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Journal of Applied Instructional Design

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The purpose of this journal is to bridge the gap between theory and practice by providing reflective scholar-practitioners a means for publishing articles related the field of Instructional Design.

JAID's goals are to encourage and nurture the development of the reflective practitioner as well as collaborations between academics and practitioners as a means of disseminating and developing new ideas in instructional design. The resulting articles should inform both the study and practice of instructional design.

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Welcome!

Don Robison, Ph.D., CPT, Editor
Eastern Virginia Medical School

Welcome, friend!

Welcome to this issue of the *Journal of Applied Instructional Design*! We have cooked up a nice fresh meal here for those of you who are interested in designing learning and performance.

We are wonderfully varied. We recently looked at the people who visited our journal website and were pleased to find that our readers are from all over the globe. As you read this issue's articles, you will also find that our authors come from diverse parts of our field. We will cover the range from medical education and simulation to student help-seeking, to new ways of thinking about accessibility and instructional technology.

We are committed to the practice of instructional design generally, but we are committed to *your* practice of instructional design. We will do practically any morally defensible thing to encourage the various practice communities of instructional designers to participate in this ever-maturing discussion and exploration of the design of learning and performance. As I travel through various spheres of influence (business, academia, non-profits, military, primary and secondary education, and medicine—to name a few), I am continually amazed by what I see. We are doing great things… I mean really great things.

What if all of us knew what each of us was doing? ...the successes and near-misses?
How great could we be?

That is the promise of this journal: it is devoted to practitioners and scholars who are focused on the a*pplication* of instructional design in its varied incarnations. I love that.

We need you. We need you to reflect on what you are doing and then share it with the rest of us. To that end, we are trying to make it less daunting to publish. See our last article in this issue about the various types of articles we are soliciting. To lure you gifted designers in, we have established a new kind of article: the Instructional/Performance Innovation Report. In these articles, we ask that you base your innovations in theory and research, but you do not need to have efficacy data yet(though we would love that). We will only publish one of these an issue, but we want to get you in the conversation. We need you in the conversation. Are you doing something that is based in great experience and good theory? Tell us about it.

We are also starting a "Letters to the Editor" section. Each issue we will publish some of these letters. Please see this issue's final article for a description of the kinds of articles we need.

The principle is simple: Together we grow, apart we wither.

You may have noticed I am not Dr. Willi Savenye. Willi, after being our Editor for the normal three years, has stepped aside. If you do not know her, you are missing a treat. I have seldom met a more selfless person. Join me in honoring her for a job well done. On a bright note, she will remain on staff as our Editor Emeritus (How cool is that?), and will continue to contribute her wisdom and expertise.

Thank you, Dr. Savenye, for your great work... Now, please relax.

Don Robison

A Word… Farewell from the Outgoing Editor

Willi Savenye, Ph.D., Editor Emeritus
Arizona State University

I am very pleased to announce that Dr. Don Robison will be taking on the position of Editor-in-Chief for the *Journal of Applied Instructional Design*. As many of you know, Don has served the journal as Production Editor since its inception. He brings to the Editor position his many years of experience as an instructional designer and performance technologist in the Coast Guard, industry, higher education, and most recently as a professor and director in medical education. Don truly blends research and practice; in his capable hands, JAID will continue to grow and flourish in service to the field. In his welcome editorial you can see the great plans Don has for increasing the impact, scope and frequency of the journal. He is building new ways for all of you to find your place in JAID's pages and to share the applied instructional design work you are doing. I'd suggest checking out JAID's web site frequently, as I know with Don's leadership, you will continue to feel welcome and energized by the new formats and innovations he is introducing.

As I conclude my three-year term as Editor, I am grateful for the opportunity given to me by AECT, and Founding Editor, Dr. Les Moller. I am also thankful to AECT for its support, as well as that of our editorial staff. I also thank the Editorial Board and all our reviewers for their hard work these past few years. As our submissions have increased, I thank, too, the ad-hoc reviewers who have shared in ensuring the quality of the journal. I hope that many of you will let Don know that you would like to join the reviewer board as regular members.

I am grateful to JAID's authors, most of whom are instructional designers and ID researchers; without authors, of course, there is no journal… But more than that, the authors who have contributed their innovations and ID best practices, cases from the field, explorations of theory and concepts, and data-based ID research, have made JAID the vibrant journal that it is today. I am excited to let you know that there are many wonderful articles in the pipeline, and encourage future authors to "keep them coming!"

Most of all, I thank our readers for your interest in, and support, for JAID. We welcome your comments and ideas, and hope you will submit your work in the near future, too.

I am proud to say that I will stay on in a new role with the journal. JAID fulfills a unique mission in the field of instructional design, as well as learning, design and technology more broadly. The journal, as we say on our masthead, bridges the "gap between theory and practice."

We are proud to be an open-access journal, freely available to readers and authors worldwide. We invite YOU to contribute your ID experience, projects and expertise as authors. As an open-access journal, JAID depends heavily on the contributions of volunteers in the form of reviewers, editorial assistants, the editorial board and advisors. We invite you to join Don and all of us in continuing to expand JAID's reach, relevance, and value to you, our field and, yes, I'll say it, the world. Thank you all and I hope to see you in our pages, meetings, and online discussions in the years to come.

2017 AECT International Convention

Leading Learning for Change

Hyatt Regency Jacksonville Riverfront
November 7 - November 11, 2017
Jacksonville, Florida
SCHEDULE: Mon. November 6: Check-in begins at Noon (No Sessions)
Wed.-Sat., November 8 - November 11 (Convention program)
Tue., Wed., Sat. November 7, 8, and 11 (Workshops)

REGISTER HERE: https://www.aect.org/events/registration/default.asp#login

Inviting Book and Blog Reviews

If you have noticed a particularly important book or blog that focuses on learning and instructional design in an applied context, we would love to hear from you.

You may review the item, provide constructive critique, point to the value of it, and submit your reviews to Don Robison at Editor@jaid.pub.

We look forward to hearing from you!

Categories of Articles for the *Journal of Applied Instructional Design*

The *Journal of Applied Instructional Design* invites you to submit reflective and scholarly articles about *applied* instructional design. The categories of articles are described to clarify the types of articles we desire. Ours is a practical profession, we all need to hear from you and benefit from your research and experience.

Instructional Design Practice. This is an *applied* journal serving a practicing community. Our focus is on what practitioners are doing in authentic contexts and their observed results. These observed results may vary in quality and detail, but the more convincing (i.e., rigorous) the processes and outcome measures, the greater the likelihood the paper will be published in this journal. These articles cover topics of broad concern to instructional design practitioners. The articles should represent issues of practical importance to working designers (Specific Categories of design and practice challenges are outlined below). **(Sub-categories include Analysis Processes, Design Methods, Instructional Strategies, Development Processes, Evaluation Methods, and Performance Technologies)**

Instructional Design/Performance Design Innovation Report. An Innovation Report introduces a new, preliminary approach to a challenge facing the instructional design community. The goal of an Innovation Report is to highlight first steps toward a solution to a common challenge. The report may highlight an innovative pilot or early-stage initiative at a single institution or preliminary research that defines the challenge and/or lays the groundwork for larger-scale approaches to the stated problem. It must also provide enough information to allow the replication of the innovation or continuation of the research in other settings.

Reported innovations must be based in the context of a theoretical framework. Efficacy data is strongly preferred, but not always required, contingent upon the potential generalizability or value of the innovation.

Design Community Challenges. Similar to the Design Practice and Challenges category, these articles focus on practice, but also the unique challenges of a specific instructional design community. These articles address challenges common to practitioners within a specific design community. Examples include an article that addresses common challenges to medical education instructional designers, or another might address common challenges related to user field performance in the EPSS development community.

Perspectives. Perspectives are short invited articles (generally about 750 words in length). They may respond to an accepted article, or may explore two or more sides of an issue. They generally have few tables or figures, if any.

Opinion Essays. Similar to the perspectives category, these more detailed opinion essays comment on or set the context for an article or articles that have been accepted for publication. They can also be essays framed as calls to action to major challenges. Essays generally have few references and rely heavily on the author's perspective and experience to support the argument. Essays may present supportive graphics or images.

Letters to the Editor. Letters can be responses to articles in the journal, replies to other letters, or about issues of importance in instructional design. They may not be reports of research or programs, although these may be mentioned briefly if germane to the letters' issues. They must not duplicate other material that has been published or submitted for publication. Letters will be published at the discretion of the editor and are subject to abridgement and editing for style and content.

Letters should be tightly focused and no longer than 400 words (including references). They have no tables or figures and no more than three authors. Submissions do not require an abstract. The cover letter that accompanies submissions must include the full citation of the article or letter being commented upon.

Authors whose published articles are the subject of a Letter to the Editor will be provided the opportunity to respond.

To Submit an article or letter:

https://www.jaid.pub/article-submit

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Accessibility and Instructional Technology: Reframing the Discussion

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Abstract: Contemporary interpretations of accessibility in education today are largely technology-centered, such as designing and developing alternative representations of text, images, video, and audio resources for people with physical disabilities. However, this interpretation fails to capture the broad value and role of accessibility in its application to design methodologies. When considered across the disciplines of special education, disability studies, and instructional technology, accessibility is a paradigm within which to consider all design activities. Four levels of accessibility are identified along with associated barriers particular to each: social, physical, intellectual, and motivational. This article also reviews the history of design theories of accessibility in education, such as Universal Design for Learning (UDL) and traces its origin to the universal design movement in architecture. Assumptions about what constitutes a disability are also discussed and questioned. Links and commonalities between UDL and instructional design are reviewed suggesting that bridging these design fields using accessibility as an organizing framework offers ways to improve design for all people in society.

Keywords: accessibility, Universal Design for Learning, instructional design

The term *accessibility* is largely interpreted today in education as providing alternative forms of text, images, video, and audio resources to people with varying physical and cognitive disabilities. However, viewing accessibility solely in such a technocentric way is limiting and apt to prematurely stop further considerations of its deeper meanings and interpretations. While it is easy to understand how the scholarship of fields such as special education and disability is pertinent to discussions of accessibility and diversity, the role that instructional technologists play may not be. Yet, instructional technology scholars have also been champions for accessibility diversity in many respects. Instructional technologists are well known for being leaders in the design of learning environments that take full advantage of technological innovations based on what we know about how people learn (cognition) and why (or why not) people want to learn (motivation).

Despite this, the leading scholars of instructional technology have largely ignored the issue of how to provide equal access to learning and education for people with disabilities. In a review[1] of all 690 articles ever published in *Educational Technology Research & Development* through 2013, only six pertained to people with disabilities (i.e. Garcia & Cuello, 2010; Hertzog & et al., 1989; Hollins & Foley, 2013; Mintz & Aagaard, 2012; Neuman, 1991; Tzeng & Schwen, 2003). Similarly, although learner analysis is a cornerstone of instructional design theory and practice, the consideration of characteristics of people with disabilities is rarely done. For example, in a review of the seminal instructional design text by Dick, Carey, and Carey (2009), the only mention of accessibility issues or design for people with disabilities is a single paragraph noting the need to "comply with requirements of the American with Disabilities Act" (p. 197) when choosing media. Although one might take the position that analyzing learners' entry skills, prior knowledge of a topic area, and general educational and ability levels subsumes consideration of people with disabilities, this is not a tenable position given the special considerations that such diversity represents and the vast literature from special education and disability studies that is completely missing from instructional design textbooks. To illustrate this gap further, among the 38 chapters in the Reiser and Dempsey (2012) book describing trends and issues in instructional technology, only one chapter (Lewis & Sullivan,

[1]These were the search terms used: Special education; Special needs students; Accessibility (used in the context of disability); Disability; Impairment; Attention Deficit Disorders; Universal design; and Universal design for learning.

