow chart has never been shared with the students themselves—once again by design).

Teams work outside of class and utilize their own processes and procedures to share information, track their ideas and arguments, compile their evidence and presentations, prepare to defend their positions, etc. They are free to utilize any social media and work sharing platforms and means of communication that they desire. Routinely they choose to create their own Facebook groups, SMS/texts and emails,

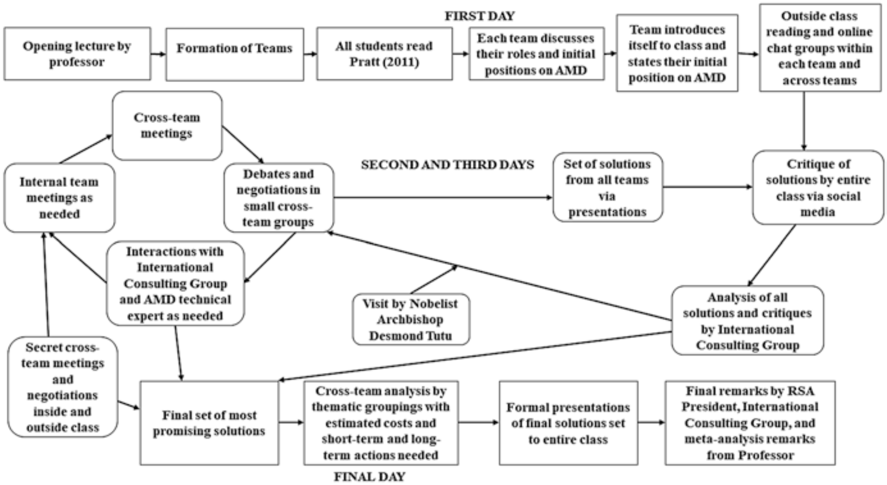

Fig. 21.1 Flow chart of 4-day simulation

and use presentation and analysis software and online work exchange platforms in the public domain and/or those provided by IÉSEG. Most also utilize face-to-face meetings at cafes or other venues including small rooms or common areas at IÉSEG. Students who are ill and unable to attend class are expected to be in touch with their teams via social media and support their team as fully as if they were physically present. The class is very demanding of students' time and sustained attention. They acquire and make sense of an enormous amount of information over a very compressed period. The professor and the ICG utilize various technologies to keep track of the ever-shifting locations of teams, cross-team meetings, "secret" meetings unknown to anyone but the ICG and professor, etc.

Each Wednesday morning, the RSA President welcomes his personal guest, the Honorable Archbishop Desmond Tutu, Nobel Peace Prize winner—a role played by the professor in African attire. This surprise visit is designed to raise issues students may not have considered, subtly remind them that some South Africans are known around the world and can be useful representatives in helping with the AMD problem, and to motivate them to renew their personal and team commitments to solve this problem—since by this point many teams have tried every "standard" technique or tool acquired during their formal business school education to no avail and many are quite discouraged and are suspecting the problem may be beyond their capabilities.

Tutu delivers his carefully crafted remarks to the entire consultation which is covered "live by international media." He reminds them of the importance of their efforts, the need to persevere in their difficult task, insights from the long and difficult anti-apartheid struggle that highlight the importance of ethics, the vital role of the nation's women, the pressing demands of social justice, the potential to lead the world on this important issue of AMD, and his own belief that the world will help RSA in its AMD efforts if it can fully and honestly face itself, resolve to make a difference on this issue, and put in place effective mechanisms that give promise of effectively addressing the many issues raised by AMD. The entire class receives an electronic copy of the speech within minutes of its delivery. Tutu departs, and the class returns to its ongoing debates, problem-solving, and coalition building. There is plenty of evidence from students' subsequent actions as well as oral and written responses that this speech spurs students to dig deeper within themselves, renews the resolve of some who were flagging in their frustrations at the many seemingly intractable aspects the AMD problem presents, and alerts everyone to some considerations that had not yet entered their minds. For many teams it releases their anxieties, opens their minds, and causes them to "double-down" to create new paths toward resolution.

Grades for the course are comprised of two components:

1. The simulation which counts for 70% of their grade: 50% of the 70% is derived from students' assessment of their own team members, including themselves and the performance of all other teams in the simulation, including their own team. The professor holds the other 50% for both individuals and teams.
2. Two essays which count for the remaining 30% of their grades. The essay topics have varied; the most recent version is as follows: The first essay is a reflective essay as to what they learned about themselves, their team, and managing creativity during the week. The second essay is selected from three set questions: (1) what they think should be done regarding AMD in RSA, (2) if they were to start a business focusing on aspects of the AMD problem what they would launch and how, and (3) a critique of two creativity techniques they used during the week (they are not allowed to write about the widely known "brain storming" or "mind map" approaches which are overused and often misapplied in many university classrooms and elsewhere within society for problem-solving purposes).

The simulation provides a unique and beneficial learning experience for students and allows for the full expression of their current twenty-first-century skills as they can be applied to a real-world problem of enormous complexity. Table 21.2 sketches out some of the major design principles that we utilized and some of the main benefits that appear to be associated with the use of each design principle in the overall structure and execution of this simulation. We believe that these design principles and benefits can be applied to many other subjects, situations, and settings to increase the intensity, challenge, motivation, and learning for students in varied settings and of varied ages. We make no claims that our insights are unique, but we have been able to create what students themselves frequently acknowledge as the most unusual, frustrating, and fulfilling course they have ever experienced in formal educational settings.

Table 21.2 Design principles and benefits

Design principle	Main benefits
Create common set of information available to all	Eliminates information asymmetry and serves as a key constraint to invoke fuller use of student imagination and creativity
Define student roles and expectations sufficiently but not so much as to circumscribe student independence of thought and action	Provides direction but leaves behaviors and actions largely within the realm of student motivation and decision-making; much of content for the class is therefore student-generated rather than largely teacher-directed
Let students self-select their communication strategies and tools they wish to employ	Allows for greater team choices and increases likelihood that strategies and tools meet student needs and performance expectations; often results in students learning about tools or techniques new to them
Utilize authentic settings or issues as the context for student learning	Elevates student motivation and engagement knowing they are solving "real problems" in the "real world"
Allow the learning experience to develop organically	Creates an experience that aligns more closely to actual life situations; incubates and increases moments of surprise, wonder, frustration, challenge, and significant achievement; makes the student-led, student creation of course "content" strikingly apparent to all
Model metacognitive reflection to stimulate self-insight	Brief daily metacognitive reflections from professor about our "day," prompt students to engage in further self-reflections and team introspection throughout and after course ends—a necessary ingredient both for course and future personal success

Insights from Select Participants About the Interplay Between Course Design and Learning Outcomes

Large numbers of students in each cohort recognize that the course "works" in an effective manner by blending elements of creativity, management, and real-world problem-solving within the context of the simulation. The simulation evolves dynamically over the 4 days as a direct consequence of students' actions, attitudes, behaviors, and their effective use of words and visual representations to understand the many issues, formulate and critique possible responses, and constantly debate, negotiate, reformulate, restate, and compromise with other students and other teams. Many students comment about aspects of the design features of the course that form the substrate within which so very many things occur—both inside and outside of class meetings. A student realized, for example, that underlying the premise of using a role-playing simulation as the major vehicle for the course was the idea "… that if you pretend to be someone else, you feel more comfortable with presenting ideas. This is because you take a different role away from having an idea to help you talk. It will also be easier to come up with additional ideas when looking at a problem from other perspectives. The technology was so well suited to the role we would have during the course and that made the conversation easier. We let ourselves get into those strange roles, think of new ways to understand and see new perspectives. To play someone else was a bit uncomfortable for me, but after a little while our team sat together as if we had never been anybody else. The advantage of this technique was primarily that it was fun and it was good to help group members feel more comfortable sharing ideas with each other. It also built trust, for shy or less self-confident people, who felt empowered to speak. The technology showed me that it was more useful than I thought and it is a tool I will use in future group work. By applying a technique like this, it makes it possible to get people who have never previously encountered [one another], feeling comfortable in a new and unknown group."

Another student reflectively captured some emotions and actions that rippled across all ten cohorts during this simulation that are also prompted by the new and "strange" design of the course: "What stuck with me most during the week-long simulation was the feeling of guilt, ignorance, and fear for people I did not know, regions of the world I never visited, especially after I realized this is not only a problem made up for our class to role play, it is happening right now on our planet. I did not expect to care about an issue beyond myself so quickly. I believe the emotions I felt were part of the reason why I wanted to be involved in class and discussions, because I am usually not as active in classes that require participation. As soon as we learned about what is required of us for this class, my immediate response was fear. Fear of having to be awake in the morning, fear of having to do "real work" in class. I wanted to give up right away and try to find the easiest way possible. However, what I did not expect was for this issue to become interesting to me, and as soon as my fear turned into curiosity, I wanted to get to know the issue more, see the outcome and other people's solutions, and I naturally became more involved. As someone who is not always an active participant in class, this was surprising to me. As soon as my brain was "on," I put in more effort to think and brainstorm, which generated ideas I otherwise would not be able to, and ideas I did not know I can think of." In addition to the stress of meeting new people, adjusting to their newly assigned role and deciding how as a team they are going to "play" that role, and with the added pressure to solve this major world problem across a single nation in 4 days always provokes many comments both during class and in their post-course reflections. A fellow participant illustrates a common understanding, "I think I had never worked under that level of stress and frustration, it took us hours the first two days to reach an agreement, and in the end to decide who was going to present the information to the group and in order to [ensure] the message was clear and concrete for others. I felt involved in a tense environment, but I noticed that I was not the only one that felt that way, my teammates felt the same."

Working by design within informational constraints also becomes something that students have never thought about before in terms of how it can spur their imagination and creativity. Speaking on behalf of many, one student noted that "During the simulation, it got frustrating at times when I figured out that the information we had was never enough to make a decision. Every time we came up with an idea, we realized that there were roadblocks that would not allow the idea to scale through. I remember the Professor saying that it was at the point when you seemed to be all out of options that 'creative thinking' will start to kick in. True enough towards the end of the third day and into the fourth day, we were able to start trying to think out of the box to find solutions to solve the AMD crisis."

A summary from one student expressed insights consistent in whole or in part with many other course participants regarding big take-away ideas from this 4-day experience:

> I learned that I could offer applicable advice on a topic in which I had no previous knowledge. This is because I discovered that creativity, a key to creating advice, is more than just stating new ideas. New ideas need to be applicable, feasible, and situational. To be creative it's important to do research on the topic in discussion so that the imagination can then work between parameters of logical possibility. I also learned that being imaginative does not always mean creating a new idea, but modifying an existing solution so that it can meet present needs …. I learned that when I am tasked with offering creative, innovative, and imaginative ideas I need to think beyond my given culture and myself.
>
> In addition to gaining [a] creativity perspective, I also learned when I needed to take a step back. Sometimes I get really excited about my own idea [such] that I am not as open minded as I should be to the ideas of others. Ideas should never be overshadowed because great opportunities can be missed. Our professor talked about how one idea may not be directly used but could influence the creation of another. Our team experienced this phenomenon on several occasions and it wouldn't have happened if we didn't have open minds. Learning the skill of listening instead of speaking will allow me to be a better professional as leadership is not always creating ideas but allowing other ideas to be fostered.
>
> From this day forward, I will now have a wider eye for recognizing and appreciating creativity. This is because I saw that sharing ideas could be intimidating for some, especially if the ideas have to be said in front of a full room. Yet having the idea is only half the battle. Before taking this class, I thought that creativity was as vast as the mind could imagine, however, I know that the other half of the battle is fighting for your idea. Creative ideas are not instantly recognized and supported by everyone or, in the case of our class, the majority. It is important to practice the skills needed to get an idea supported and implemented.

Mission accomplished—enough said. We encourage others to utilize our learning design approach and welcome inquiries from instructors who may even have a use for this topic and our materials as they presently exist.

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Chapter 22
How Social Presence on Twitter Impacts Student Engagement and Learning

Shelly Vohra

Introduction

The ways teenagers engage and communicate have evolved due to access to mobile phones and the evolution of social media platforms like Facebook, Instagram, Twitter, Snapchat, and YouTube. Approximately 95% of adolescents own or have access to a cell phone, thus providing them with the ability to access these platforms (Anderson & Jiang, 2018). Teenagers who own or have access to a cell phone use texting as their primary means of communicating with their friends, whereas adolescents who do not have access to a mobile phone use social media to engage with their peers via their laptops, desktop computers, and game consoles (Anderson, 2015). At one point, Facebook was the dominant platform used by adolescents; in 2015, 71% of teenagers communicated with their peers through this social media platform (Lenhart, 2015). This number has now fallen to 51% in 2018, while other platforms have seen a rise in their use among teenagers, namely YouTube (85%), Instagram (72%), and Snapchat (69%) (Anderson & Jiang, 2018). Approximately 32% of adolescents engage with Twitter; as adolescents get older, their use of Twitter increases; 24% of teenagers aged 13–14 years use this site, while 38% of teenagers aged 15–17 years use Twitter to communicate with their friends (Anderson & Jiang, 2018).

Rheingold (2009) argues that the integration of social media in education, like Twitter, allows students to take ownership and responsibility for their learning. Rheingold also states that, for social media use in education to be successful and useful, educators must engage in professional development and be permitted to use

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S. Vohra (✉)
Peel District School Board, Ontario, CA, Canada

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social media in unique and creative ways, such as connecting with other professionals from the field, learning from others, and using global issues for learning. Marshall McLuhan (1964) used the term "global village" to describe a series of networks in which the world could be connected in order that events in one part of the world could be shared with individuals in another part of the world. Twitter is one example where people can share and discover what is happening across the globe related to news, entertainment, and sports.

Although Twitter has a reputation for cyber-bullying and hate speech, Twitter still has many benefits as evidenced by its increasing popularity with teenagers. Students say they like Twitter because it allows for communication, making connections, building relationships, and learning about world issues (Andersen & Jiang, 2018). Twitter allows for conversations to happen in a stream where multiple people can be in a chat discussing a variety of issues and topics, which is not always possible with other platforms (Vaynerchuk, 2015). Twitter also allows users to post links to articles, upload videos, and add visuals to support their tweets. However, these students also acknowledge that Twitter can have its disadvantages; they cite bullying and the pressure to present themselves in a certain manner as negative aspects of social media (Andersen & Jiang, 2018).

The company's CEO, Jack Dorsey, also acknowledges the negative behaviors and says that he and his team are brainstorming solutions to some of these problems with research teams. For example, he is thinking about how to best promote what he calls "conversational health"; in other words, he is helping users to have healthy dialogues in order to enhance the quality of communication (Stelter, 2018). Dorsey is also rethinking the "like" button and how users' "followers" numbers are displayed because, according to him, these two features can cause inappropriate behavior in the quest for popularity (Stelter, 2018).

Despite some of the drawbacks of Twitter, it was selected for this study due to its positive features, such as the ability to: (a) have multiple students talking under one thread; (b) add links, videos, and visuals; and (c) "retweet" the tweets of others. Even though students were asked to create a private account to protect their privacy (i.e., names, location, and profile picture were not posted), having a public account could be a powerful way for students to develop their digital citizenship skills as they engage with a variety of people from around the world. In this scenario, students still would not post any personal information that could compromise their safety. However, due to the nature of this study, it was decided a private account would be best.

Even though adolescents are using social media tools for personal communication and individual use, the incorporation of these platforms for learning is still in its infancy in education. The majority of the research has been conducted in higher education institutions (i.e., colleges and universities); very little research exists that explores the impact of social media use for teaching and learning at elementary and secondary school levels. This study, therefore, explores the use of Twitter in a Grade 8 mathematics classroom during an instructional unit on Data Management and Probability.

Literature Review

The review of the literature demonstrates that Twitter can be used for teaching and learning in a variety of ways, such as increasing engagement, improving communication skills, meeting course objectives, learning another language, and building a sense of community in the classroom. Elavsky, Mislan, and Elavsky (2011) examined the use of Twitter in a university Media and Democracy course and found that 78.2% of students found Twitter to enhance their engagement in the course. However, Jacquemin, Smelser, and Bernot (2014) explored the use of Twitter in university-level biology courses and found that 67% of students did not see Twitter as a useful tool in the classroom.

Andrade, Castro, and Ferreira (2012) explored the integration of Twitter in a masters' level class in Portugal and found that students were involved in answering questions, posting comments, and discussing the issues presented by their professor. Gunuc, Misirli, and Odabasi (2013) examined perceptions of Grade 7 students use of Twitter as a communication tool and found that 67% of students did not view Twitter as a valuable tool for communication and learning because they were also not using it for personal and social communication.

Domizi (2013) explored the use of Twitter to build community in a pedagogy design class and found that students felt more connected to each other because of Twitter use. Therefore, they felt more comfortable voicing their opinions and sharing information. During an 8-week practicum, pre-service teachers engaged in Twitter and Wright (2010) discovered these teacher candidates felt a sense of community was built due to the use of Twitter. The pre-service teachers were not only grateful to receive encouraging messages from their peers when they were facing challenges during their practicum but they also welcomed reading about the experiences of others. Wright also found that the teachers reflective practices improved; they were not only reflecting on what they were doing but why they were doing it.

Tanner, Hartsell, and Starrett (2013) investigated the use of Twitter in an algebra college course and found that students enrolled in this course scored higher across three exams compared to other algebra classes that did not use Twitter because when students encountered challenges during homework completion, they would take a picture of their work and send a tweet to their instructor who then responded with suggestions and different strategies. Furthermore, students started to respond to each other's questions and challenges in understanding algebraic concepts and, therefore, students became the teacher, helping their peers and themselves in consolidating their learning.

Lomicka and Lord (2011) investigated the use of Twitter in an intermediate university-level French course in which students were communicating with each other and native French speakers in French and found that students recognized that Twitter is a valuable tool to learn the French language and culture. Castrillo de Larreta-Azelain (2013) explored the use of Twitter among Spanish-speaking students in a German language course and found that approximately 72% of students found Twitter to be an important tool to improve their written communication skills in German. A review of the literature, therefore, revealed a gap in terms of how Twitter is used in elementary school settings.

Conceptual Framework

Social presence theory, first developed by Short, Williams, and Christie (1976), was used as the conceptual framework for this study. The term "social presence" is used when describing how engaged individuals are when they are interacting through a communication medium (Short et al., 1976). For example, a podcast is considered to have low social presence (i.e., audio) while a Google Hangout has a high social presence (i.e., video). Rourke, Anderson, Garrison, and Archer (2001) identified three categories related to social presence: (a) affective, (b) interactive, and (c) cohesive. The affective category relates to the use of humor, emotions, and emojis. The interactive component is defined by responding to others, asking questions, and communicating agreement. The cohesive category includes the use of names, pronouns, and salutations. Therefore, social presence theory formed the foundation of this study and the findings were interpreted through the three categories as identified by Rourke et al. (2001).

Methodology

The purpose of this qualitative case study was to explore how social presence on Twitter impacts students engagement and learning in a mathematics classroom. The integration of Twitter in elementary education is a relatively new phenomenon, and according to Creswell (2007) a qualitative approach should be used to develop a deeper understanding of a new phenomenon. Merriam (2009) and Yin (2009) also posited that qualitative research should be conducted to describe a phenomenon because it provides a rich detailed description of said phenomenon. An embedded single case study design was selected to align with the purpose of the study. Creswell (2007) defined a case study as a research design that involves, "an issue explored through one or more cases within a bounded system" (p. 73). In this study, the case was a Grade 8 mathematics course and the embedded unit of analysis was an instructional unit on Data Management and Probability (Vohra, 2016). According to Merriam (2009) a case study design requires data collection from a variety of sources such as interviews, questionnaires, survey, and electronic communication. For this study, data were collected from student and teacher interviews, student and teacher questionnaires, course objectives, and student and teacher tweets.

Due to Twitter's policy and procedures and privacy issues, students created a new Twitter account, which was private. Students were instructed not to post a profile picture of themselves nor were they to add any personal information about themselves on the biography portion of the platform (i.e., real name, city, and school name). All students complied with these guidelines.

The following research questions were developed based on the case study design.

Central Research Question

How does social presence on Twitter impact student engagement and learning when a mathematics teacher integrates this social media tool into mathematics instruction?

Related Research Questions

1. How does a teacher use Twitter to help students improve their learning in mathematics?
2. How does a teacher perceive the value of students using Twitter to improve their learning in mathematics?
3. How do students perceive the value of using Twitter to improve their learning in mathematics?
4. How do documents and artifacts such as tweets and problem-solving notebooks support student learning in mathematics?

This study was conducted in a school district in a province in Canada over a 4-week period. Participants included six Grade 8 students enrolled in a Grade 8 mathematics course and the classroom teacher. According to Merriam (2009), this sample size was justified because the purpose of qualitative research is to provide a rich thick description of the phenomenon. I designed two instruments for this study: (1) an oral questionnaire for the teacher and student interviews and (2) a written questionnaire for the teacher and student reflection journals (Vohra, 2016). For the interviews, a semi-structured format with open-ended questions was used, and interviews were conducted in a conference room to ensure privacy (Vohra, 2016). The written questionnaire consisted of three questions each for both the teacher and students and was completed once a week via a private blogging platform. Course objectives for the mathematics course were collected and student and teacher tweets were collected once a week. Both the oral and written questionnaires aligned with the research questions (Vohra, 2016).

Data were analyzed at two levels. At the first level, data were coded and categorized from each data source (Vohra, 2016). These coded data were analyzed by using the constant comparative method as suggested by Merriam (2009) to construct categories (Vohra, 2016). For the document and artifact analysis, a content analysis was conducted. At the second level, data categorized across all data sources were analyzed in order to establish themes and discrepant data. These emerging themes and discrepant data shaped the key findings of the study and were analyzed according to the research questions; the findings were interpreted through social presence theory (Vohra, 2016).