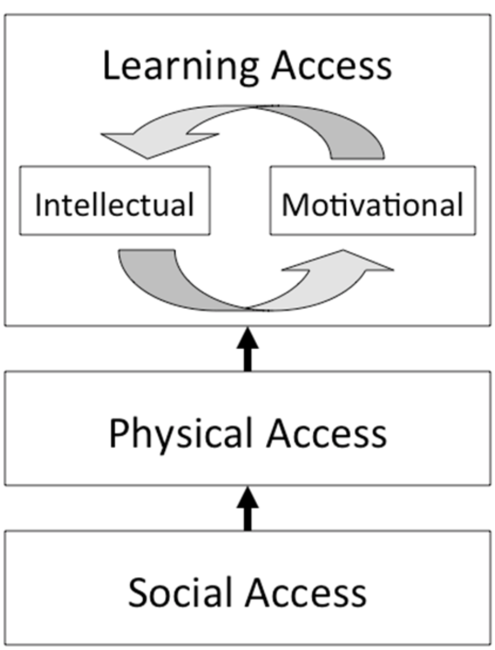
2012) deals with diversity and accessibility, with only four pages devoted to people with disabilities.

There is clearly a need for instructional technology scholars to devote more attention to accessibility. The purpose of this paper is to reframe and redefine accessibility more broadly and to show how the work and literature from special education, disability studies, and instructional technology can be linked by the paradigm of accessibility. This offers a new way of understanding the role that instructional technologists play in making education and instruction inclusive for all people while also offering a new framework for instructional design. In this paper, we describe four levels of accessibility that subsumes physical access within a broader framework. We then review some of philosophical and social roots of what it means to be *disabled*. Attention is then given to probably the most well known instructional design framework related to accessibility, that of Universal Design for Learning. We end by integrating the most contemporary design ideas from the field of instructional technology into an accessibility framework.

Levels of Accessibility

Accessibility is about having something when you want it or need it and being able to overcome any obstacles that may get in your way when you try to obtain it. Accessibility is about having one's fair share of opportunities, then making the most of those opportunities. Increasing access can be equated with removing or reducing barriers. Defined in this way, accessibility is an issue that affects everyone, not just those with physical and cognitive impairments. The history of design theories of accessibility in fields such as architecture demonstrate that design improves by first examining the needs of people usually viewed at the margins of society (Catanese, 2012). Likewise, designing for accessibility has much promise in informing and improving current instructional design methodologies.

Figure 1. Levels of Accessibility.



In educational contexts, there are at least four levels of accessibility with associated barriers particular to each (see Figure 1): social, physical, intellectual, and motivational. Each level is prerequisite to the next. The range of accessibility begins with a person's access to information. This type of access is more accurately framed as a social issue, that is, having the opportunity to use resources and materials available to members of a society. The most prevalent obstacle to social access is the financial ability to pay for resources you need. People, who have limited access to basic information and services, whether these are from government, employment, or education, will likewise have much fewer opportunities to reach their full human growth potential. One obviously needs access to a computer and an Internet connection in order to access the information available on the World Wide Web. The difference of access between the most and least privileged in society is often referred to as the *Digital Divide* (DiBello, 2005; Warschauer & Matuchniak, 2010). Although instructional technology professionals may be limited in their ability to influence social access for people, opportunities to do so exist, such as the work by David Wiley and his colleagues to advocate for open educational resources demonstrates (Robinson, Fischer, Wiley, & Hilton III, 2014; Wiley, Green, & Soares, 2012; Wiley, Hilton, Ellington, & Hall, 2012).

Physical access addresses cases where the resource is available to an individual, but not in a form that the person can actually use, due to a physical impairment (e.g. sight, hearing). Physical accessibility is the predominate meaning most educators currently attach to accessibility and is the meaning behind such labels as *web accessibility standards* and *being section 508 compliant*. This barrier is largely technical in nature and can be overcome by any design team that chooses to address it. Examples include providing a textual description of a graphic, animation, or video for a person who cannot see in a format compatible with a screen reader that converts the text to spoken speech, or providing a written transcription of the audio track accompanying a video or animation for someone who is unable to hear the audio.

Developers of educational media often resist meeting physical accessibility standards, or do so begrudgingly, often merely to avert lawsuits or to maintain government funding. Indeed, institutions can face significant legal penalties combined with expensive retrofitting of already existing materials if they fail to meet accessibility standards and are challenged in court (Crow, 2008; Edmonds, 2004). However, meeting physical-based accessibility standards is relatively easy and inexpensive for a design team when it is considered from the very beginning of a project, but if it is ignored the design team will need to eventually retrofit the design to make these accommodations. Such retrofitting can be complex, difficult, and expensive.

While physical access is necessary, it is far from sufficient – merely gaining physical access to education, whether the context is a school, training facility, or an online course, is not enough. Learning access is a combination of intellectual access and motivation – a person has both the intellectual capacity to understand the content or skills *in the form presented* while also desiring to do so. The emphasis on the way the content is presented is crucial, otherwise anyone with the needed prerequisite knowledge could learn a subject just by consulting a technical manual. The term *form* is used here as shorthand for a large number of variables associated with how the content or skill is represented, in what context, and for what purpose. A student who has physical access to a lesson (whether in school or online), but does not understand the concepts being taught based on the strategies chosen by the teacher or designer, is experiencing a problem of accessibility. So too are students who see no relevance of a subject to their lives and choose not to try to learn it – a lack of motivation is a serious obstacle to overcome (Keller, 2008; C. Kim & Keller, 2010).

Interestingly, the goal of increasing learning access (intellectual and motivational) could be just another way of describing the mission or purpose of the instructional technology field. Educational technology is defined as "…the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources (AECT Definition and Terminology, 2008, p. 1). The goals of facilitating learning and improving performance imply reducing the intellectual and motivational barriers that learners face by improving the design of learning materials and generating interest and relevance among learners.

Even a casual review of the published research and development by instructional technology scholars demonstrates how the field's major work can be interpreted as increasing learning access to diverse populations. For example, Table 1 presents an informal representative sample of recent research and development work published in the journal *Educational Technology Research and Development*. Each of these articles has expressed goals of increasing access to learning across a wide range of audiences, topics, and technologies. Most are focused on both intellectual and motivational access. These few examples, though not chosen systematically, demonstrate well the instructional technology

Table 1
Representative sample of the most recent instructional technology research and development published in the journal Educational Technology Research & Development *consistent with an accessibility paradigm.*

Author (Year)	Learning Task/Skill	Technology	Focus on Intellectual Access	Focus on Motivational Access
Baylor (2011)	Improving self-efficacy	Digital agents/avatars		✓
Huang, Liang, Su, and Chen (2012)	Reading	e-Books	✓	✓
Hwang, Sung, Hung, Huang, and Tsai (2012)	Science	Gaming	✓	✓
Jackson, Brummel, Pollet, and Greer (2013)	Elementary mathematics	Interactive tabletop computers	✓	✓
Kang and Zentall (2011)	Geometry	Computer graphics	✓	✓
ChanMin Kim (2012)	Remedial mathematics	Virtual change agents	✓	✓
Lee and Choi (2011)	Post-secondary education	Online learning	✓	✓
Lim, Song, and Lee (2012)	Elementary school curriculum	Digital textbooks	✓	✓
Liu, Horton, Olmanson, and Toprac (2011)	Middle school science	Problem-based learning	✓	✓
Renninger, Cai, Lewis, Adams, and Ernst (2011)	Mathematics teacher education	Online learning	✓	✓
Segedy, Kinnebrew, and Biswas (2013)	Science	Virtual agent	✓	
Shaw, Nihalani, Mayrath, and Robinson (2012)	Reading comprehension	Graphical organizers	✓	
Shelton and Scoresby (2011)	Language arts	Gaming	✓	
Wise, Saghafian, and Padmanabhan (2012)	Educational technology	Online discussions	✓	
Woo, Chu, and Li (2013)	Collaborative writing	Wikis	✓	

field's interest in identifying barriers to learning – both intellectual and motivational – and designing creative strategies with existing technologies to reduce or eliminate these barriers. The diversity of people and their learning needs require educational approaches that are likewise diverse in order to accommodate them, as these published articles exemplify.

Considering the Philosophical Roots of Disability

It is important to stop and reflect on the philosophical roots of the construct of disability. People without a *diagnosed* disability take it for granted that seeing is better than not seeing, or that hearing is better than not hearing. For example, there is a tendency to "view Western solutions as superior regardless of the systemic implications of those solutions in different cultures" (Carr-Chellman, 2005, p. 8). Likewise, it is easy to assume that it is "better for a child to walk than roll, speak than sign, read print than read Braille, spell independently than use a spell-check, and hang out with nondisabled kids as opposed to other disabled kids" (Hehir, 2002, p. 1). For people without a disability, it is *natural* that a person without these abilities would be considered *not normal*. But mixing the terms *natural* and *normal* belie a huge set of social constructions that few people recognize. There is currently a debate among scholars of special education and disability whether *disability* is rooted in biology or sociology referred to, respectively, as the *medical model* and the *social model*; see Anastasiou and Kauffman (2011, 2012). As Gallagher, Conner, and Ferri (2014) point out,

> In the not too distant past, the meaning of the term disability was thought to be universally self-evident – the inability to do something that most others can do as a result of a specific impairment in physical, psychological, or intellectual functioning (p. 1122).

In contrast, those holding a social model view disability as "…something imposed on top of our impairments…" (Union of the Physically Impaired Against Segregation, 1976, p. 3). Impairment is defined as something distinct from disability. Disability is the "result of restrictive social practices imposed upon people with impairments (in sum, a form of oppression)" (Gallagher et al., 2014, p. 1123). Advocates of the social model of disability, similar to many within the field of instructional technology, subscribe to constructivist orientations to learning. That is, what we know is intertwined with our experiences and values.

The label *learning disability* is applied much more subjectively than would a physical disability. It seems straightforward to state whether or not a person is able to see or hear. However, determining whether such a difference constitutes a disability is far from clear. An interesting historical case study presented by Groce (1985) illustrates this. The case concerns the high percentage of deaf people living in a particular community in Martha's Vineyard in the nineteenth century. These individuals had achieved a higher than average literacy rate due to the number of residents who graduated from the Hartford School, founded by Thomas Gallaudet and later to be known as the American School for the Deaf. It was typical of other people living in the community to have less education – most needed to go and work in the fishing industry at a relatively early age. Consequently, the prevalence of deafness and the distribution of skills among all community members on the island led most hearing people to learn how to sign. Knowing how to sign was considered *normal* and unremarkable in the community. As this historical example shows, the question of who is *disabled* in a community is open to multiple interpretations. If the world were dominated by people who did not hear or could not see, the physical infrastructure of society – its buildings, roads, and technologies – would be vastly different, and very likely inconvenient and frustrating for those who happened to have the senses of hearing and sight.

Universal Design for Learning

Probably the most well articulated perspective on increasing or enhancing accessibility from the special education or disability studies literature is Universal Design for Learning (UDL). We present an overview and brief history of UDL (Rose & Meyer, 2000, 2002) in order to suggest ways in which it relates or links to contemporary ideas in instructional technology. Interestingly, scholars of special education have called for the UDL philosophy to be considered within an instructional design framework (Basham & Gardner, 2010; Basham, Israel, Graden, Poth, & Winston, 2010; Edyburn, 2010). They argue that doing so bridges UDL with the best practices and ideas resulting from the past 30 years of research in instructional technology and the learning sciences.

Historical Background of UDL

The principles of UDL were developed at the Center for Applied Special Technology (CAST.org). UDL was inspired by, and is a special case of *Universal Design*, a movement begun in architecture to make physical space accessible to all people regardless of the physical disabilities they might have. Although UDL differs in considerable ways from universal design, it is important to understand the historical connection between the two and the fundamental principles they share. For example, when accessibility is considered at the beginning – whether in an architectural or instructional design project – there is no need for expensive and awkward retrofitting in order to accommodate people not served well by the original design. It is useful to first consider the implications of this principle in architecture. For example, consider the need for a person in a wheelchair to enter a large government building built many years ago. It is likely the person will be confronted with dozens of steps leading to huge and heavy front doors. The person would need to be carried up the stairs. The person would need to be helped again to open and pass through the doors. Buildings such as these that were later retrofitted with a wheelchair ramp often required the ramp to be in the back of the building due to space limitations. Having to be carried up steps, or having to enter at the back of the building is a humiliating experience. It makes clear you were not important enough to be considered in the building's original design. You are someone who was not meant to be here.