Results

The findings for the related research questions are presented first since the central research question consists of a synthesis of all the findings based on the interviews and the reflective journals. In relation to the first research question, the key finding was that the teacher used a variety of strategies to support student learning of data management concepts such as posting daily word problems, asking probing questions, providing feedback, posting videos and visuals, and answering student questions. For example, the teacher posted her lessons on Twitter for students to refer to later as well as asking probing questions such as “How would you make this graph bias?” and “What makes you think this?” to further their learning (Vohra, 2016).

In terms of the second related research question, findings indicated the teacher found Twitter to be a valuable tool for learning because students were building community, assuming the role of the teacher, reflecting on their learning, responding to the questions and challenges posted by their peers, and sharing resources on Twitter (e.g., videos and visuals). The teacher also stated how students took on the role of the teacher when she said,

> ...other kids would jump in and help the other students and answer the question for them so that was really awesome because they just seem so much more independent, and I didn’t feel like I had to always respond to them right away because they were like actually teaching each other. responding to the questions and challenges posted by their peers on Twitter (Vohra, 2016).

Consequently, the teacher found the number of tweets she had to respond to decreased because students were teaching each other. Additionally, the teacher discovered that students who do not usually work together in class were now collaborating because they were interacting on Twitter after school (Vohra, 2016).

> I noticed the collaboration in the class just seemed to improve so they were more willing to work with other people and I just think they felt more comfortable (Vohra, 2016).

The teacher also noted that the use of Twitter helped her ESL students:

> We have a lot of ESL students in this class, and a lot of them are really quiet; they don’t really like to participate in class. Actually I shouldn’t say that they don’t like to [participate], but it’s more they don’t feel comfortable participating or putting up their hand[s] to speak in front of the class, but I actually found that with Twitter, it helped improve the communication and interaction between them and other classmates (Vohra, 2016).

Results for the third related research question indicated that the majority of students found Twitter to be a helpful tool for their learning because they were collaborating on group assignments outside of school (e.g., “We did a group project and on Twitter. When we were at home we could communicate our ideas and still work on the project [because] we had Twitter”), observing the different strategies used by their classmates to solve problems (e.g., "You're basically learning about what other people are thinking about and how they solve the problem which could be different from yours and then you're adding your own ideas"), answering probing questions, receiving timely feedback (e.g., "It was easy to talk to your classmates online…You can post [work] on Twitter and then get feedback"), reflecting on their learning, and sharing resources in the form of videos and visuals from classroom lessons. Students identified their learning was enhanced because classmates were posting YouTube videos to increase their understanding of concepts like central tendency and misleading graphs as evidenced by one student who said, "We were posting and exchanging videos...and you can post pictures to help the learning" (Vohra, 2016). One student, however, did not find Twitter to be a valuable tool because he identified his learning style did not suit the use of this platform. He believed he learned best in face-to-face situations with the support of his teacher and peers (Vohra, 2016).

> I feel there is no need to use Twitter. I like the old days; well, not the old days but I like when teachers stand up in front of the chalkboard and give you an actual lesson. I feel that helps me more than Twitter. I found Twitter was alright, but I personally would not do it next time (Vohra, 2016).

In relation to the fourth related research question, the teacher used ministry objectives related to the mathematics course to align her lessons to support student learning. In terms of the artifacts, findings indicated that tweets supported student learning of data management concepts because students were answering word problems, working together on group projects, posting videos and visuals, responding to teacher questions and feedback, and exploring the different strategies in solving word problems (Vohra, 2016). One student tweeted, "To make his survey non-biased, he should ask random people in the cafeteria. What do you think?" to which another student responded, "Totally agree. Maybe next time, Arun should equally ask certain members from all the sports teams." Students were also reflecting on their learning such as when one student tweeted, "The cake lesson was a good visual example and made me understand the difference between bias and non-bias" and another student tweeted, "The lesson was very fun to do. I really learned about histograms like that. They have a lot in common with bar graphs." Another student reflected on a test, "The test was pretty simple, still need extra time drawing the graph for the second one though #et 😋😋✏️." Students also independently started using emojis and hashtags in their tweets, such as when a student tweeted, "Great video!!! 😀 Showed how to get a good representation of the population without bias and misleading factors ✏️👍🏼 #igetit #learning."

Students also started to tweet about non-academic related topics such as "When are we getting report cards this year?", "I love pasta, it's the best! #yummy", and "I love pineapples 🍍!" (Vohra, 2016).

The results from Andrade et al. (2012), Domizi (2013), Elavsky et al. (2011), and Tanner et al. (2013) support the findings from this study that Twitter is useful to build community, engagement, and learning. Therefore, the data support the key findings in terms of the central research question that social presence on Twitter had a positive impact on student engagement and learning in a mathematics classroom (Vohra, 2016).

Interpretation of Findings

All three categories of social presence theory (i.e., affective, interactive, and cohesive) were present demonstrating that Twitter had a high degree of social presence. The teacher and students used emojis and hashtags to convey their feelings about the data management activities, such as the bar chart and smiling face emojis and hashtags such as #mathisfun and #IGetIt (Fig. 22.1). They also posted visuals of the daily lessons and videos to support and extend their learning of data management concepts such as central tendency and misleading graphs (Fig. 22.2) (Vohra, 2016). For the interactive component, students responded to each other's tweets, which consisted of homework questions, challenges encountered, and alternate strategies to answer word problems (Fig. 22.3). This allowed students to reflect on their learning, which allowed them to consolidate their learning of data management concepts. There were several occasions when one tweet led to multiple students communicating with each other under one thread, resulting in a network of students learning together (Fig. 22.3) (Vohra, 2016). Students also expressed their appreciation to each other and their teacher on Twitter with the assistance they received with their schoolwork. Due to this, the teacher found students who usually do not work together in class were now working together in the classroom due to their interactions on Twitter. Furthermore, students took on the role of the teacher because they answered each other's questions before the teacher had the opportunity to respond. The cohesive component was evident as students referred to each other by name as well as using pronouns such as "you," "she," and "we." Therefore, all three categories of social presence theory were present, indicating that Twitter had a positive impact on student engagement and learning (Vohra, 2016).

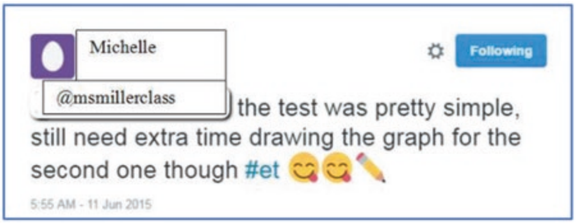

Fig. 22.1 Michelle sharing her thoughts on a quiz (Vohra, 2016)

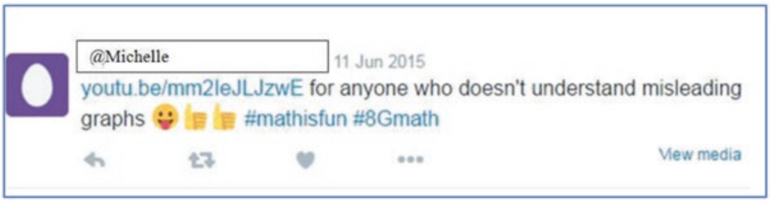

Fig. 22.2 Michelle sharing a YouTube video on misleading graphs (Vohra, 2016)

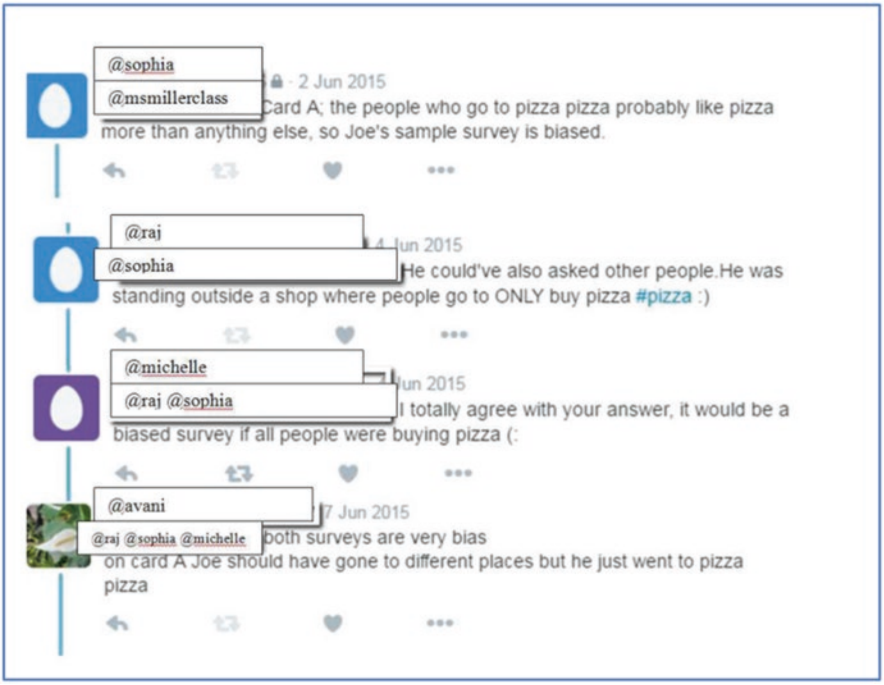

Fig. 22.3 A group of students sharing their thoughts about a sampling scenario (Vohra, 2016)

Implications

The results of this study have several implications for social change. One contribution is enhancing knowledge about how technology tools can impact teaching and learning in education. A tool such as Twitter allows every student to have a voice compared to the classroom where only a few students regularly participate in the classroom since not everybody is comfortable voicing their thoughts in class (Vohra, 2016). Everyone can contribute to a conversation on Twitter leading to a variety of perspectives and opinions that can be analyzed and discussed to enhance learning.

The second implication is enhancing effective teaching practices in mathematics education. Students can communicate with each other after school hours, collaborate on projects, ask questions, seek clarification, reflect on their learning, and receive feedback in order to support their learning. Because students were able to view the work of all their peers on Twitter as opposed to only their group members in class, they were exposed to a variety of strategies and thinking, which developed their understanding of mathematical concepts. Additionally, students were supporting each other in their learning because they were helping each other with homework and participating in discussion threads about sample size, bias, and central tendency. Hence, students were taking control of their learning and forming relationships online (Vohra, 2016).

The third contribution is related to social change. Twitter encourages students to form a network of learners who learn not only from each other but also from Twitter itself, such as using hashtags to conduct research (Vohra, 2016). Even though students in this study were only communicating with each other and their teacher, seeking out professionals according to their subject discipline would allow students to not only communicate with each other but also interact with professionals from the field by asking questions and consolidating their learning, thereby creating an effective personal learning network that spans the globe. Having their own personal learning network and global community of learners would allow students to develop "soft skills" (i.e., teamwork, problem-solving, communicating, leadership, and interpersonal) that goes beyond meeting course expectations. With so much information available to us because of technology, Twitter affords the opportunity for students to discuss, synthesize, brainstorm, and exchange ideas in order to create solutions and make sense of information. In order for this to be as effective and meaningful as possible, students would need to establish effective digital citizenship skills, which can be honed by engaging in Twitter itself.

Future Research

One recommendation for future research is to replicate this study over a longer period of time and using more than one instructional unit in mathematics. A 4-week instructional unit on data management might not represent students' experiences with using Twitter; therefore, conducting a longer study with multiple mathematics concepts might yield different results. Another recommendation is to conduct this research at a different time of the year. This study was conducted near the end of the school year, where students are busy with graduation preparation, final assessments, and preparing for their summer. The timing of the study could have impacted the results; therefore, the use of Twitter could be explored starting at the beginning of the school year. An additional recommendation would be to investigate the use of Twitter in other subject areas. Although mathematics can lend itself to some deep conversations in terms of how problems were solved and the strategies used, subjects such as history and science also lend themselves to stimulating conversation. For example, in history, students might discuss how events unfolded and the missing perspectives of various communities and groups (e.g., First Nations). In science, students can dive into discussions about factors that impact our environment or stem cell research. A fourth recommendation would be to explore how student self-reflection and self-assessment are impacted by the use of Twitter; the results of this study indicated that students were reflecting on their learning when they saw the different ways in which their peers solved problems and when they encountered challenges with data management concepts as reflected in their tweets. Therefore, exploring student self-assessment and self-reflection could be a possible focus for future study. Another recommendation would investigate the impact of Twitter on classroom community building. The teacher and students reported they felt classroom climate was enhanced because of their online interactions; students who normally did not communicate with each other were now interacting because of their use of Twitter. Hence, exploring the use of Twitter and its impact on classroom climate would be beneficial. A sixth recommendation would be to examine the use of Twitter among English language learners to determine the impact on their experiences and identity. Finally, this study was conducted in a location where the socioeconomic status is mid- to high-level; repeating this study in a location where students are from a low socioeconomic status in order to determine if results would be similar would be useful (Vohra, 2016).

Conclusion

The results of this study provide additional proof that social media tools like Twitter can positively impact student learning and engagement. Twitter affords students the ability to build relationships through communicating, collaborating, and interacting with each other online. Furthermore, social media platforms allow every student to have a voice, which includes ESL students and students who are reluctant to participate in a face-to-face classroom. Even though technology has been a focus in recent years in education, social media has not been integrated into teaching and learning even though adolescents are using these platforms for social and personal use. Education and teachers need to embrace these tools for teaching and learning due to their popularity among teenagers so that these students can build their learning networks, enhance classroom community, and communicate and reflect on their learning.

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Chapter 23
Breaking Bad: The Role of Landscape Architecture in Shaping the Future of Higher Education

Ryan A. Hargrove

Introduction

This chapter begins with the acknowledgement that design students must go beyond skill acquisition and develop a unique way of seeing and experiencing the world. Educating future problem solvers involves a balance between finding their creative muse and acquiring the technical skills and expertise to be valued as a professional. In a perfect educational model, these two objectives come together, develop in parallel, and complement one another. However, not everyone as creative thinkers develops in the same way or at the same pace. This journey is far less prescriptive and requires one to look inward to find a creative balance between skilled development and ways to apply it in creative ways. The willingness and ability to do so is not easy for an 18-year-old who is just entering college, nor is it easy even for most individuals regardless of age. Many students come to a university and have to overcome preconceived notions and barriers that have been placed on them since the time they were perhaps the most creative: when they were 5 years old. Many students arrive to college life as teenagers and in a few short years they graduate and reenter the outside world as young professionals. When they enter the profession, their focus is typically not on creative thinking. The system is broken unless the goal is to produce and employ professionals who are utilizing a full spectrum of creativity. The pedagogical approach highlighted in this chapter calls for landscape architecture educators to lead a radical change in education and outlines a roadmap for adopting what may be the ultimate creative challenge of our lifetime: to produce landscape architects who are as creative as they are skilled in their profession.

In this chapter, educators in landscape architecture are challenged to step outside of their traditional role and answer a call to action to innovate in a current education

R. A. Hargrove (✉)
University of Kentucky, Lexington, KY, USA
e-mail: ryan.hargrove@uky.edu

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system that may not fully endorse this perspective. This step would extend beyond the built environment, and require landscape architects to look inward and share a more creative approach in seeing and experiencing the world. This proclamation is based on the realization that landscape architects are uniquely qualified to transform the model of education in the United States (Berk, 2016; Davis, 2017). Landscape architects can become agents of change on a much larger and impactful scale, helping shape the creative capacity of the next generation.

Did You Say Landscape Architecture?

It has always been important for students to be technically prepared and professionally competent. However, the future requires a very different kind of person with a very unique skill set (Florida, 2002; Hawkins, 2001). We are now a part of a new world in which creative thinking is essential (Pink, 2006). Developing an understanding of creative processes can help to extend beyond the predictable outcomes to create new, more innovative solutions to problems. Today's decision makers must use a variety of thinking styles, methodologies, and creative processes. They must learn to leverage their unique perspectives that use tools and techniques that are based on cutting-edge research.

If the goal is to develop students who are able to express a higher level of creativity, then educators must link educational activities to existing research in learning theory and metacognition and develop approaches to learning that more effectively enhance creativity (Sawyer, 2015). These approaches to learning must go beyond those of the past with iteration and reflection as essential parts of the process. This will enable us to go beyond teaching the way we were taught, to understand why some strategies work and some do not, and to find new approaches that will develop creativity in all of our students.

Design education is built upon the development of creative problem solving, a skill that is largely absent in much of current K-12 educational enterprises (Davis, 2010a, 2010b; Wagner, 2012). The iterative process of discovery is fundamental to how designers solve problems and ultimately engage in issue resolution. Landscape architect educators in particular are trained to teach their students to serve as mediators, communicators, and empathizers—all skills identified as essential to creative mastery (Brown, 2009; IDEO, 2015). They acquire a fundamental understanding of the creative process and establish a shared language across many disciplines and ways of thinking. Furthermore, fostering the ability to see the world with fresh eyes and understand how to frame problems is essential to ensuring that future generations are equipped with the same creative capacity to thrive (Dorst & Cross, 2001; Horowitz, 2014). The interplay of divergent and convergent thinking throughout the phases of planning, guidance, modeling, and evaluation must all be part of even the most ambitious and challenging design problems (Brown & Kuratko, 2015).

This chapter is a call for landscape architects to accept the challenge of helping build a culture equipped to collectively innovate. In addition, this chapter will highlight a collection of projects led by landscape architecture faculty, professionals, and students. These projects demonstrate the power landscape architects possess when moved to respond to this call for action. Each example highlights the tremendous impact landscape architects can have in the effort to reimagine education at all levels. Projects range from middle and high school levels all the way through higher education and address the role of designers across various modes of engagement. For example, one project challenges middle and high school students to design and implement a new curriculum in their school based on design thinking principles. Another project focuses on collaborating with administrators at the university level to establish a curricular enhancement plan built around creativity as an immersive experience. It is hoped that all case studies presented represent a model upon which a larger effort can build to effect change at all levels of education.

LA 111: Living on the Right Side of the Brain

The following collection of projects was all heavily influenced by a course developed at the University of Kentucky entitled *LA 111: Living on the Right Side of the Brain*. This course challenges students to explore their creative thinking process through the framework of metacognition, thinking about thinking. The course was originally conceptualized and offered to landscape architecture students as an elective to supplement their studio curriculum. Several years ago when the university implemented a new general education core curriculum, this course was chosen to serve as one of the first offerings in the Creativity Inquiry category. This shift opened the course to a countless number of students across campus who would never have been exposed to the concept.

The goal of this course is for students to gain an understanding and awareness of creative strategies that may be used in future problem solving. These strategies help encourage creative thinking that leads to more innovative and novel solutions. Students practice a metacognitive approach by reflecting on their own thinking in an effort to enhance self-regulation and ultimately realize creative potential.

There are six major learning outcomes included for students participating in this course:

- To be able to appreciate the influence of personal experiences on the creative process.
- To successfully outline their creative process from early awareness and conceptualization to a more detailed realization.
- To evaluate various creative thinking strategies in relation to problem solving, select a path of action, and justify their choice.
- Be adept at understanding the relationship between cognitive choices and personally or collectively held values.
- Be comfortable documenting their personal approach to the creative process.

- Be capable of applying the ongoing design and realization of their creative process to not only their entire educational experience but more broadly to their daily lives.

Students are exposed to modes of thinking, including the discovery, application, integration, and the sharing of knowledge. This is accomplished in lecture format, discussion sessions, and a variety of contemplation exercises. The latter are assigned requiring writing enhanced with supplementary diagrams, sketches, and photos. While asking students to reflect on content introduced throughout the semester, these exercises are intended to externalize, articulate, and chronicle the development of students' creative process. The five reflective exercises include the following subjects: Creative Self, Creative Making, Creative Reflection, Creative Search, and Creative Lessons Learned.

An essential aspect of students' reaching their creative potential is learning through experience (Kolb, 1984; Moon, 2004). Therefore, in addition to the assigned exercises and activities, part of this class involves requiring students to post and comment on the class blog. There are two different types of activities on the blog. The first activity involves reading responses. Students are required to participate as an author on a weekly basis. The blog serves as a forum for reading discussions and allows for the sharing of ideas. Ultimately this fosters discussion of various topics related to this course and beyond. The second is response to the weekly Chatter lecture series. Chatter promotes interaction and reflection with a collection of creative professionals who serve as guests throughout the semester. These interactions focus on each individual and the role creativity has had in their past, present, and will have in their future lives. Students are asked to post reflections/responses on the blog in an effort to broaden their perspective on the creative process.

Finally, students' work throughout the semester on a comprehensive thinking exercise entitled the "Design Thought Model." This project is intended to provide students some scaffolding in the construction of a personal creative process. Students' creative and metacognitive thinking is assessed through this final design project for the course. In this summative, performance-based project students are required to construct a three-dimensional personal philosophy of their creative process (Fig. 23.1). The project is non-discipline-specific in nature and places an emphasis on the awareness and understanding of one's personal creative thought processes. The project guidelines are provided at the beginning of the semester to allow students the duration of the semester to consider their response. The process requires students to first provide a written summary of their design process during the semester. Next, they transform their written explanation into a three-dimensional expression of their philosophy. Last, at the end of the semester, an exhibit is held in which students are required to present to neutral judges how their philosophy is represented in their model. Giving students the opportunity to create a physical artifact affords them the opportunity to externalize the cognitive processes of creative problem solving.