The term *universal design* has been best defined by the late Dr. Ron Mace who coined the term while a professor of architecture at North Carolina State University: the "…design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (Mace, Hardie & Place, 1991/1996, p. 2). A core value shared by Universal Design and UDL is that there are primary and secondary audiences who benefit from proactive, inclusive designs. Not only does a person in a wheelchair benefit from the convenience of a universally designed building with an elevator and ramp but so does a delivery person wheeling packages into the building on a dolly, a teenager on crutches who is unable to climb stairs, and a child who finds the ramp preferable to the stairs. Similarly, an educational video that is closed-captioned is of benefit to those with a hearing impairment as well as those in a noisy student center, café, or in the quiet of home when others are asleep and turning the volume up may not be desirable.

As a result of these efforts begun in architecture, the concept of universal design spread to many other areas of public and private life, from environmental initiatives, recreation, and the arts, to health care and now to education.

Research on Universal Design for Learning

Rose, Harbour, Johnston, Daley, & Abarbanell (2006) describe the influence of brain research on universal design for learning principles. In their article titled, *Universal Design for Learning in Postsecondary Education: Reflections on Principles and their Application*, the authors identify recognition, strategic and affective interdependent cognitive networks used during the learning process. Recognition networks work to help an individual sense, recognize, and interpret information in order to assign meaning to patterns from the stimuli being received. Strategic networks help the individual to plan, execute, and monitor actions and skills appropriately based on recognized information. Affective networks lead to engagement and the formation of emotional connections to our perceptions of the world. Table 2 lists the three design principles of UDL, each based on one of the three cognitive networks (CAST, 2011).

Universal Design for Learning and the field of instructional technology have commonalities beyond the use of technology to facilitate meaningful learning experiences. For example, both are grounded in theories of cognitive psychology. According to the National Center on Universal Design for Learning (n. d.):

[UDL] is deeply rooted in concepts such as the Zone of Proximal Development, scaffolding, mentors, and modeling, as well as the foundational works of Piaget; Vygotsky; Bruner, Ross, and Wood; and Bloom, who espoused similar principles for understanding individual differences and the pedagogies required for addressing them (para. 2).

The research and practice of UDL involves leveraging technology to make information accessible and meaningful at a cognitive level for a specified target audience as well as a broader, secondary audience. Principles of UDL call for multiple means of representation to support recognition learning networks, multiple means of action and expression to address strategic thinking, and multiple means of engagement to support learner affect. If an educational intervention supports the recognition, strategic and affective neural networks in this way, it has met the spirit of UDL. Supporting diversity by designing for individuals with special needs at the onset of a project is more efficient and cost effective than retrofitting the technology later. Even so, operationalizing UDL in practice is no easy task. UDL applications often incorporate several layers like Marino's (2009) science intervention where a student could:

…click on the term, hear its definition, and see a visual representation of how the Kelvin scale compares to the Celsius scale (p. 89) [or] …select the concept and receive a tutorial that included visual representations, animations, supplemental text, and question prompts (p. 98).

The degree to which each student is served in education depends largely on the attention designers dedicate to meeting individual needs. Such efforts may help narrow the achievement gap that persists among students in the majority and in the minority today (Edyburn, 2010).

Many learners are capable of comprehending content if it is presented in a way that is both accessible and meaningful. Offering multiple representations can serve a variety of learning styles (Spector, 2012). By representing focused content in multiple ways and allowing learners multiple ways to act and express knowledge,

Table 2
*Principles of Universal Design for Learning (*CAST, 2011)

Principle 1: Provide Multiple Means of Representation
- "Guideline 1: Provide options for perception" (p. 14)
- "Guideline 2: Provide options for language, mathematical expressions and symbols" (p. 16)
- "Guideline 3: Provide options for comprehension" (p. 18)

Principle 2: Provide Multiple Means of Action and Expression
- "Guideline 4: Provide options for physical action" (p. 22)
- "Guideline 5: Provide options for expression and communication" (p. 23)
- "Guideline 6: Provide options for executive functions" (p. 25)

Principle 3: Provide Multiple Means of Engagement
- "Guideline 7: Provide options for recruiting interest" (p. 28)
- "Guideline 8: Provide options for sustaining effort and persistence" (p. 30)
- "Guideline 9: Provide options for self-regulation" (p. 32)

UDL promises to develop recognition skills and strategic thinking. Consider the UDL Editions by CAST project, where digital online books are designed for readers aged 10 and older. Readers choose maximum, moderate or minimal supports. They explore the meaning and translation of words; add and remove text highlights and compile highlights in a separate window; and follow a four-step process to read strategically. The learner has some control over the presentation of information while interacting with the content that is represented in a number of ways designed to support a range of ability.

UDL is particularly well suited for research and development in the field of instructional technology and in the learning sciences because it represents "a fundamental shift…from external organization of content to one built around the internal workings of the learner" (Center for Applied Special Technology, 2007, p. 2). Research involving instructional design, cognitive tools, and adaptive systems can inform UDL studies that tend to overlook the research and models in the instructional technology field (Marino, 2009). Likewise, instructional technology and the learning sciences may benefit from a UDL approach that serves both primary and secondary target audiences efficiently and to the greatest extent possible. With UDL, those in the margins are placed at the center of design decisions.

Designing for Accessibility

The first step for practicing accessibility design is the simplest, but perhaps the most important: begin by making a commitment to do so on every instructional project you begin. The second step is to assume diversity is the norm and plan the design to meet both physical accessibility standards and learning accessibility standards. Adopt an attitude that every project should be usable by all learners to the greatest extent. Finally, begin all design efforts from the perspective of persons who are underrepresented or with special needs, including those who may become disadvantaged as a result of poor design.

Part of the design conversations should also acknowledge ways in which other people will benefit from these design accommodations. For example, a design project that will contain animations of important principles, such as the physical relationship between acceleration and velocity, should include narrative explaining the animation from the point of view of someone who cannot see the animation. Rather than consider the writing of such a narrative as a nuisance, the design team should see the task as an opportunity to give a valuable extra resource to those students who can see the animation. Early research on animation from the 1990s demonstrated that students often failed to *see* the important relationships depicted in the animation. That is, they watched the animation, but they often failed to recognize the principles demonstrated by the animation (Rieber, 1989, 1991). These students would benefit from having these important principles deliberately and carefully pointed out and explained with text or audio (Mayer & Anderson, 1992a).

A good example of how providing a verbal description benefits everyone is the New York Beyond Site project (http://www.nybeyondsight.org/) where prominent New Yorkers describe their favorite places and landmarks in the city, such as the Brooklyn Bridge and the Apollo Theater. Not only does this make New York's visual culture available to those with visual impairments, but also it also greatly enhances the experience for people who can see. As described on the Web site, a verbal description is "a way of using words to represent the visual world. It helps people who are blind or visually impaired to form mental images of what they cannot see, and provides a new perspective for people with sight" (para. 2).

Meeting the standards for physical access to educational materials, such as designers in the United States complying with Section 508 of the Rehabilitation Act, is a fairly straightforward technical endeavor. Far more difficult, but much more interesting from a design perspective, is how to meet the standards of learning access. Although UDL has been described as an instructional design framework (Basham & Gardner, 2010; Basham, Meyer, & Perry, 2010) and instructional design has been described as the essence of Universal Design for Learning (Edyburn, 2010), literature in each area often fails to cite research and practice documented in the other. This may be due to a limited amount of instructional design research and development with attention to diverse learner needs. According to Basham, Israel, et al. (2010) "there is a lack of literature… that considers the merit of…variables such as purposeful instructional design and technology to support all learners" (p. 244). More research in this area is needed.

Edyburn (2010) proposes the following steps for moving forward: (a) design "diversity blueprints" (p. 36) that show how to design interventions for the special needs of learners; (b) focus on product development in order to enable teachers to differentiate in other ways; (c) distinguish what is and is not UDL implementation and assume technology is a critical component; (d) challenge designers, through competition or other means, to develop UDL skills that are refined over time; (e) explore the benefits of cognitive prosthesis (i.e. tools or assistive technologies used to enhance a person's performance [Edyburn, 2007]) on scaffolding and augmenting learning in relation to UDL products; and (f) research the efficacy of UDL by measuring impact on the primary audience, benefits for a secondary audience, and influence on learning and performance.

Although the steps that Edyburn (2010) proposes – and the principles on which they are based – are discussed in the special education literature predominately in K-12 school contexts, they apply equally to instructional design efforts in business and industry. As a practical example, consider a hypothetical instructional design project to teach a group of accountants about changes in laws about financial privacy and the implications of those laws in their day-to-day work. Among these accountants are likely a few who are well versed or excel in legal matters, a few who are largely ignorant of legal issues, and the remaining majority who are somewhat familiar. Similarly, a few are likely to be very motivated and interested in legal ideas, a few who are adamant in their dislike for legal topics, and again a remaining majority who are ambivalent. Let's also imagine that this group is older than the general public with typical physical limitations of an older group. Several people in the group also self-report that they are visually or hearing impaired. Where should the design start? Design that is content-driven will likely work best just for those who already have much expertise or much motivation to learn. The majority will likely force themselves to complete the instruction at a satisfactory level. The rest would likely find the instruction to be worthless. However, if the designers start their work from the point of view of those will little to no knowledge or interest, they will likely find themselves needing to be much more creative and resourceful in how and what they design. Similarly, by designing text-based alternatives to all visuals and animations in the instruction at the start of the project, the designers will be challenged to be more creative in order to build better examples and cases to present. The resulting instructional design will likely appeal to and be understood by a much larger number of the accountants in this target audience. A key step to understanding this hypothetical example is defining which people are most marginalized in a given group or context. Marginalization can occur at any of the four levels of accessibility, not just those with physical disabilities.

The long history of research in instructional technology also seeks to provide learning access to learners, even though it is not framed this way in the literature. The irony is that this literature rarely included special populations within their research traditions. However, researchers have focused their efforts on understanding how people learn given access to the wide range of technological innovations. As a result, the best of these respective literatures provides significant and appropriate guidance on meeting standards of learning access. Time has come to merge the mission and outcomes of research on special needs, disability, and instructional technology.

These research literatures offer different, but complementary approaches. For example, unlike UDL research, the instructional technology literature is based in psychology, not neurology, but the parallels are easy to spot. The literature on multimedia learning (Mayer, 2001, 2005; Mayer & Anderson, 1992a, 1992b; Rieber, 1990, 1994) and multiple representations (Ainsworth, 1999; Ainsworth, Bibby, & Wood, 2002; Moreno & Duran, 2004) are aligned with the recognition principle. The constructivist literature related to project-based approaches to learning has obvious relevance to strategic principle (Blumenfeld et al., 1991). The vast motivational literature, with Keller's ARCS model as a prime example (Keller, 1983, 2008), is relevant to the affective principle.

Describing an adequate comparison between the UDL and instructional technology literatures is outside of the scope of this paper. However, this point can be made well by considering the most recent work of David Merrill, a pioneering researcher, thinker, and practitioner in instructional technology. Merrill reviewed successful models of learning and instruction across the IT/LS literatures and generated a surprisingly short list of principles found common to all. Consequently, Merrill (2002) labeled these as *first principles of instruction* due to their foundational nature (see Table 3).

What is most compelling is the way that these principles seem to capture the best ideas from a wide range of epistemological positions, from behavioral to constructivist. For example, these principles capture well design models leading to robust tutorials as well as those leading to microworlds, simulations, and games (diSessa, 2000; Rieber, 2003).