Students are also responsible for attendance and participation in weekly workshop sessions, first participating in hands-on problem-solving activities and then

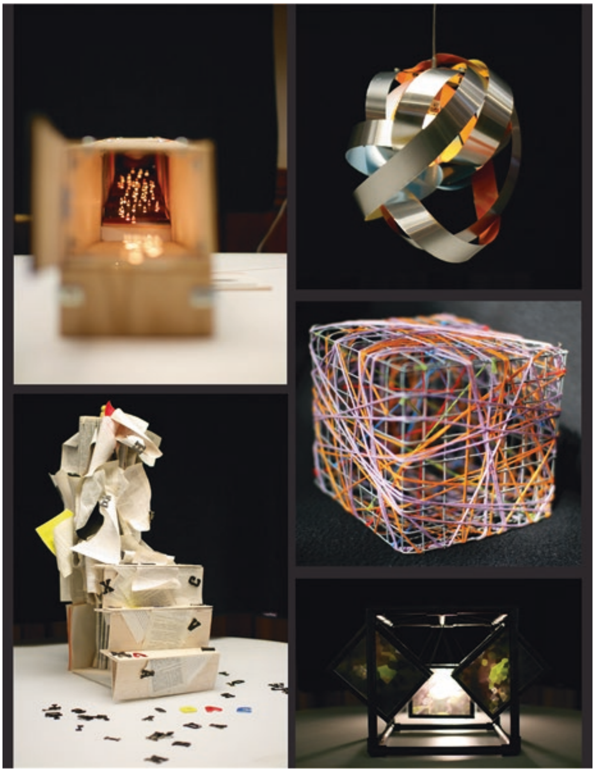

Fig. 23.1 Example of various Design Thought Models

sharing their experiences/observations relating to creative strategy use. By expressing their own creative strategy use, students are forced to externalize a process that is typically internal and are consciously building a greater understanding of their creative process. This expression of process will not only benefit them, but fellow students will be able to compare and contrast different approaches to problem solving, ultimately gaining a broader perspective through shared insight and reflection.

The Creative Study Tour

One of the projects that evolved from the LA 111 course is an experience called The Creative Study Tour. Born out of the overwhelming positive impact of the Chatter Series lectures, this project was conceived as the next step, seeking creative insight and perspective from leading designers across the country. Led by a landscape architecture educator, this experience provides small groups of students who are the first generation of their family to attend college the opportunity to travel and interact with various creative professionals. Through the support of the University of Kentucky First Scholar Program, past trips have included Louisville, Nashville, St. Louis, Chicago, Indianapolis, New York City, and many others. The group typically consists of only six to eight students to allow for interactions to happen in a very personal way. The meetings are typically informal and explore the themes of person, place, and story. Usually the interactions occur in a meaningful space; a studio for an artist, kitchen for a chef, building being constructed for an architect, library for a children's book author, etc. Discussions are generally interactive and at times revealing on many levels. Basic subjects relative to a participant's story, their current work, lessons they have learned about their creative process, etc., are all common elements, but often the discussion opens a window into their creative spirit and way of being.

Each year a trip is planned around multiple stops with a collection of participants (graphic designers, landscape architects, children's book authors, chefs, singer/songwriters, architects, illustrators, fashion designers, and many more). As the Creative Study Tour has evolved so has the documentation component. The first two trips were captured through books detailing students' reflections. Three years ago, a videographer was hired to follow the group and capture the experience with student narration. In addition, students were asked to record audio after each stop in an effort to capture their reflections in the moment. The past 2 years have focused on trips to New York City and included artist Veronica Lawlor documenting the entire trip through a series of illustrations (Fig. 23.2). These reportage style illustrations help capture the dialogue and emotion of the encounters between students and professionals. They include a beautiful melding of reflective and instructive content from both students and professionals. Finally, it is important to emphasize just how transformative these trips are for everyone involved. The more than 50 students who have participated in the tours identified this experience as one of the most influential in not only their academic careers but their lives. Perhaps the greatest impact is simply building students' creative confidence as they recognize the shared experience of all who engage in creative problem solving.

Gear Up Kentucky

In 2017, an opportunity arose following the success of LA 111 and the Creative Study Tour to impact a younger demographic across the state of Kentucky. Gear Up Kentucky was a six-year grant program funded by the U.S. Department of Education from 2011 to 2017. The program served 29 middle schools and their corresponding high schools in the state of Kentucky. Students who attended a Gear Up school and entered the seventh grade in 2011, 2012, or 2013 were Gear Up Kentucky students. The program provided services for students beginning in seventh grade continuing until at least 2017. One of these services was the Summer Academy offered during students' junior and senior years of high school. These immersive experiences were offered in partnership with universities across the state of Kentucky in order to best prepare students for college and career readiness.

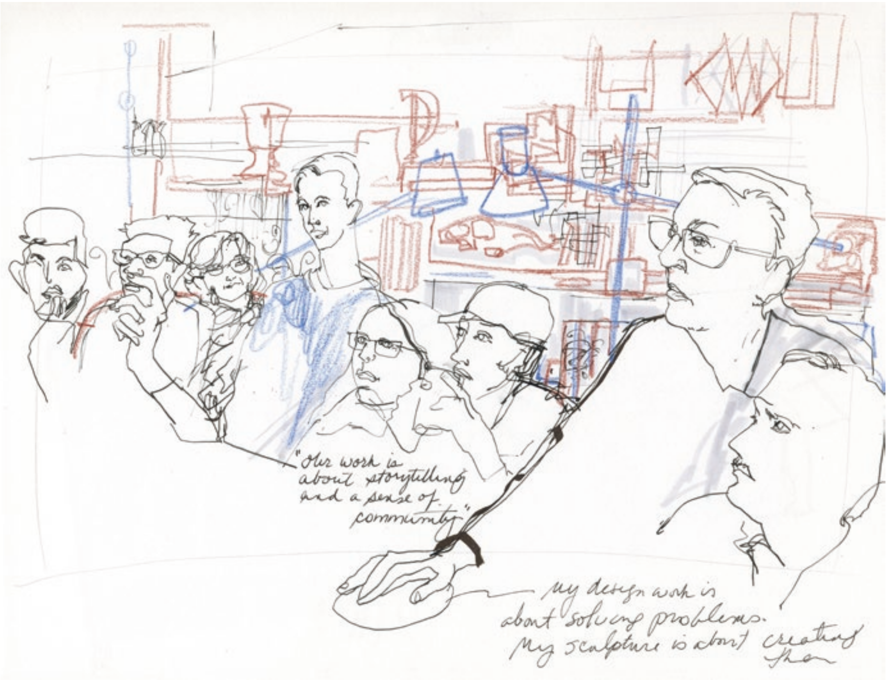

Fig. 23.2 Illustration capturing an interaction between students and a professional during the 2017 Creative Study Tour

The 2017 Summer Academy at the University of Kentucky shifted from previous iterations and focused on developing students' creative thinking capacity. A four-week deep dive was designed and led by landscape architecture instructors and students to foster creative growth through the framework first established in LA 111 and The Creative Study Tour. With an emphasis on self-reflection, experiential problem solving, and interaction with a diverse group of creative professionals the Summer Academy became a wonderful laboratory in pursuit of creative knowledge relative to both problem solving and pedagogy (Fig. 23.3). During the 2017 Summer Academy, 22 high school students and their instructors engaged in an immersive creative problem-solving experience designed to investigate the future of education programs like Gear Up in Kentucky and generate innovative pathways moving forward. For these 4 weeks, students were introduced to a new way of thinking, The Creative Process.

Of particular importance is the role landscape architecture faculty and students played in stepping outside of their traditional role in both designing and leading this experience to high school students. Landscape architecture students and subsequently the participating high school students helped reimagine education at all levels and across various modes of engagement. This project and others represent a model upon which a larger effort can build to effect change in education.

Fig. 23.3 Working with Gear Up students to pitch their creative solutions

Into the Fog

The third project to be highlighted was most recently completed and represents a collection of all that was learned in the previous examples. *Into the Fog* worked closely with a multidisciplinary student team from the University of Kentucky and Vanderbilt University to explore ways to foster individual and team creative growth. Together the team focused their efforts on (1) solving a design challenge "How might institutions of higher education develop creative problem solving through immersive educational experiences?" and (2) creative process documentation of the entire project. This documentation was collected throughout the semester through a variety of digital mediums and shared on the project webpage. In addition, a series of exhibition boards were created as a final project deliverable that directly addressed the original challenge question.

This project is worthy of recognition, as it provides a window into how any creative individual might pursue their own creative growth by stepping *Into the Fog*. This project was conceptualized by a landscape architecture faculty member and executed by a landscape architecture student as a part of their senior project. By their very nature landscape architects must be creative in their professional pursuits. However, this project offers a framework for any student seeking to develop proficiency at solving creative problems and does so through the exploration of self.

The purpose of this project was to illuminate three foundational beliefs regarding creativity and personal growth. One, everyone is creative. It is a learned competence, defined broadly, realized differently for each person (Runco, 2004). Two,

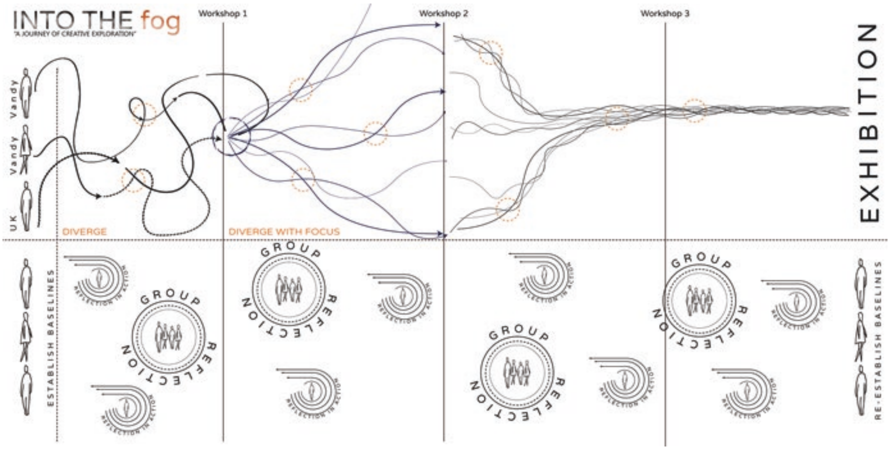

Fig. 23.4 Outline of the Into the Fog project highlighting the interplay of production and reflection

there is tremendous value in seeking and fostering a personal creative process. Three, the act of developing the creative process while at the same time reflecting-in-action is the most valuable component of growth (Schön, 1983). Immersion into a creative problem state and the act of reflection is ultimately how you grow as a creative individual (Hansen, 2008; Mainemelis, Boyatzis, & Kolb, 2002). As a result of the exploration, the team was able to provide a detailed solution to the challenge question. This served as a plan of action for Vanderbilt University, which is currently undergoing curriculum restructuring geared toward providing students opportunities for creative immersion.

The nature of this project is complex in that it not only sought to find a creative solution to a challenge question but also layered in a reflection-in-action component to promote personal growth and creative development (Fig. 23.4). The project needed a way to not only capture but share these two threads across the spectrum of the entire project. Starting from a blank slate and designing a web platform was the best option to not only ensure clarity but also disseminate the work to a broad audience. Into the Fog was a four-month challenge aimed at answering one question. The project asked its participants to reflect on their journey. Individual daily and weekly reflections took the form of various written, audio, and video presentations. Video blog reflections were posted in the Reflection-in-action section of the project Website.

Into the Fog was strategically phased into five parts: Research, Ideas, Refinement, Exhibition, and Impact. Participants actively contributed to each phase by documenting their journey along the way, enhancing their understanding of the problem at hand, and ultimately discovering both viable solutions and themselves. In summary, the Website serves to provide a broad look into the entire process including all aspects of the personal reflective journey and the challenge question. It serves as both an information hub and a resource for future journeys.

Integral to this problem-based learning project was an intense process of reflection with documentation of personal discovery and growth and how this shared process was negotiated across team members in various geographic locations. This project explored a better understanding of how students negotiate a creative process both individually and collectively. As a pilot project, Into the Fog had a tremendous impact on the students, faculty, and universities involved; however, the framework established through this model has the potential to impact educators and students at various levels across the world. The hope remains that Into the Fog becomes a catalyst, not only for designers, but also for any individual seeking a greater understanding of themselves and the world around them.

Looking Back

Some overarching conclusions relative to these highlighted projects can be made. First, these experiences examined the role of reflective practice on creative skill development. Reflective practice has been found to be one of the missing pieces that prevent most of us from reaching our creative potential (Feldhusen, 1995; Hargrove, 2012; Pesut, 1990). In my experience, this ideally should take place throughout the problem-solving process, including pre, post, and most importantly reflection-in-action. Second, these projects used multiple approaches to develop a flexible creative process. The approach to problem solving is not fixed and develops over time through self-reflection and self-regulation (Jausovec, 1994). I have found that building this fluidity in students' creative process is far more challenging than providing the creative skills to be successful. Third, the experiences were grounded in a belief that places value on preparing students (future professionals) as creative problem solvers. Participant educators valued the role students had in solving and leading transformational change. They focused on developing students who will eventually help solve the most challenging issues facing our cities, regions, and the rest of the world (Juul-Sorensen, 2014). I have found the creative leadership piece to be essential in not only providing the skills and experience to solve problems but the capacity to lead others in finding the ability and confidence to do the same. Fourth, these projects began with a foundation of learning the power of self-awareness in realizing creative potential. Perhaps the greatest skill a person can have is self-awareness. Building an awareness and understanding of how one thinks provided the groundwork for future growth (Hargrove & Nietfeld, 2015). Throughout these projects, I have found it alarming how unaware students seemed to be of such a personal process. Fifth, these experiences developed an appreciation for experiential lifelong learning. The development of creative thinking is not a list of items on a checklist. It requires a holistic approach to the way we see and experience the world (Sawyer, 2003; Sawyer, 2015). It my view this requires students to actively engage real-world problems and propose solutions based on not just ideation but articulation, prototyping, and testing. Thus, all creative problem solving begins with the dance of life.

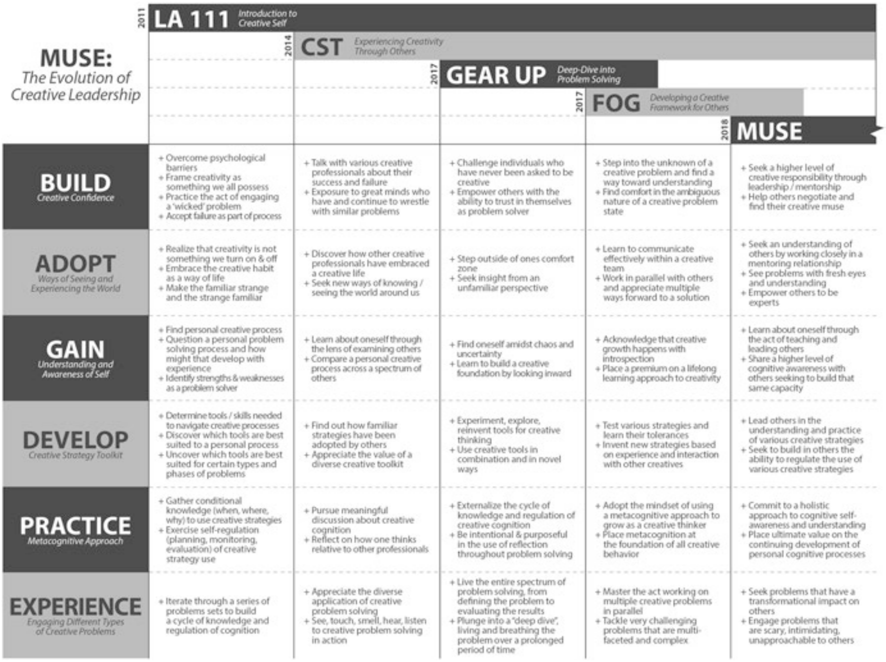

Fig. 23.5 Evolution of the work leading to the Muse project

Moving Forward

This chapter describes how landscape architecture educators have embraced the challenge to shape the future of higher education at the University of Kentucky with the hope that it will serve as an example for other institutions to follow. A response to this call may take many forms and levels of involvement. Therefore, in continuing the progression of experiences highlighted in this chapter, this final example is provided to first show that one such commitment is possible and second that ultimately this goal will be achieved through action in a continuous cycle of refinement. This timely and comprehensive initiative that was directed by a single landscape architecture educator at one university was ambitious but was well positioned to be successful. The goal is for this program to grow into a more permanent fixture at the University of Kentucky and become a more commonly followed model across the country.

Beginning in the fall 2018 semester at the University of Kentucky, a cohort of landscape architecture students and faculty will pilot a program that engages students across undergraduate and graduate education in creative problem solving with a focus on fostering creative leadership. As shown in Fig. 23.5, the newly launched program, titled Muse, borrows from all of the previous experiences outlined in this chapter while attempting to create a truly immersive experience aimed at elevating students into creative agents of change. It will ask senior undergraduate students in landscape architecture to lead diverse groups of freshman students enrolled in LA 111 through the beginning stages of creative inquiry before transitioning into a second semester involving the latter stages of prototyping and testing with stakeholders and professional partners. In this model, the landscape architecture students are developing skills as leaders in creative problem solving through the engagement, teaching, and reflection with less experienced students. They will then be challenged to develop these ideas, insight, and experiences into real solutions and test each in collaboration with various communities of interest. This model is proposed as a vital step for students post undergrad to acquire expertise in creative leadership through a collective deep dive into a complex problem. It is the experience of working in a leadership capacity, negotiating the problem while helping others find their creative muse that will equip them to fill a void so desperately needed throughout our world. The impact of the lone creative genius is insignificant compared to the capacity to foster in others the ability to see and experience the world through a creative lens.

This pilot model will include a two-semester experience that begins with landscape architecture students serving in a leadership capacity and transitions into vertical creative studio with these landscape architecture students being assisted by graduate students from various disciplines, community and industry partners, and high school students seeking college credit. This team will seek to test, prototype, and model potential solutions before proposing a final action plan and helping stakeholders launch the solution into action. At the end of this pilot period, the program will be evaluated and modified for university approval as a permanent certification or degree.

By building off of the previous experiences, this model incorporates aspects that help foster creative thinking while adding the critical piece of leadership. It is this last piece that elevates the student into a position of influence and action and promotes the notion of creative problem solving as a foundation to higher education. The goal is that responses to this call for action, such as this program, will empower other educators in landscape architecture to seek opportunities to influence. And in doing so build a network of experiences aimed at illuminating complex problems and elevating students with the capacity for transformative change.

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Chapter 24
Creating a Rubric to Support the Development of Authentic Learning Experiences

Annette McNamara and Jennifer Englund

Introduction

Learning spaces in higher education often reside within walled gardens. Instructors and students may bring content, such as current events, news stories, or personal experiences into the learning space to stimulate discussions or formal assignments, but often course content is produced for, and lives within, the context of a course or an academic program. In an authentic learning environment, students' perspectives, voices, or their student-produced work would also travel in the other direction—to be shared beyond the learning space and into the larger world. One characteristic of authentic learning is that students demonstrate their knowledge and skills through activities that have relevance to real world problems—problems that are ill-defined, complex, and provide opportunities to examine and address the task from multiple perspectives, collaborate, reflect on their learning, and integrate their knowledge in a variety of ways (Oliver, Herrington, Herrington, & Reeves, 2007). While a number of existing frameworks and models explain the characteristics of authentic learning environments, they can be challenging for instructors and instructional designers (IDs) to apply in concrete, specific ways. To fill this gap, this chapter outlines the creation of a rubric for IDs to use in developing authentic learning experiences during the course design process. This rubric draws upon elements of two frameworks—Student as Producer and Social Pedagogies.

A. McNamara (✉) · J. Englund
University of Minnesota, Minneapolis, MN, USA
e-mail: amcnamar@umn.edu

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Background

Our Roles

The authors are colleagues on a higher education team that provides instructional design, development, and project management services to instructors from various disciplines across the five campuses of our institution. As we worked together, we saw commonalities in how we approached instructional design projects, specifically those projects in which the instructor seemed open to creating authentic, open-ended, collaborative learning experiences for students. We found that we shared similar philosophies of instructional design, education, and teaching and learning. This realization prompted us to explore course design frameworks and look for those that seemed to best fit our philosophies.

Below, each author shares her design philosophy as illustrated by the course design project that sparked the idea for this chapter. While these philosophies are provided as background for our desire to contribute to the practice of developing authentic learning experiences during a course design process, we realize that the design philosophies of others may differ. The rubric we seek to create might not be universally useful to all instructors and IDs, nor in all settings.

Design Philosophy: Annette I have long been interested in student-created learning "artifacts" (authentic, real-life evidence of learning) that are shared with an authentic audience; for example, an assessment requiring learners to create a marketing plan for an existing company, after which members of that company are asked to provide feedback. I am also interested in how narratives or stories fit into the educational experience to help create an authentic, meaningful context for content. When the following request came to our team of academic technologists and IDs, I quickly contacted this instructor to learn more:

> I'd like guidance in ways to keep learners engaged while they are off campus for several weeks during an externship in wildlife care and handling. My initial thought is a 3 minute digital story presented weekly. That could be posted to Canvas. All students will be with me on campus for the first seven weeks of spring semester so we would have time to learn about and practice technology.

First, the instructor and I considered: What were the assignment *goals*? Who were the learners; what was their impetus for being *engaged* in the course? How did he define *digital story*? Who would the *audience* be for the digital stories?

Next, we discussed various solutions:

1. Each learner creates a portfolio of their digital stories, which is shared with the class, and also shared beyond the class timeframe and with a broader public audience.
2. The course curriculum addresses the basics of media literacy as related to their digital stories.
3. Learners choose their own topics for their digital stories.

4. Learning assessments include both peer-review and instructor-review of the projects.
5. Technology tools could either be left open to student choice, or could be limited to minimize student confusion with the technology.

Collaboratively, we identified project goals:

1. Learners will create original works, authentic to their externship sites.
2. Their audience will be each other, as there was no easily identifiable external audience.
3. Projects will demonstrate appropriate media literacy practices (including locating and citing reliable sources and Creative Commons licensing).
4. Media tools will be pre-selected for learners based on basic functionality and ease of use.

Finally, we created a brief, seven-week curriculum that included media literacy, story design/storyboarding, and media tool skills and training; peer reviews were implemented at each step. Based on the project goals, we decided that sharing the students' work outside of the class audience was not appropriate at this time.