Table 3
Merrill's First Pinciples of Instruction

Principle 1: Task-centered approach
"Learning is promoted when learners are engaged in a task-centered approach, which includes demonstration and application of component skills. A task-centered approach is enhanced when learners undertake a progression of whole tasks.)" (Merrill, Barclay, & van Schaak, 2008, p. 174)

Principle 2: Activation
"Learning is promoted when relevant previous experience is activated." (Merrill, 2002, p. 46)

Principle 3: Demonstration (Show me)
"Learning is promoted when the instruction demonstrates what is to be learned rather than merely telling information about what is to be learned." (Merrill, 2002, p. 47)

Principle 4: Application (Let me)
"Learning is promoted when learners are required to use their new knowledge or skill to solve problems." (Merrill, 2002, p. 49)

Principle 5: Integration
"Learning is promoted when learners are encouraged to integrate (transfer) the new knowledge or skill into their everyday life." (Merrill, 2002, p. 50)

Conclusion

Addressing individual differences in education has been an ongoing problem in need of a creative solution for decades. While there is a genuine concern for the "democratic value of respect for the individual" (Parker & Russell, 1953, p. 168) in public education, the ways in which we address individual learner needs have not led to sustainable solutions to achievement gaps affecting "students with disabilities, students of color, students of poverty, and English language learners" (Edyburn, 2010, p. 37). Universal Design for Learning holds promise for many reasons, not the least of which is that it leads to flexible instructional designs for people in and out of the majority. More research on the effects of universal design on primary and secondary audiences is needed (Edyburn, 2010).

By considering individuals who are traditionally at the margins of the intended audience of our design work and moving their needs to the front of our design thinking, instructional designs and technology will address a broad need efficiently and effectively. This shift in design philosophy is important because personal values and assumptions tend to influence one's choice of technologies (Eastmond & Bentley, 2005) and design decisions (Molenbroek & Bruin, 2006). Unless we recognize and advocate for the diverse needs of learners we will continue to develop interventions inherently tainted by our own experiences and perspectives.

Instructional designers and other educators can choose to practice accessibility design for many reasons, such as legal, professional, economic, and moral. From a design perspective, a compelling reason is that embracing an accessibility paradigm should lead to better and more creative designs. These designs begin from the point of view of people who have barriers – physical, intellectual, and motivational – to understanding. The best approach will likely be task-centered, such as students working together on an authentic project that all find important and meaningful. The students will need to have different ways of accessing and interpreting resources. As more resources are created and delivered in digital form, the resources will be inherently more flexible in how they deliver information and engage students. The best resources for learning will be highly interactive and experiential, such simulations, games, and microworlds. These activities begin with the simplest examples of the domain, and provide flexible learning paths as students progress through them.

Current statistics suggest yet another reason to support a design approach based on accessibility – you yourself may one day become a beneficiary with an impairment that requires accommodation. In the United States, one person in five has a disability, "…making people with disabilities the largest minority group and the only group that anyone can join at any time: at birth or through an accident, illness, or the aging process." Based on data collected from the National Health Interview Survey in the United States during 1997-2007 involving over 18,000 people aged 50-64 years, people reported increased mobility-related problems as they age, such as grasping small objects, stooping, bending, and reaching overhead. Other data, such as that from the 1990 United States Census, demonstrate the strong relationship between aging and disability. By the time Americans reach the age of 65, these data show that 70% will have a disability of some type, with 25% having a severe disability (McNeil, 1993).

The field of instructional technology has a long history of developing and researching instructional design models to optimize student learning and understanding (Reiser, 2012; Saettler, 2004). These models have been based on the psychology of learning and motivation coupled with the affordances of technology. Time has come to bring the best ideas from the instructional technology field to the design challenge of meeting all levels of accessibility. In 1991, David Jonassen asked whether the field of instructional systems technology (IST) needed a new philosophical paradigm (Jonassen, 1991), namely that of constructivism. We believe accessibility may represent another major design paradigm for instructional technology in the coming years.

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Stakeholder-driven Learning Analysis: A Case Study

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Abstract: Instructional analysis is intended to generate meaningful data that fuels design decisions. An important consideration is the transfer context, where learners will perform the skills gained through instruction. This context is often implicit in on-the-job training but many educational programs that build workplace skills are far removed it and may miss crucial design insights. This case study describes an analysis for the design of a graduate degree program using a stakeholder-driven approach rooted in the transfer context to ensure relevancy of the design. It also describes innovative approaches to integration of data from disparate sources and scenario-based recommendations.

Keywords: instructional analysis, instructional design, needs assessment, stakeholder involvement, transfer context, higher education, curriculum design

Introduction

Analysis is one of the initial steps in the instructional design process; it typically involves investigating the targeted instructional needs, skills, learners, and/or context to gather information necessary to make effective design decisions (Dick & Carey, 1990; Molenda & Boling, 2008; Smith & Ragan, 1999; Tessmer & Richey, 1997). When they are properly understood and addressed, contextual influences in particular can provide crucial support for transferring learning gains to real-world performance settings, or what is called the transfer context (Tessmer & Richey, 1997). When training is provided in an organizational setting, it is likely that many or all of the people involved in the design process have some implicit knowledge of the transfer context as it is their shared workplace. However, learning experiences often take place in settings removed from transfer context. Higher education is one such example, where students go on to work in a broad and disparate array of settings outside of academia. For those tasked with curriculum development in higher education – particularly developing or refining degree programs or professional training – incorporating the transfer context during front-end assessment and analysis may represent an innovative and effective way to ensure that students' learning experiences are relevant and enduring beyond the classroom (Kaufman, Watkins, Guerra, 2002). However, there is much to be discovered about how curriculum planners and decision-makers can best use front-end analysis processes to ensure calibration between the curriculum design and the transfer context.

Given contemporary demands on higher education institutions to provide students with skills that will be valued in the marketplace, the inclusion of practitioners and future employers in a needs assessment (Guerra-López, 2012), and related analysis processes is a valuable approach for alignment with the transfer context. Although generally scarce in the literature, some studies have sought to investigate the role of stakeholders from transfer contexts in curriculum development for degree programs in higher education. These have included a multi-stakeholder model for validating curriculum topics via ranking sheets, surveys, and focus groups (Autry et al., 2001); a competency-based model that incorporates input from industry and faculty representatives (Sutcliffe, Chan, & Nakayama, 2005); and needs assessment that mapped competencies for curriculum development by integrating employer, practitioner, and academic input (Jeffrey & Brunton, 2010; Meyer & Bushney, 2008).

While it is heartening to see an emphasis on these stakeholders, the existing studies lacked sufficient detail regarding data collection methods (including the types of data gathered) and analysis procedures, as well as clear alignment between findings and recommendations for curriculum decisions. Without sufficient specificity, it is difficult to gain insight into how stakeholder data can be used or to appreciate the advantages and shortcomings of particular methods in particular contexts. Curriculum design teams in particular may have limited resources to conduct comprehensive instructional analyses, so it is especially important to share the challenges and solutions that emerge from similar constraints in authentic settings. These lessons can also be valuable to other instructional designers and practitioners outside of academia who may be removed from transfer contexts important to their learners, who may have limited resources for thorough front-end analysis but seek to make the best use of the data they are able to gather.

In this case study we describe analysis techniques used to define the design requirements for a graduate-level program within the international development sector, with a special focus on stakeholder participation to maximize the transfer value of this degree. The analysis team had an accelerated timeline and constraints on data collection, which led to innovative approaches to analysis and reporting of findings to make the best use of available data. In light of these issues, the key question we have sought to address in this case study is: assuming multiple methods and multiple stakeholders are included in the curriculum analysis process, how can the needs analysis team best collect, calibrate, analyze, and synthesize data to support meaningful decision-making within given resource constraints? The goal for this case study was not to present a textbook example of needs analysis or prove a particular hypothesis, but rather to share the insights that emerged from the complexities and compromises inherent in real world settings.

Context

The primary client for this case study was a large international development organization that was providing technical assistance to a regional institute with affiliations to a major university in Eastern Europe for the purpose of developing educational programming in food security. The institute works in the food security sector in Eurasia, offering interdisciplinary research, policy, and technical services in the region with a complementary goal of developing a network of academic and research institutions (regional and international) that will contribute to improved agricultural and food security policies both in Eurasia as well as globally. The funding agency had played a key role in the initial development of the institute as part of an arrangement with the national government of the institute's host country, which included the establishment of a knowledge management center and learning program. Developing local capacity is an important strategic goal for both the funding organization and the institute; thus this learning program was intended to build a pool of professionals with advanced food security expertise to work in the region covered by the institute, in response to the international community priorities around ensuring food security. Research was conducted on the various sources impacting food security, and one key area identified as a priority was advanced food security expertise. This was the basis for a recommendations to establish a master's degree program in food security with an emphasis on hands-on application. It is in this context that front-end curriculum analysis described here occurred.

The needs analysis team was brought in at the point when relevant, documented data about the needs of transfer-context stakeholders could support and accelerate the design and development of the curriculum. The clients were able to articulate the basic goals of the analysis; they were not, however, able to define the best approach to accomplish those goals. Particular areas of interest to the curriculum development team included content topics, program structure, pedagogy, delivery format (specifically online vs. face-to-face settings), and capacity for e-learning. Tasks for the needs analysis team included identifying the skill and knowledge needs of transfer-context stakeholders and other relevant benchmarks; analyzing and integrating the resulting data; and presenting curriculum recommendations driven by the evidence and analysis.

Methodology & Findings

The stakeholder analysis approach described here consists of reiterative rounds of data collection and analysis. Phase 1 consists of needs identification based on input from end-users, which provided the framework for the second phase of the curriculum analysis. While phase 1 was focused on identifying the actual learning needs, key tasks for Phase 2 included further data collection and analysis to support the generation of recommendations related to: curriculum topics; e-learning capacity; curriculum format and delivery; content and pedagogical issues; and language of instruction.

Phase 1: Needs Identification and Analysis

The initial phase of the needs analysis was centered on identifying needs that the institute's educational program was intended to address. One important consideration from the outset was ensuring that external stakeholders from the five countries targeted by the institute for this program were given a substantial voice to represent the transfer context. As mentioned earlier, the institute's mission includes a commitment to building professional and educational networks within the region, and a driving purpose of this project was to develop professional capacity in the region via graduate-level training in food security. In order to effectively achieve this, it was necessary to understand the perspective of end users (including potential employers of future graduates of the program), to identify the skills and knowledge that they believed were necessary to build the field as well as the perceived obstacles to participation. As such, the team decided to use prospective end-users, potential employers of graduates, and food security professionals already working in the field as anchors for the data collection during the identification phase, augmenting their opinions with expert reviews as well as competitor benchmarking. Prospective end-users consisted of a variety of individuals that may have been working within food security in the public or private sectors, with some education and experience in relevant fields, but who lacked a professional or specialized level of technical knowledge, skills, and expertise in food security. Potential employers were identified as mid to high-ranking officials and policy-makers from relevant government ministries, development agencies, and private sector companies. Targeted experts included researchers and practitioners from various Eurasian universities and food security institutes and outreach organizations working directly with farmers in the field.

Rather than turning first to faculty and using their opinions to set the template for further data collection and analysis, this needs analysis project worked from the outside in, using end-user data as the framework for the curriculum analysis, then moving inward to contextualize findings to the specific academic setting (in this case one major university in Eastern Europe) to ensure close alignment between market demand and supply.

Initial data collection took place during a series of face-to-face workshops with 28 participants who were practitioners and five participants who were faculty at various universities in the region. Participants in this convenience sample were selected to include a range of professions relevant to food security including government officials, policy makers, researchers, program managers, private sector leaders, technical specialists, and trade association leaders. Because people in these positions would be the future employers and colleagues of the target audience (as well as potential students themselves), their input would provide the necessary data to align curriculum recommendations with the needs of the professional workplace. Without their voice, the analysis would be relying on assumptions and perceptions of faculty and/or the development team members who may be biased based on their own area of expertise or country of origin. Essentially, the curriculum would be driven by supply (of current researcher and faculty expertise and preferences), rather than the needs of the region. The three-day workshops were held in a central city to minimize travel burdens, ensuring that attendees from all target countries would be represented; distribution ranged from two to seven subjects per country. Participants were organized into workshop groups by country (four country-specific groups in total, as one group included a smaller group of representatives from two countries); a fifth group included international professionals in the international development sector with expertise in food security. Each workshop was approximately two hours of roundtable discussion, facilitated by an experienced professional with both an academic and practitioner background in front-end assessment and analysis of learning and performance, with assistance from two junior facilitators who also took notes during the workshop to capture participant ideas and recommendations for later analysis.