As previously mentioned, I value the creation of learning artifacts, authentic assessments and audiences, and integrating narratives or stories into the educational experience. This value is not universal, of course. The value I place on these elements might not be appropriate for every educational setting or every instructor. Working on this project revived my longtime questions: How do instructors and instructional designers value authenticity in assessments and audiences? Can that value be measured? If authenticity is considered to be effective for meaningful learning, how can we help achieve authenticity incrementally by determining an *appropriate* level of authenticity for the learners, the instructor/s, and the subject matter and level?

Design Philosophy: Jennifer As a course designer, a primary component of my design philosophy is to integrate student-centered learning experiences and assessments at all levels of the course. I am particularly excited to work with instructors who have similar teaching philosophies. Our team received the following message from an instructor:

> I am looking to add a component to my class this fall where students create a website.

I was curious to connect with the instructor and explore what she had in mind. After she provided the course syllabus and related materials, I read through them prior to our initial meeting. One of the learning outcomes was for students to be able to read and interpret findings from evidence-based literature based on a rubric for a lay audience. Development of web literacy skills, such as website creation, was not explicitly listed. During our initial meeting we discussed this dynamic and developed a class project that showcased students' capabilities to interpret findings from the literature on a public-facing platform.

The elements of the class project included:

1. In groups, students would select a topic and choose one article from a teacher-curated list of evidence-based articles.
2. They would read the article and complete a module to understand how to develop an appropriate summary.
3. Students would write the summary and group members would review it.
4. After revising their summaries, students would enter details about it in an electronic form.
5. The information gathered from the form would be used to populate the public-facing website. Due to the compressed frame of the course, the instructor elected to handle this component.

After the semester concluded, the instructor finished posting the final summaries to the public website. Working with the instructor on this project and observing her desire for students to create authentic resources for an external audience prompted me to think through my approach to course design. Similar to Campbell (2015), I also view the process of designing "...as process-based, relational, and transformative" (p. 233). A key component of my design philosophy is to implement small-scale transformations for each course that I co-design with instructors. Small-scale transformations look differently for each course, as each course has a unique instructor with unique students. It can oftentimes be challenging for me to describe what a small change would be at an abstract level, and it can be challenging for instructors to envision what a small change looks like for their discipline and context. To help with that, I searched for frameworks and models that meshed with my design philosophy and that could serve as a roadmap for future projects.

Review of Frameworks

Scholars in the field of educational technology have written extensively about the importance of practitioners understanding how their values and beliefs influence their selection of frameworks, models, and design decisions (Jonassen, 1996; Soloman, 2000). A common exercise for IDs-in-training is the creation of an instructional design philosophy. This philosophy is based on personal beliefs and values; it defines what we deem to be important and consequently guides and directs our behavior. As we progress throughout our careers, it is important to continuously reflect on our design philosophy and articulate it as we recognize that we have a specific philosophy from which we are operating and "...an awareness of the values that are inscribed into the artifacts and experiences designers create" (Gray & Boling, 2016). We draw attention to this as the two frameworks (Social Pedagogies and Student as Producer) used as the basis for rubric development were intentionally chosen in accordance with our design philosophies.

Student as Producer

The working definition of the Student as Producer model is "...a fundamental principle of curriculum design whereby students learn primarily by engagement in real research projects, or projects which replicate the process of research in their discipline. Engagement is created through active collaboration amongst and between students and academics" (Neary, Saunders, Hagyard, & Derricott, 2010, p. 8). Learners are not simply consuming information and knowledge, but rather are taking part and contributing to the production of information and knowledge. As Neary (2010) states, the focus broadens from learning outcomes to learning outputs, and "...learning outputs build on learning outcomes by recognizing the importance of creativity and originality in student work. Learning outputs encourage students to develop their own critical insights and understandings through interactions with teachers" (p. 15). The Student as Producer framework (Neary, Saunders, Hagyard, & Derricott, 2010) has eight components, which are outlined and summarized in Appendix A.

In order to create these learning outputs, the learning goals and processes may need to be revised. New learning standards may need to be addressed in our learning experiences; for example, the incorporation of these twenty-first Century Learning and Innovation Skills: Creativity and Innovation, Critical Thinking and Problem Solving, Communication, and Collaboration (Battelle for Kids, 2019). As a result, instructors may be concerned by losing time for "content" as new standards are incorporated. If the definition of content is broadened, and considerations are taken to use the most authentic content possible, it may be necessary to move away from self-produced lecture content and toward the re-use of existing or open content. Learning activities may also shift as students move toward an active role in producing their own learning through synthesizing, problem solving, and creating their own meaningful outputs.

In sum, Neary (2010) suggests that institutions ask themselves how "... their programmes enable students to see themselves as subjects rather than objects of history and to recognise themselves in a world of their own design" (p. 14). Based on this, we characterize the framework with the term "agency," defined as *the capacity, condition, or state of acting or of exerting power* (Merriam-Webster, 2020).

Social Pedagogies

Social Pedagogies are design approaches for teaching and learning that connect students with an authentic audience (other than the course instructor), which allows them to share their knowledge constructed in the course (Bass & Elmendorf, 2011). By connecting with an authentic audience, students increase their understanding of course content. The Social Pedagogies framework includes five elements: Task, process, communication, assessment, and integration, which are outlined and summarized in Appendix B. It places strong emphasis on the social dimensions of learning and seeks to make visible the learning traits that emerge from authentic learning situations. Specifically, the framework emphasizes the ability of learners to use knowledge in fluid and shifting contexts, transfer knowledge to new situations, and function in environments with uncertainty. These learning traits are often not clearly represented in course design and assessment. To make them apparent, intentional choices by instructors or course designers need to be made. The Social Pedagogies framework is thus an effort to help these groups consider the design elements and goals of the course in order to make authentic learning experience visible.

Social Pedagogies build on the authentic learning model developed by Oliver, Herrington, Herrington, & Reeves (2007) and extend it in a key way: Through the addition of the communication or social element. This element recognizes the impact that social media, participatory culture, and networked information have had on education, while also acknowledging that educators, designers, and educational institutions do not fully understand all of the emerging impacts.

Bass & Elmendorf (2011) repeatedly return to the concept of authenticity in each of the components of their framework: Engaging with authenticity, authentic audiences, authentic learning, authentic tasks, and authentic learning activities. Based on this expressed importance, we characterize the Social Pedagogies framework with the term "authenticity." They do not explicitly define the term at a high level in their work. However, Greenfield, Finch, & Margarita Johnson (2017) in their application of the Social Pedagogies framework in language learners define authenticity as "...learning objects that are produced, curated, and consumed by students" and learning resources that "...represent a student's authentic communication to an authentic audience" (p. 169). This definition of authenticity is used for this chapter.

Creation of the Rubric

From our combined experience as higher education professionals, we acknowledge that change in higher education is often incremental and iterative. While the ideas that underpin the Students as Producers and Social Pedagogies frameworks are well-established in the literature on teaching and learning (Freire, 1970; Jenkins et al., 2009; Vygotsky, 1986), they also present tensions with the instructional practices in higher education. Traditional instructional practices were teacher-centered; as the literature around teaching and learning shifted to learner-centered approaches, instructional practices have not followed at the same pace (Bransford, Brown, & Cocking, 2000). In addition, the system of rewards in higher education does not place equal value on the teaching outputs of instructors as compared to their research outputs (Boyer Commission, 1998). "Higher education places a high premium on originality, whereas adapting or improving another's educational materials is rarely understood to be a creative, valuable contribution" (Iiyoshi & Kumar, 2008, p. 432).

To help facilitate a move toward increasingly learner-centered teaching approaches, IDs and instructors often need to deconstruct dense, complex instructional theories into manageable, concrete steps to improve our own perceptions and practice. As Wilson (2018) noted, "… every instructional theory is seriously underspecified - that is, it doesn't really tell you everything you need to design a lesson based on that theory. [They] are necessarily abstract and general, leaving so much to real-life teams and individuals" (p. 66). In our case, both the Students as Producers and Social Pedagogies frameworks offer clear benefits to student learning through their authentic learning and assessment strategies, but since the information presented in them is at an abstract level, the frameworks are difficult to apply in practice.

Although the Social Pedagogies framework has been applied in different learning contexts from e-Portfolios to study abroad to second language acquisition (Bhika, Francis, & Miller, 2013; Greenfield, Finch, & Margarita, Johnson, 2017; Hubbard et al., 2017; Warner & Richardson, 2017), it still requires an additional level of interpretation for use in the varied contexts that IDs working in higher education often find themselves. The Student as Producer framework has been applied in numerous contexts and is well-documented in its approach (Neary, Saunders, Hagyard, & Derricott, 2010). However, as it was applied to a wide-range of contexts, it has grown into a comprehensive, robust framework that can be overwhelming for those who wish to apply it in their course design work.

While we found value in both frameworks, we wanted to see them taken a step further. We did not find specific, action-oriented steps to help break down the frameworks and apply them on a small-scale to course design projects. With this gap identified, a question emerged: How could these frameworks be adapted for use in faculty development, curriculum planning, and course design for an audience of IDs and instructors? We decided to create our own set of rubrics: One rubric for each framework. Each rubric was comprised of categories based on each of the framework's components: The Students as Producers framework yielded eight categories, and the Social Pedagogies framework yielded five categories. Each category contained three sets of criteria. The criteria were developed from the frameworks' implementation projects, as described in Bass (2014), Bhika, Francis, & Miller (2013), Greenfield, Finch, & Margarita Johnson (2017), Neary, Saunders, Hagyard, & Derricott (2010), and Warner & Richardson (2017). The rubrics were designed for two primary uses: (1) to allow instructors to evaluate their own teaching and learning approaches and to serve as a guide in setting small, achievable goals toward increasing authenticity and/or agency and (2) to allow IDs to use the rubrics with instructors during design consultations in order to raise awareness about authenticity and agency and provide concrete steps toward changes in course design. The initial rubrics can be viewed on the OER Commons (Englund & McNamara, 2018).

Gathering Practitioner Feedback

As our goals for the rubric were to help increase agency and authenticity in learning experiences, and also to be useful to IDs in their work, it was important to gather feedback from practitioners who were in a position to use the rubric. The following section will describe how we gathered feedback from IDs during interview sessions, which resulted in substantial edits to the initial rubrics. While IDs found value in using the rubrics in the initial format, they recommended changes and asked questions that prompted rubric revisions.

In July and August 2018, after going through the IRB process, the initial rubrics and supporting frameworks were presented to instructional designers with a range of professional experience and disciplinary backgrounds. The designers were then invited to take part in an interview session with the authors. Five IDs agreed to participate. The interview sessions followed a semi-structured interview protocol and included questions that elicited feedback about the rubrics' format and content and suggestions for revisions. Participants shared their thoughts regarding the benefits and challenges that might arise when using the rubrics in their own work.

During each session, one author facilitated and the other took notes and observed. The sessions were recorded and transcribed by the authors. After the interview sessions, we began the coding process. It followed two stages—first cycle and second cycle coding. For the first cycle, each author individually generated descriptive and in vivo codes for each interview. After the first cycle, we discussed our coding process and the codes that we created. The discussion paved the way for the second cycle of pattern codes and themes generation (Miles, Huberman, & Saldaňa, 2014). Our second cycle of coding yielded the following themes: Overall implications for rubric use and two major areas of revisions.