During each workshop, in-depth discussions lasting approximately two hours each were held around performance requirements, job tasks, skills and knowledge, required resources, and learning formats. For each topic covered in the workshops, the semi-structured conversation explored elements of an ideal or desired state (what skills, knowledge, and job roles would be essential to ensure the performance requirements were met) as well as current challenges faced by participants in realizing the exemplary state. Each workshop group articulated content needs in a manner unique to the national and professional perspectives of the participants. In order to integrate the resulting data sets, four lenses were used to view participant perceptions including: current job tasks (duties or expertise as described by individual participants in relation to their own professional roles and requirements); necessary skills (tasks or expertise identified as important, desired, or critical for supporting food security); gaps/anticipated needs (tasks or expertise identified as particularly deficient either currently or in the future food security); and desired content (any topics that participants specifically mentioned they would like to see included). In addition, the workshops included discussions of available resources and barriers to participation in such learning programs, particularly in relation to e-learning possibilities.

As mentioned, participant opinions were recorded by a junior facilitator, translated into English (four of the five focus groups were conducted in Russian), and then validated by the facilitator as well as development agency observers who had sat in on the workshops and spoke both Russian and English. A qualitative inquiry approach was applied to the resulting notes in order to code and integrate major themes that emerged from each of the five workshops. This involved a reiterative process of reading the workshop minutes, taking notes, and then rereading the data to identify prominent ideas and issues. A thematic content analysis was conducted, which consisted of categorizing topics into three major areas: course content, course format, and resources. Subsequently, additional conceptual domains were developed within each area to provide a framework for grouping individual topics within the theme. As an example, within the course content area, five conceptual domains were identified: socio-political topics; management and leadership topics; monitoring and evaluation topics; bio-physical topics; and farmer outreach. Similarly important themes relating to course formats, delivery modalities, and existing resources and challenges were also identified. Workshop notes were then reviewed again and each mention of a topic was recorded in a master matrix under the appropriate country and discussion lens (as described above) to track how often topics and conceptual domains were mentioned overall, as well as frequency counts per country and per lens for topics and conceptual domains. Two additional food security experts that did not participate in the workshops, but were asked to review the initial findings and suggested additional curriculum topics that were potentially relevant to the program.

Once the initial data analysis had been completed, a preliminary report was prepared to outline preliminary needs as identified by participants. These included 94 potential course topics spread among the five conceptual domains. In terms of delivery options, many participants expressed an interest in e-learning formats (including fully online and blended courses) as well as options for both short- and long-term courses with options for either certification or a formal graduate degree as potential program outcomes. Pedagogy was another important concern, with participants emphasizing hands-on instruction with opportunities to apply skills and knowledge; integrated international experiences; user-friendly technologies; inclusion of the most current data and tools; and a sensitivity to local and national contexts and issues within the region. Although e-learning was a preferred option, concerns were also raised regarding a lack of technology infrastructure in target countries, along with inadequate educational equipment, shortage of qualified instructors, lack of familiarity with distance learning for the general population, time commitments required of students who likely will have full time jobs, keeping students in the region after program completion in order to meet regional needs, and difficulties arising from limited finance options for students. Finally, language issues were also raised as a potential challenge, with some participants advocating for instruction in Russian while others preferred English or their main national language.

Phase 2: Second Round Analysis

Based on the identification of the actual learning needs in Phase 1, key tasks for Phase 2 included further data collection and analysis to support the generation of recommendations related to: curriculum topics; e-learning capacity; curriculum format and delivery; content and pedagogical issues; and language of instruction. Given the constraints of reality such as a limited timeline and resources as well as access to a wider range of data, there were some limitations on the team's ability to collect and analyze data in an ideal fashion, particularly related to e-learning capacity. At the same time, these limitations provide a valuable opportunity to demonstrate how front-end analysis can still generate useful, evidence-driven recommendations when the realities of time and money are obstacles to a model-perfect process.

Curriculum topics. The team identified the following data as necessary to develop a deeper understanding of relevant course content needs:

- *Additional private sector perspectives*. Because only one private sector representative had been able to attend the in-person workshops, individual interviews were conducted with four private sector representatives following a semi-structured interview protocol that covered the major issues that were explored during the workshops. These areas included current job tasks, necessary skills, gaps or anticipated needs, and desired content. These interviews were analyzed and recorded using the framework that emerged from the workshops by synthesizing interview data into the broader workshop data themes.
- *Benchmarking of existing educational programs in food security*. A total of twenty existing educational programs in food security, ranging from self-paced online courses to PhD programs, were reviewed (note: 23 programs were identified, but three included insufficient information on curriculum to be included in the benchmarking data). Drawing on published descriptions of courses, curriculum topics were identified and incorporated into the master matrix developed during Phase 1. This benchmarking was intended both to identify current standards for curricula in food security as well as uncover potential gaps in existing programming that may have presented an opportunity for a competitive advantage.
- *Individual course topic demand rankings*. Once interview and benchmarking data had been added to the master course topics matrix, a survey was developed and sent electronically to all workshop participants. The survey included all potential course topics (for example, food security assessment; food security policy, human and rural development, monitoring and evaluation, etc.) identified in the workshops, interviews, and benchmarking survey. Respondents were asked to rank their personal demand for each topic on a scale from 1 (no interest) to 5 (strongly interested/I would register for this course). This step was similar to the fold-back analysis described by Loos (1995), in which qualitative findings from initial data are used to build quantitative collection instruments in subsequent data collection rounds. Twelve subjects out of 29 completed the survey, representing a 41% response rate.

The private interviews supplemented the workshop data with additional perspectives, while the benchmarking process generated external data from established competitors as a gauge for existing performance standards. Finally, by surveying workshop participants on an individual basis several weeks after the workshop, it provided them with an opportunity to not only confirm the analysis team's interpretation of their expectations, but to also privately reassess the importance of topics raised in the workshop without any influences from the group. Taken together, these datasets offer a richer understanding of curriculum needs than any one might offer on its own. Once data collection was complete, it became necessary to integrate the three primary data pools regarding course topics in order to arrive at recommendations for the issues that would be most relevant to this food security learning program, given market needs and expectations.

This integration presented a challenge, as the data did not share the same scales; the workshop and benchmarking raw scores represented the number of times a topic was mentioned (in discussions or course descriptions), while the raw scores from the individual surveys represented the average value that respondents placed on a topic. Furthermore, the low response rate to the survey required a cautious approach to weighting its results in relation to other data. A ranking system was constructed as a way to compare the importance placed on curriculum topics across all dataset. In brief, each raw score was converted to an ordinal score and sorted from highest (most valued) to lowest (least valued) within each conceptual domain and each dataset. The top topics within each of the five conceptual domains (ranging from one quarter to one third of the identified topics, depending on the total number of topics) from all three datasets were added to a master matrix. Next, the mean of all three rankings for each topic was calculated and topics were sorted by mean ranking score to determine the most desired courses within each domain. The top half of topics in a given conceptual domain, as well as any topics ranked first within an individual dataset, were identified as being the most valued for a food security curriculum. For the socio-political and biophysical domains, which had the highest number of potential topics, a secondary analysis was performed, comparing the findings with curriculum topics included in comparable Master's programs in order to lend an additional layer of validity to the subsequent recommendations.

While this approach does have limitations (in particular, the ranking hierarchy did not reflect the magnitude of difference between two topics, only their position relative to each other), it does provide a basis of comparison when dealing with diverse datasets. The resulting findings were carefully considered within the context of all relevant data and analysis and the approach proved to be reasonable and useful for this situation. See Table 1 for an illustration of each of the ranking results for each data source, as well as the integrated average of the rankings for each topic, which allowed us to provide an overall ranking for each topic, and provide the basis for a potential order of priority.

E-learning capacity. Both the project team and the end-user workshop participants identified e-learning as an important consideration for the proposed project, with implications for curriculum format and pedagogy. A comprehensive assessment tool for existing e-learning design and development capacity was developed in order to better understand these dimensions. The instrument assessed faculty availability and experience in designing and/or delivering e-learning content as well as resources available in reference to e-learning design, development, marketing, technical needs, and incentives for students and teachers. Due to resource limitations and limited access to key sources at the university (to which the institute was affiliated) that would be hosting the program, the instrument was not completed. As such, it was not possible to identify or validate, data-driven needs in this area.

In lieu of this, the needs analysis team developed a self-assessment tool that the institute could use at a later date to assess e-learning capacity in terms of e-learning design and development (EDD) experience and time commitment (TC); both individual and institutional capabilities could be assessed via this instrument. Users could rate themselves (or their institution) as either high or low on both dimensions, leading to four scenarios: high EDD, high TC; high EDD, low TC; low EDD, high TC; and low EDD, low TC. For each scenario, general recommendations and strategies based on best practices in the field were developed (3-5 per scenario), and a cost-consequence analysis (CCA) was conducted (Kaufman and Guerra-López, 2013). The CCA analyzed each recommendation in terms of its estimated time commitment, potential costs, potential risks associated with not implementing the recommendation, and its potential value or impact on performance. See Table 2 for a sample of the CCA. Which includes time estimates, cost considerations, risks, and potential value/ cost for each of the recommendations.

Course duration and delivery. As mentioned before, because a primary intention of the program was the establishment of a Master's degree program, the context analysis also led the team to identify any institutional requirements that might be relevant to the program. This involved research to uncover any national regulations governing the host university as well as regional guidelines outlined by the European Credit Transfer and Accumulation System (ECTS), as adherence to their requirements would lend further credibility to the program and facilitate attendance for students

Table 1

*Topic Rankings in the Socio-Political Conceptual Domain**

Socio-political topics (aggregated top ten topics from each dataset; 1-40 scale)		RANKING			
		Workshop, interviews, internal review	External benchmarking (all programs)	Course rankings	Average Rank
1	Food security policies & policy development	3	2	1	2.00
2	Food security assessment	14	3	1	6.00
3	Market analysis/forecasting	1	8	10	6.33
4	Econ/geopolitical analysis	2	5	19	8.67
5	Research/research methods	5	8	14	9.00
6	Human & rural development	15	3	10	9.33
7	Policy analysis/forecasting	5	21	6	10.67
8	Legislation (domestic & international)	5	13	19	12.33
9	Poverty & inequality (factors/influences)	15	13	10	12.67
10	International trade	11	7	21	13.00
11	Global food/agriculture systems	15	17	8	13.33
12	FS strategy & strategy development	3	40	1	14.67
13	Food security concepts/principles	40	1	5	15.33
14	Simulation/forecasting methods/tools	6	30	14	16.67
15	Statistics	6	8	37	17.00
16	Econometrics	5	30	17	17.33
17	Policy implementation	12	30	10	17.33
18	Agriculture in economic development	15	30	8	17.67
19	Regional issues in food security	40	13	1	18.00
20	International development	40	5	27	24.00
21	Resilience in food security	40	30	7	25.67

**Note: The topics are organized in priority order with the number 1 position (first column) indicating a top ranking.*

Table 2

Sample Cost-Consequence Analysis (CCA) for E-learning Capacity Recommendations for High Expertise, Low Time Commitment Scenario

Recommendations	Time	Cost Considerations	Risk	Value/Impact
Prioritize e-learning offerings in the forms of: • Self-directed, self-paced, individual, interactive e-tutoring systems • Online or CD-based or Mobile app-based tutorials, quizzes/tests/exams • Web-supplemented e-learning with the majority of teaching and learning activities in face-to-face settings • Peer coaching or peer mentoring	This minimizes the time commitment required from institute faculty	Assumption is that there is high internal expertise, which means that there would not be significant cost investments other than development of course materials. If expertise is low, significant upstart costs for instructional designers and developers, as well as development of materials (e.g. mobile app based tutorials)	It is not the most conducive option for developing institute faculty capacity, as it rests on the assumption that there is high capacity already within institute.	Allows institute to launch their e-learning program more quickly and fully.
Prioritize e-learning on content and subject areas which require less frequent updates (e.g., fundamental sciences, theories)	Some time commitment upfront to design and develop the initial e-learning versions. Little maintenance time required	Cost are controlled because one version of the course can last longer, with minimal requirements of updates (costs are incurred primarily through "time/labor" and to a lesser degree on technology infrastructure)	Risk of not progressing to other e-learning topics	Opportunity to develop full e-learning courses from the very beginning. These could become the core of the on-line offerings
Additional teaching and supporting staff	Alleviates time requirements from full time faculty	Salaries plus benefits paid out	Additional teaching and supporting staff might end up with all (or primary) online responsibilities, and deter the online capacity building of current teaching and support staff	From an implementation perspective, this might be a feasible approach to rolling out the e-learning curriculum, and provided there is a capacity development plan for current teaching and support staff that is well executed
Outsourcing e-learning technical support for instructors and students	Minimal time commitment for tech support. Time can be reallocated for instructional/ pedagogical support	Vendor fees	Outsourcing provides instant support, but does little to build internal capacity.	From an implementation perspective, this might be a feasible approach to rolling out the e-learning curriculum, and provided there is a capacity development plan for current teaching and support staff that is well executed

from the five end-user nations. ETCS regulations primarily address the number of course hours (spent in instruction and self-study) required per credit as well as the number of credit hours needed for full-time study per academic year. The host country's regulations also addressed the number of credits required for a Master's degree, outlined requirements for the ratio of time that courses could spend in lectures vs. other types of instruction or self-study, and set a minimum number of in-residency credit hours. Furthermore, both the client and the end-user stakeholders had expressed a desire for shorter, more time-intensive courses as it was anticipated this format would be more viable for potential students. In order to make this information useful within the context of this project and generate recommendations for the client, the team developed a matrix that compared credit hours, course hours, course duration (in weeks), along with best practices for e-learning, to make recommendations regarding the best use of online, in-person, and hybrid courses given specific course duration scenarios.

Content and pedagogical issues. In light of stakeholder interest in developing e-learning components, it was important to provide recommendations that addressed what types of content are best suited to online vs. face-to-face learning. Likewise, given end-user and client interest in constructivist instructional practices with an emphasis on hands-on learning, guidelines were needed to help the client identify opportunities to integrate these experiences in online and face-to-face contexts. For this portion of the analysis phase, best practic-

Table 3

Final Curriculum Topic Recommendations

Conceptual Domain	Topics
Socio-political	Food security policies & policy development
	Food security assessment
	Market analysis/forecasting
	Econ/geopolitical analysis
	Research/research methods
	Human & rural development
	Policy analysis/forecasting
	Legislation (domestic & international)
	Poverty & inequality (factors/influences)
	International trade
	Food security concepts/principles
Management & Leadership	Project planning & management
	Internal coordination
	Finance/budgeting
	Communication/marketing/PR
	External coordination
	Food security educational program management
Monitoring & Evaluation	Monitoring projects/programs/policies
	Policy impact evaluation
Biophysical	Sustainable development/production
	Food safety/quality
	Agricultural production/agronomy
	Technology
	Nutrition
	Hydrology/water systems
	Food standards/regulations
	Agricultural R&D
	Food supply chain
	GIS
Outreach	Farmer training

es for adapting content and pedagogy to specific learning environments were identified and synthesized in order to provide the client with guidelines for future decision-making. As further support for sound instructional decisions, a method-means analysis (Kaufman and Guerra-López, 2013) was conducted; this process involved recommending course duration options and outlining advantages and disadvantage for each option, with the goal of helping the client contextualize the opportunities and limitations of their solution choices in relation to its own goals and resources.

Language of instruction. Finally, an important area of concern for all stakeholders was the language of instruction to be used in the programming. The target audience spanned five countries with different primary languages, with varied capabilities in common languages such as Russian and English. To augment language preference data gathered during the end-user workshops (which showed a near-even split between the two common languages), benchmarking data were collected on existing food security education programs (described earlier). These data showed that all but two of the 23 programs were conducted solely in English, with all eight Master's programs conducted in English only. Furthermore, concerns had been raised by a few end-users that the target student population (under age 30) in some of the included countries had very low levels of fluency in Russian, and the international development agency (the funder) had an established mandate to build capacity and sustainability within the institute. This information was integrated and used to drive the final language of instruction recommendation, which was primarily Russian.

Phase 3: Recommendations

Drawing on the data collection and analyses conducted during Phase 2, evidence-driven recommendations were developed during Phase 3. As noted earlier, it was not possible to document specific needs in all areas (such as e-learning capacity), so the team used

EDDD (Expertise in e-learning design & development) **Choose which description most closely matches your institution (or self)**	
Well-staffed with experienced experts (or equipped with personal expertise) in all of the following areas: instructional design, emerging learning technology, Course Management System (e.g., MOODLE), educational multimedia design and development	Staffed with experts (or equipped with personal expertise) in two (or less) of the following areas: instructional design, emerging learning technology, Course Management System (e.g., MOODLE), educational multimedia design and development
HIGH EDDD	**LOW EDDD**

TC (Time commitment) **Choose which description most closely matches your institution (or self)**	
With ALL of the following: • Institutional policies and incentive systems recognize the additional time and efforts it requires to deliver and update e-learning courses and programs, compared to face-to-face offerings; • Awareness of the additional time commitment required for e-learning delivery, site maintenance and content updates on the individual, departmental and institutional levels; • Readiness to devote the additional time for e-learning delivery, site maintenance and content updates on the individual, departmental and institutional levels	With ANY of the following: • No clearly stated institutional policies or incentive systems to recognize the additional time and efforts it requires to deliver, maintain and update e-learning courses and programs, compared to face-to-face offerings; • Lack of knowledge or understanding of the additional time it requires for e-learning delivery and update, compared to face-to-face offerings; • Faculty are not granted with additional time for e-learning delivery, site maintenance or content updates • Departments and institutions do not support regularly scheduled e-learning content updates or site/system maintenance
HIGH TC	**LOW TC**

Figure 1. E-learning Capacity Self-Assessment Tool

available data to provide self-assessment tools based on likely scenarios for the client to use in the future. Recommendations for curriculum topics, e-learning design and development, course duration and credit hours, content and pedagogical approaches, and language of instruction are summarized below.

Curriculum topics. Out of a pool of 90 potential topics, 30 were identified as being highly rated by workshop groups, benchmarking data, and individual end-users. Table 3 illustrates the main conceptual domains, along with the specific potential course topics. For example, under the socio-political domain, topics like food security policies and policy development, food security assessment, market analysis/forecasting, Econ/geopolitical analysis were some of the top topics that emerged.

E-learning design and development capacity. As mentioned, a self-assessment tool was developed for the client. Figure 1illustrates the e-learning self-capacity assessment that was developed to determine the level of expertise in e-learning design and development (high vs. low), as well as the level of time commitment available to support e-learning (high vs. low). Figure 2 then provides recommendations given each of the four scenarios (1) high e-learning design & development expertise-low time commitment; (2) high e-learning design & development expertise-high commitment; (3) low e-learning design & development expertise-low time commitment; (4) low e-learning design & development expertise-high commitment.

In addition to general best practices for e-learning that were included in the report, client-specific recommendations were included for developing e-learning capacity within the target institute, both leadership and faculty. Table 4 presents examples of the recommendations that were made specifically for the institute leadership and faculty. For example, a key recommendation

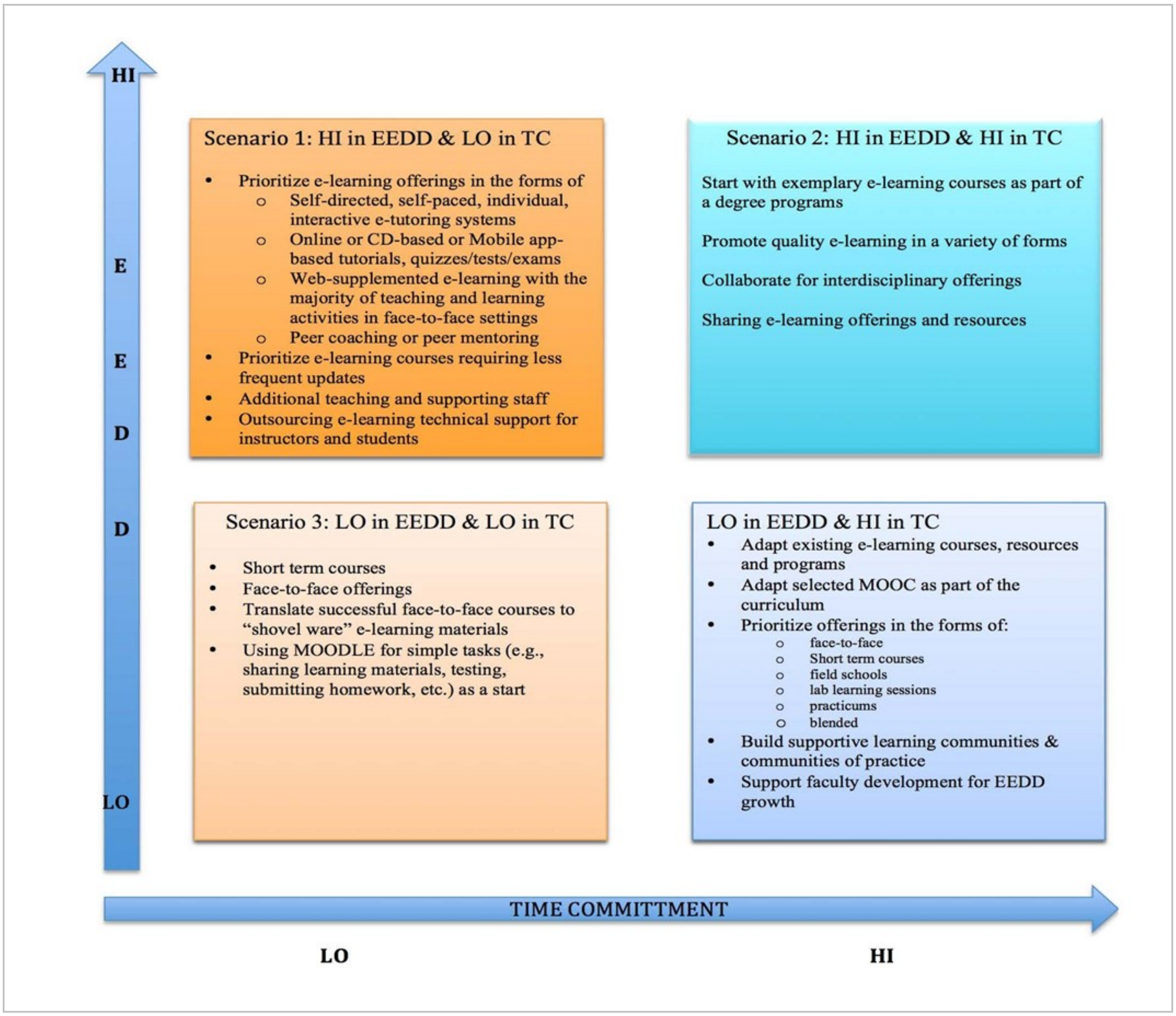

Figure 2. E-learning Capacity Scenarios and Recommendations

for leadership was that expectations for e-learning design, development, and facilitation be explicitly clarified (who, when, how, etc.). One of the recommendations made to faculty was that they proactively seek to observe other faculty who are more experienced with successfully teaching online.

Course duration and format. Data on end-user preferences and relevant academic regulations were integrated with best practices for instructional design to develop a matrix illustrating the relationship between these variables (see Figure 3) and arrive at recommendations for course duration and format, outlined below.