Feedback and Suggestions

Results from the focus group interviews were categorized and summarized as follows:

Overall Implications for Rubric Use

Benefits When IDs were asked about potential benefits and challenges of using the rubrics in their own work, the overall reaction was positive. Participants seemed familiar with the concepts of agency and authenticity, and for the most part placed value on these concepts in their work with instructors. One participant indicated that she would definitely use the rubrics with instructors as they are thinking about creating their course and how they are going to deliver and assess their content. Another said the rubrics could be used to provide clarity on how to develop new learning goals. As such, the rubrics were viewed as a concrete guide to help change practice and facilitate greater authenticity and agency in course design projects.

During an instructional design consultation, it can be challenging for an ID to move the conversation from a simple, technical question to a more meaningful pedagogical conversation about authentic learning. Perhaps instructors do not necessarily believe that authentic learning is effective, or they simply have not been exposed to the idea before. One participant indicated that rubrics based on peer-reviewed research and the inclusion of specific criteria could help lend legitimacy to instructional practices that may otherwise be passed-over.

Participants identified specific ways in which the rubrics might be helpful in their work with instructors. For example, they could be used to facilitate conversations with instructors about their use of authenticity and agency, both in current practice and to help set goals for future practice. Additionally, the rubrics could be used to provide guidance to graduate Teaching Assistants (TAs) or new instructors. As they begin their teaching journeys, these populations are often highly motivated to spend time exploring best practices and effective strategies.

Challenges Participants identified challenges in using the rubrics; a frequently mentioned barrier to instructional change was simply a lack of time and motivation. One participant noted that, in her experience, most instructors want to be effective in facilitating student learning, but oftentimes they simply run out of time to make substantial changes. A rubric might provide inspiration or concrete action steps for change, but it will not necessarily create the time needed to implement that change.

Participants also mentioned challenges related to implementing the rubrics in the situational context of an ID's job. Instructional design work is highly dependent on factors that vary greatly between multiple projects, and sometimes even within a single project. For example, instructional change can often be facilitated by a strong relationship between an instructor and an ID, but oftentimes the luxury of developing that relationship over time is not an option. One participant mentioned that she will typically see instructors one time per year (often in the fall), when they are preparing to teach again after summer break. Second, instructors might request assistance on any number of topics from instructional practices to technology use, or anything in between. There seemed to be a general acknowledgement that while the rubrics may be helpful tools to assist IDs with their work, they may not be enough to overcome challenges in the context of any specific project.

The language used in the rubrics were seen as a challenge by some participants. While the rubrics were designed as a concrete tool to help increase authenticity and agency, participants mentioned that the language was dense and difficult to interpret. Participants recommended that including concrete examples for each category of the rubrics would be helpful to them. As IDs work across a wide spectrum of disciplines and instructors, they need to translate educational jargon. As such, the challenge with the rubrics is making it specific enough to be helpful, but not too opaque or overwhelming in its language.

Revisions After reviewing participant comments regarding the benefits and challenges of using the rubrics, two specific areas for revision became evident.

Revision 1: Identify a Primary Audience for Rubric Use

At their inception, the rubrics were designed for multiple audiences and multiple purposes. Instructors could use them independently or in consultation with an ID. IDs could use them as a mental framework to guide their work, or as an actual evaluative tool when working with instructors.

When asked who might benefit most from using the rubric, participants primarily identified IDs working in consultation with new instructors, beginning TAs, or experienced instructors who would like to continuously improve. As originally written, the rubrics may be too overwhelming (too many criteria, too much unfamiliar language) as a self-assessment for instructors, and may be better off used by IDs in a consultation setting. An ID could use their expertise and the rubrics to guide a conversation to either facilitate a small change in practice or a more substantial change, depending on the specific situation.

As such, we identify the primary audience as IDs who will use the rubric in consultation with instructors, either as part of an internal toolkit to guide a conversation or a physical artifact to evaluate and measure instructor practice. Rubric language will be consistent for use by an ID audience.

Revision 2: Simplify Content and Layout

At their inception, the rubrics were designed to be used in conjunction with each other to measure agency and authenticity. While the content of both rubrics was seen as relevant, participants raised issues related to overlap and repetition within and between the two rubrics.

Participant comments indicated that the authenticity rubric seemed to repeat itself by frequently suggesting the use of "real-life experiences." Overall, both rubrics were found to be overly long and complex. One participant said it was hard to take it all in. One ID, who is also an instructor, mentioned that she wanted to be able to get to a particular section of the rubric as quickly as possible. Finally, the wording was seen as inconsistent, and sometimes confusing. For example, the original rubrics included separate criteria for Inquiry-based learning, Problem-based learning, and Research-based learning, but one participant thought that there was not enough distinction in their descriptions that could lead to confusion.

As such, the content and layout were simplified. The two rubrics were combined into one; the rating scale changed from a three-point rubric to survey-style answers (e.g., Never, Sometimes, and Frequently). The rubric was organized into usable categories quickly pointing users to the most relevant section depending on their needs, for example, Learning Task, Learning Process, Social Learning, Learning

Assessment, and the Life-long Learning. In this way, an ID can customize their use of the rubric, based on the specifics of any instructional consult or design project.

The revised rubric can be found in Appendix C.

Summary and Next Steps

Throughout the interviews, the ID participants indicated that a rubric addressing the development of agency and authenticity would be a welcome tool for their work, and identified a broad range of audiences and settings for rubric use. While the above-outlined revisions were made at this time, additional modifications to the rubric could introduce its use into the following use cases for future practice and/or research:

1. Create a self-evaluation tool for instructors to identify their current level of practice and to identify some goals for future development.
2. Use the rubric and supporting frameworks to create faculty development programs for new or experienced instructors.
3. Supplement the rubric with additional background resources to help educate about the value of student learning when implementing these two frameworks.
4. Create a catalog of exemplary use cases to provide both instructors and IDs with concrete ideas on how to increase agency and authenticity in their own work.
5. Create a rubric for students to evaluate their achievement in the agency and authenticity criterion.

Any of these options could be beneficial in increasing the use of agency and authenticity in the development of authentic learning experiences during the course design process and in other aspects of teaching and learning in higher education.

Appendix A: Students as Producers Framework

Component of Students as Producers Framework	Description
Discovery	New programs or modules should be presented in a *discovery* mode, which in higher education is usually characterized as one of the following three approaches to learning: 1. Problem based 2. Inquiry based 3. Research based
Technology in teaching	Research-engaged teaching implies a change in the relationship between tutor and student. This changing relationship and the emergence of the concept of digital scholarship can be facilitated by *online technologies*.

Component of Students as Producers Framework	Description
Space and spatiality	Learning *spaces* in higher education may be on-campus, off-campus, online, including for diversity and accessibility.
Assessment	*Assessments* reflect the discovery mode of teaching and learning. Research-engaged teaching is inherently practice-based and should demonstrate the ways in which research is incorporated into their assessment criteria.
Student voice	A *community* of learners and teachers is developed, which is respectful of diversity and difference, allows for the space of dissensus and disagreement, and is driven by engaged and participatory pedagogies.
Research and evaluation	The scholarship of teaching and learning is addressed in evaluations of teaching practices that include student feedback, and the pedagogical *research* of students/faculty into their own learning and teaching experiences.
Research-based learning	Students have the opportunity to make intellectual and practical connections between the content and skills that characterize their programs, and the *research* approaches and frontiers of the underlying disciplines.
Creating the future	A clear focus is placed on the experience of students when they leave the university. Student as producer supports the career preparation and aspirations of students, in the form of a traditional route into graduate jobs and the professions, creating a new business, finding employment, or pursuing further study.

Appendix B: Social Pedagogies Framework

Component of Social Pedagogies framework	Description
Engage with authenticity and difficulty	Learning tasks combines iterative cycles of engagement with the most difficult course material and practical application of thinking, practicing, and communicating within the field of study.
Value process and product of learning	Learning process that develops students' adaptive expertise, including the ability to work with uncertainty, adapt to ambiguity or even failure, and to feel increasingly comfortable working at the edges of their competence and knowledge. Throughout the learning process, students participate in communication-intensive activities to continuously develop and refine their knowledge with the most difficult course material.
Represent knowledge for an authentic audience	Social core that combines constructing and communicating understanding for authentic audiences (primarily defined as audiences other than the instructor). Authentic audiences can take four forms: Faculty and peer feedback, collaborative work, external audiences, and knowledge communities.

Component of Social Pedagogies framework	Description
Participate in an intellectual community	Learning assessments that connect students with community within and outside of the classroom through meaningful reflection and constant communication of content, knowledge, application, and synthesis throughout the course.
Connect the affective and cognitive	Learning integration of students' stages of knowledge acquisition and students' feelings about knowledge acquisition. This combines metacognition and professional identity development to enable students to understand how to translate their ideas for others, negotiate with peers around meaning, and internalize standards for quality and excellence.

Appendix C: Assessment of Authentic learning Rubric

Learning tasks
In this area, learning goals and tasks engage learners in solving authentic, difficult problems to achieve deep conceptualized learning.

	Never	Periodically	Frequently
Learners complete authentic learning assignments.			
Learners work with peers (internal or external group learning).			
Learners create new understanding about course concepts.			
Learners are presented with open ended problems to solve.			
Learners are encouraged to take responsibility for organizing their peer learning groups.			
Learners have opportunities to direct their learning process with support from a tutor or instructor.			

Learning process
In this area, the learning process encourages acquisition of flexible knowledge in open ended contexts.

	Never	Periodically	Frequently
Learners reflect and refine their own their ideas over time.			
Learners communicate their growing knowledge and ideas for an external audience.			
Learners work with ambiguous information; they may not immediately have all of the answers to a problem/question/idea.			
Learners receive training from university library staff on effective information literacy and research skills.			

	Never	Periodically	Frequently
Learners engage in real research projects, or projects which replicate the process of research in their discipline.			
Learners are given opportunity for the management and delivery of their own learning.			
Learners are introduced to and choose from a wide range of technology tools (blog, wiki, personal website, etc.) in order to appropriately manage their educational tasks.			
Learners practice digital scholarship: Use digital, networked, open methodologies and technologies in their learning and research.			

Social core

In this area, learners represent knowledge for an authentic audience and develop a voice and purpose specific to their field or area of study.

	Never	Periodically	Frequently
Learners work with peers to create a collaborative project.			
Learners receive peer-feedback on their work.			
Learners share their work and/or engage with the community outside of the campus.			

Learning assessments

In this area, learners participate in an intellectual community where they give and receive feedback from multiple perspectives.

	Never	Periodically	Frequently
Learners communicate with external audiences to discuss topics of personal/professional interest or topics pertaining to the course content.			
Learners are involved in the process of grading.			
Learners are involved in designing assessments.			

Lifelong learning

In this area, learners develop a personal and intellectual significance in their field of study and become lifelong contributors and learners in their field of study.

	Never	Periodically	Frequently
Learners regularly reflect on their learning.			
Learners network and collaborate within the class group AND outside of the class group.			
Learners work collaboratively on learning projects.			
Learners work at a distance, both synchronously and asynchronously.			

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