Table 4

E-learning Capacity Development Recommendations for the Institute

Recommendations for Institute Leadership

- Ensure the expectation for e-learning design, development and delivery is shared by all institute leadership and faculty, including specific milestones (e.g. which faculty will teach online, which courses, which semesters, with what support, etc.)
- Improve EFCS faculty skills and knowledge in e-learning design, development, and delivery through professional development activities (for example, e-learning design instructional guide and upcoming March 2014 workshop)
- Provide sufficient time and incentives (e.g. release from teaching other courses during the first year teaching online) for institute faculty to devote to the adaptation of their traditional face-to-face courses to e-learning courses, which will take significant more effort.
- Provide technical staff that can offer technical support for faculty and students
- Provide instructional design staff that can support the design and development of courses, with the involvement of faculty (in order to support faculty capacity to be enhanced). For example, the instructional design staff can support with basic online course structure elements (e.g. general online course information to students, netiquette, discussion, course guide templates, unit content folders, unit agenda templates, etc.)
- Provide student assistant support to assist with course management (taking care that faculty are still leading course facilitation in order to support faculty capacity development, rather than transferring online facilitation to student assistants, which does little to develop faculty capacity)

Recommendations for Institute Faculty

- Observe or ask for "guest" privileges in online courses taught by faculty with demonstrated expertise and success with applying online best practices (in design and facilitation)
- If full instructional design support is not yet available, start with using MOODLE for one or more simple tasks: sharing learning materials and readings, testing, submitting homework, etc.
- As an initial step, translate successful face-to-face courses to "shovel ware" e-learning materials: simply digitizing learning materials and making them available for supplemental e-learning. This can be done as faculty work on developing their e-learning capacity, not as a substitute.
- Build supportive learning communities & communities of practice (COP) by using MOODLE to set up student discussion forums and blogs that you can moderate
- As a transition to improved capacity, focus on the development of relatively short- to mid-term courses (6-8 weeks) that can better allow you to integrate e-learning best practices in a smaller scale (relative to a full 20 semester course)

	COURSE DURATION IN WEEKS[1]							
	1	2	4	6	8	12	16	20
ECTS Credits[2]	1.5	3	6	9	12	18	24	30
Course Hours[3]	45	90	180	270	360	540	720	900

Face-to-Face →→→→→→→→ Blended/Hybrid →→→→→→→→ Fully Online

[1]This chart assumes that 45 hours a week are available for course hours (9 hours a day, Monday-Friday).

[2]Each ECTS credit is equivalent to 25-30 course hours. To err on the side of caution, we have used the higher figure to plot the number of course hours for the duration scenarios.

[3]This chart assumes that the course hours estimation includes homework time (at least 50%) with the remaining time allotted to instruction (not more than 20% lecture hours).

Figure 3. Course Duration and Format Matrix

Recommendations for short-term courses

- For the shorter professional development (non-degree) courses (from one week to a few weeks in duration), a face-to-face delivery approach would be a better fit.
- Courses ranging from four to eight weeks (and beyond) are good candidates for a hybrid approach that blends face-to-face and e-learning (taking under consideration topics that are appropriate for this duration as discussed below).

Recommendations for Master's courses

- Courses that are longer in duration, from 12 weeks up to 20 (the latter being the equivalent of a Russian semester), are generally appropriate candidates for full online delivery as they can more feasibly incorporate a full range e-learning best practices.

Course content and pedagogy. Recommendations for course content and pedagogy relative to course duration and delivery format were developed to address end-user preferences for active, hands-on instructional strategies while also accounting for how the nature of the content might be best matched to the duration and delivery.

Recommendations for short-term courses (face-to-face delivery):

- Content is subject to frequent changes or requires updating on a regular basis in order to stay meaningful and relevant.
- Content can be covered in the given short-term duration (ranging from 4 days to 4 weeks) OR content can be divided into smaller topics that can be delivered in individual modules; depending on the nature of the content, the modules may be offered independently or as part of a linked series with all required to meet a competency.
- Content delivery will benefit from hands-on or practical pedagogical strategies.

Recommendations for Master's length courses (online or hybrid delivery):

- Content is fundamentally static and does not change substantially from year-to-year.
- Content is lengthy, complex, and/or difficult to subdivide in a meaningful way.
- Content requires a minimum of six weeks (and beyond) to be effectively delivered using best instructional practices.
- Content can be effectively taught without hands-on or applied teaching approaches OR with applied learning activities that students can complete on their own (such as case studies) OR in a blended delivery format, with the face-to-face components focused on hands-on pedagogical strategies.

Conclusion

This case study illustrates one approach to conducting stakeholder-driven learning analysis while working within data collection and timeline constraints. This case study begins with the selected solution (i.e. a learning program), and delves more deeply into the specific learning needs and expectations held by stakeholders in the transfer context in order to articulate specific solution requirements that will be a critical input for design and development ((Tessmer & Richey, 1997).

As higher education institutions face mounting pressures to meet market needs by developing relevant degree programs that will position graduates for meaningful employment (Guerra & Rodriguez, 2005; Kaufman, Watkins, & Guerra, 2002), it will be critical for institutional leaders and instructional designers to consider using an outside-in approach as demonstrated in this case study. Instead of relying on assumptions or perceptions that may be inadvertently biased with an excessive "supply" lens (what the faculty can and want to offer), design teams would contribute greater value by involving external stakeholders (including those in the position to hire future graduates) in the definition of needs and requirements. This would become a key input to drive the design and development process. The resulting offering, will only be as good as the decisions that are made throughout the process, and those decisions will only be as good as the evidence that informs them (Guerra-López & Norris-Thomas, 2011).

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Achievement Goal Structure and Type of Assistance Sought in an Undergraduate Classroom

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Abstract: In the face of adversity, learners seek help when confronted with a gap in knowledge. Unsurprisingly, past research focused on the personal costs, burdens, and risks of asking for help. Researchers now identify adaptive help-seeking as a beneficial strategy for learning. This study explored whether instructors could successfully integrate mastery or performance achievement goal structures into undergraduate course assignments. The implications for integrating help seeking strategies in an online learning environment are discussed.

Keywords: help-seeking, goal structure, online learning

Despite decades of research, a comprehensive understanding of academic help seeking has remained elusive (Ames & Lau, 1982; Newman, 1994; Karabenick & Newman, 2009; Schworm & Grubber, 2012). At its core, learners seek help to continue learning when confronted with a gap in knowledge or comprehension; it is persistence in the face of adversity. Historically, researchers from western cultures viewed seeking help as an undesirable trait that signified an abnormal dependence on others. Unsurprisingly, past research focused on the personal costs, burdens, and risks of asking for help. However, Nelson-LeGall (1985) identified adaptive/instrumental and executive academic help-seeking as two distinct processes (Nelson-LeGall, 1985). In adaptive help-seeking, the learner is motivated by a desire to master the material and requests hints and assistance. In executive help seeking, the student requests the answer without the desire to build competency or mastery. Researchers now identify adaptive help-seeking as a beneficial strategy for learning as it positively correlates to academic achievement, even when controlling for prior achievement (Ryan & Shin, 2011).

Seeking help involves social, cognitive, and metacognitive processes, as it requires learners to not only employ self-monitoring and evaluation strategies, but also to interact with others to learn (Barnard-Brak, Lan & Paton, 2010; Karabenick, 2004; Pintrich, 2002). An online or hybrid environment presents different opportunities and challenges to the learner (Yu-Chang, Yu-Hui, Mathews, Carr-Chellman, 2009; Schworm & Gruber, 2012, Whipp & Lorentiz, 2009). Traditional conceptualizations of academic help-seeking require learners to engage socially with another individual, adding a unique set of costs and benefits (Nelson-LeGall, 1984; Karabenick & Newman, 2009). In a face-to face-environment, it is readily apparent who asks for assistance and what assistance is needed. In this context, learners reveal their failure to understand directly to their peers and to their instructor, which may carry fears of embarrassment, social risk and hinder help-seeking behavior (Ryan & Pintrich, 1997; Ryan, Pintrich & Midgley, 2001; Schworm & Gruber, 2012). An online environment may influence help-seeking behavior by reducing the social costs of face to face help-seeking.

The focus of this study was to extend current research into help-seeking behavior by exploring whether an instructor can successfully craft an assignment with a mastery or performance achievement goal structure and whether this achievement goal structure influences help-seeking behavior. In addition, the study sought to explore whether the learning environment influences how learners engage in traditional help-seeking behavior as well as assistance through online means.

Literature Review

Help-seeking is a complex phenomenon affected by a multitude of interacting factors. Some of these factors are internal to the learner, including personal characteristics, motivations and preferences. External factors include the environment and other's responses to help-seeking bids. Help-seeking has been studied for decades, yet as technology changes, the research on help-seeking in academic endeavors has not kept pace. Many, but not all, of the steps involved in seeking help deal with SRL and metacognitive activities, such as identifying comprehension gaps and selecting strategies. Only a few steps are directly related to the overt behavior of seeking help. Many help-seeking models have implicitly defined seeking help as requiring face-to-face interaction with another individual or require instantaneous feedback. These models do not take into account the advances in technology that have made online and hybrid learning environments ubiquitous in higher education. It appears there is a paucity of empirical studies available which focus on help-seeking behavior which occurs in the context of today's online world. However, as the largest threats to seeking help are social in nature, this results in a lack of understanding how learners seek assistance to persist in their learning endeavors.

Help-Seeking Process

Learners engage in help-seeking behavior to resolve a comprehension or knowledge gap (Nelson-LeGall, 1985). Help-seeking on its own is not beneficial, it is only when recognizing help-seeking as part of a strategy to persist through adversity in learning does the importance of help-seeking behavior become important (Newman, 1994). Help-seeking models recognize that learners make intentional decisions to seek help for a number of reasons. These decisions require significant metacognitive resources and active participation from the learner (Newman, 2002). Karabenick and Newman (2009) synthesized a number of models, including Nelson-LeGall's (1985) seminal conceptualization of help-seeking as the behavioral outcome of cognitive and metacognitive processes, driven by motivation. First, learners determine both that a gap or problem exists and then decide that help is needed. Learners become aware of a comprehension gap in a variety of ways, such as self-monitoring, comparing performance against internal goals, receiving feedback and/or other metacognitive activities. Simply recognizing that a gap in comprehension or an inability to perform an assignment exists does not automatically kick start the help seeking process (Mercier & Fredericksen, 2007). Once learners recognize a gap exists, they may try other strategies, such as quitting, or immediately determine that seeking help is the most appropriate strategy (Karabenick & Newman, 2009).

Instructor Influence

Contributing to any learning environment is the presence of the instructor. The learner's perception of instructor support also impacted whether or not a student perceived a classroom as mastery oriented in face-to-face environments. Karabenick (1994) assessed over 1000 undergraduate students' perceptions of instructor support for student questions during class and found these perceptions correlated with the learners' perception of the goal orientation of the classroom. When students believed that their questions signaled a "desire to learn" to their instructor rather than their inability to comprehend the material, they were more likely to view their classroom as mastery oriented (Karabenick, 1994, p. 199). Other studies provide similar results. For example, Kozanitis and colleagues (2007) measured self-reported help-seeking behavior and found that learners' perceptions of the instructor positively influenced adaptive help-seeking. The researchers theorized that the instructor's verbal and non-verbal communication can support help-seeking behavior. These studies also focused on semester-long face-to-face environments and measured traditional face-to-face help-seeking. While these studies did investigate a distinct component of help-seeking, the influence of the instructor, they did not drill down to determine what made the instructor appear to value the learner's questions. In addition, they did not address if a student sought to overcome comprehension gaps through other means, such as independent online searches, or if a hybrid environment might alter help-seeking behavior, where the verbal and non-verbal communication methods are mediated through a computer.

Few studies have examined help-seeking in an online or hybrid environment. However, the existing research in this area reinforces the instructor's influence on student help-seeking behavior. One study demonstrated that students who had high numbers of interactions with instructors perceived as providing academic and social support sought help most frequently in an online environment (Whipp & Lorentz, 2009). While the study identified accessibility of the instructor as an important trait in help-seeking, the help requested was logistical and technical in nature. For example, students tended to contact the professor when issues with exams arose or when they had difficulty understanding an assignment prompt. The study did not investigate other avenues of seeking assistance with completing the course requirements.

Technology and Help-Seeking

While researchers have extensively studied help-seeking in a face-to-face environment, less attention has been paid to the online environment. The mediating effect of technology is important to consider when thinking about academic help-seeking. An online environment may ameliorate many of the threats and the social risks present in a face to face classroom (Kitsantas & Chow, 2007; Schworm & Gruber, 2012; Whipp & Lorentz, 2009). Support for this hypothesis can be drawn from Kitsantas and Chow's (2007) study in which 472 undergraduate students were surveyed across four different types of instruction media: traditional, distributed, web with synchronous discussions and asynchronous only web-based classes to determine if the instructional medium impacted help-seeking from formal sources, such as their instructor. They found that students in the web-based sections sought help more frequently and felt less threatened to do so, whether or not they had synchronous elements to them. However, this study utilized 11 different instructors and three distinct content areas which aligned with the instructional medium, perhaps confounding the results.

As previously noted, learning strategies can shift based on the domain, thus the alignment of discrete content areas with different delivery media may have influenced the results. A more thorough exploration of the potential of the environment to mitigate help-seeking barriers is necessary to further support these findings.

Purpose

The purpose of this study was to examine whether an instructor can intentionally craft a mastery or performance assignment and whether this will influence help-seeking behavior. Previous research relied on the learners' perception of the goal orientation of a semester-long class without understanding how an instructor may deliberately influence this perception through factors under their control, such as assignments. In addition, few studies have investigated academic help seeking in an online or hybrid setting (Kitsantas & Chow, 2007; Whipp & Lorentz, 2009) and many of the threats that are typically associated with help-seeking may be diminished in an online environment. The following research questions guided this study:

1) Does the learner's perception of the achievement goal of an assignment match the intention of the instructor who created the assignment?
2) Does the classroom environment influence whether learners are more likely to seek help from a formal source, such as their instructor, or an informal source, such as their peers or online?

Method

Research Design and Participants

The study consisted of a mixed-methods quasi-experimental design and participants were recruited from a course with an enrollment of 60 students in three sections. A total of ten participants responded to a series of surveys exploring the effects that classroom environment had on help-seeking behavior. The students were enrolled in an undergraduate degree program at an urban university in the Mid-Atlantic region. The class was a general education course with students drawn from across the university. Participants who audited the class as well as students who had previously taken the course or withdrawn from the course previously were excluded from the study.

Procedures

A Web Quest and an Annotated Bibliography were used as two assignments for this study. The Web Quest assignment required students to simply find information using library research methods. The more complex Annotated Bibliography project required participants to locate and analyze primary and secondary source material, organize their research, create annotations summarizing and relating material to their topic of choice. Both assignments were graded by the instructors via a rubric

In both the hybrid and face-to-face sections of the class, participants were presented with identical assignment information in terms of content and expectations. However, half of each section of the class received the assignment embedded in a mastery-oriented context and half received an identical assignment embedded in a performance-based context. Participants were not aware of the treatment conditions. In the mastery-oriented treatment group, the instructions emphasized learning the material deeply and accurately. The performance treatment group received assignments emphasizing performance and grades as the primary goal. Students completed the assignments in their respective environments through the sixth week of the semester.

Data Collection

Data were collected following each assignment during the study. Participants responded to a survey provided to them by the instructors via a link in an email.

Scales. To assess the type of help-seeking, participants completed an adapted form of the computer science help seeking scales (Appendix A) (Pajares, Cheong and Oberman, 2004). This assessment measured instrumental (adaptive) and executive (non-adaptive) help-seeking. Pajares and his colleagues (2004) found an alpha co-efficient of .89 and .92 for these scales respectively. As noted by the authors, these scales can be adapted by researchers in domains other than computer science. The instrument used an 8-point Likert-type response scale ranging from definitely false to definitely true, with no descriptors in between. This scale was administered following the submission of each assignment.

To assess the learner's perception of the achievement goal structure of the assignment (Appendix B), the researchers adapted and utilized Elliot and McGregor (2001)'s personal goal achievement scale. As Karabenick (2004) successfully demonstrated, personal achievement goal scales can be successfully adapted to reflect the classroom environment rather than individual preferences. This can be accomplished through such phrases as "In this class, the teacher" and "In this class, it is important to…" (p.574). This scale was adapted to reflect the assignment, rather than the class using phrases such as, "On this assignment, the teacher…" and "On this assignment, it is important to:" This survey was administered following the submission of each assignment.

Survey. Students completed one survey (Appendix C) consisting of three questions, which reported the number of times they sought help from their peers as well as any other sources they sought help from. This survey was administered twice, once following the Web Quest assignment and once following the Annotated Bibliography assignment.

Results

Frequency of Help-Seeking by Environment

There were five participants in the mastery condition and five participants in the performance condition. On the Web Quest assignment, students sought help an average of 1.66 times, with a median of 1, while on the Annotated Bibliography assignment students sought assistance an average of 3 times, with a median of 2. An independent samples t-test was run to determine if there were differences in the type of help sought between the mastery and performance conditions. Across both the Web Quest and the Annotated Bibliography assignments, the mean for both conditions was 1.8, with a standard deviation of .45. No difference resulted from the treatment conditions. For the Annotated Bibliography assignment, 100% of the participants in the hybrid section sought help, while only 25% of the students in the face-to-face section sought help. However, Fisher's exact test yielded a non-significant result (p = .4).

Assignment Achievement Structure and Type of Help-Seeking

Two scales were employed to measure adaptive and non-adaptive help-seeking behavior (Pajares et al. 2004). Each construct scale consisted of ten questions. Both scales had a high level of internal consistency as determined by a Cronbach's alpha of .96 for the adaptive scale and a Cronbach's alpha of .97 for the non-adaptive scale. In addition, one 12 item scale with four sub-scales assessed the perception of the achievement orientation of the assignment (Elliot & McGregor, 2001).The Cronbach's alpha for the four sub-scales ranged from .86 to .67.

The scales were administered after each assignment and analyzed separately. One-way ANOVAs were conducted to determine if the mastery condition resulted in a higher frequency of adaptive help-seeking behavior as predicted. See Table 2. For the Web Quest assignment, participants were divided into two conditions: mastery (n = 4) and performance (n = 5). The data was normally distributed as indicated by a Shapiro-Wilk's test (p > .05) and there was homogeneity of variances as assessed by Levene's test for equality of variances (p = .576). In this case, adaptive help-seeking was higher for the performance condition (M = 5.64, SD = 1.84) than for the mastery condition (M = 4.83, SD = 2.69), but the difference was not statistically significant $F(1,7)$ = .293, p = .605.

In the Annotated Bibliography assignment, the participants were divided into two conditions: mastery (n = 2) and performance (n = 7). The data were normally distributed as indicated by a Shapiro-Wilk's test (p > .05). There was one outlier which was left included as it did not affect the outcome of the analysis and appeared to be a true value, not a measurement or reporting error. There was homogeneity of variances as assessed by Levene's test for equality of variances (p = .707). The mastery condition was more likely to report adaptive help-seeking behavior (M = 6.7, SD = 1.55) than the performance condition (M = 5.48, SD = 1.24), however, the results were not statistically significant $F(1,7)$ = 1.39, p = .277

In contrast, an ANOVA (Table 1) conducted to determine whether the assignment achievement structure influenced non-adaptive help-seeking behavior did yield statistically significant results on the Annotated Bibliography assignment. While students in the performance condition were more likely to report non-adaptive help-seeking behavior (M = 3.09, SD = 2.16) than those in the mastery condition (M = 1.75, SD = 1.11), the results were not statistically significant, Welch's $F(1,6.2)$, p = .273.

For the Annotated Bibliography assignment, there were no outliers. Seeking non-adaptive help was statistically significantly different between the mastery condition (M = 1.05, SD = .06) and the performance condition (M = 3.22, SD = 1.83), Welch's $F(1,5.07)$ = 8.46, p = .033 with students in the performance condition more likely to seek non-adaptive help than those in the mastery condition.

Source of Help

In the second research question we sought to explore the influence of the environment and goal orientation on the source of the help. For the Web Quest assignment, a chi test for association revealed a non-statistically significant association between the orientation of the assignment and the source of help $\chi^2(1)$ = .75, p = .39. However, overall, 66% of the participants sought assistance online rather than from an individual known to them. For the Annotated Bibliography assignment, there was a similar result with a non-statistically significant association with regard to treatment condition $\chi^2(1)$ = .75, p = .38, and an overall higher frequency of seeking online help (66%) rather than face-to-face assistance The data analysis for the

Table 1

Adaptive and Non-Adaptive Behavior by Assignment and Condition

	Web Quest			Annotated Bibliography		
	Mastery (n=4)	Performance (n=5)	F	Mastery (n=2)	Performance (n=7)	F
Adaptive Help Seeking	4.83 (2.69)	5.64 (1.84)	.293	6.7 (1.55)	5.84 (1.24)	1.39
Non-Adaptive Help-Seeking	1.75 (1.11)	3.09 (2.16)		1.06 (.06)	3.22 (1.83)	8.46*

*p < .03

hybrid environment showed no association between the hybrid section of the classes and whether they sought help from a professor or online $\chi^2(1) = .75$, $p = .38$ for the annotated bibliography assignment. No data were available for the Web Quest assignment.

Discussion

This study provided valuable insight for instructors and instructional designers who seek to facilitate adaptive help-seeking. Help-seeking is situated in self-regulated learning and influenced by the environment (Karabenick & Dembo, 2011). Previous research has demonstrated that many factors may influence student help-seeking behavior, such as the perception of the instructor and the perceived achievement orientation of the class, but has not identified how learner perceptions may be influenced intentionally by the instructor (Karabenick, 2004; Kozanitis et al., 2007). Primarily, this study explored how one instructor-controlled environmental factor, the achievement goal orientation of assignments, influenced help-seeking. Research has demonstrated that environments perceived as mastery-oriented by the learner positively influence adaptive help-seeking (Karabenick & Dembo, 2011). For instructors and designers, the issue of how to create this mastery-oriented environment has largely been left largely unexplored. Assignments are one area which instructors control and can manipulate in the classroom. Other factors may include orienting students to acceptable questioning practices (i.e. hold questions until after the lecture) and scaffolding student self-monitoring of performance (Karabenick & Dembo, 2011). Thus, in this study we aimed to test whether the manipulation of assignments impacted learner perceptions, and by extension, help-seeking behavior. This study extends the current research on help-seeking behavior by examining whether specific assignments/assignments may be embedded in an achievement goal structure to facilitate adaptive help-seeking.

The results from this case study suggest that embedding assignments in a designed mastery or performance-based context can influence help-seeking behavior. Specifically, in this study we found that an assignment embedded in an intentionally created performance context resulted in statistically significant non-adaptive help-seeking. Furthermore, the results also suggest that a mastery context may facilitate adaptive help-seeking. Task complexity may have also played a role as participants were more likely to be affected by the achievement goal structure of the assignment on more complex assignments, especially in the performance condition. Task difficulty has been identified as a factor that can affect help-seeking (Stahl & Bromme, 2009). During this study, participants sought help more frequently on the more complex and difficult Annotated Bibliography assignment and less frequently on the simple Web Quest assignment. In addition, the less complex Web Quest assignment also resulted in the students in the performance condition seeking non-adaptive help, that is non-learning oriented help, at higher rates than did those in the mastery condition, but to a non-significant extent. These findings extend those of prior research which linked the learner's perception of the achievement goal structure of the class as a whole to help-seeking (Karabenick & Dembo, 2011; Ryan, Gheen & Midgley, 1998) and suggest that the achievement goal structure of the assignment plays a role in this link.

The results suggest that a hybrid environment does influence help-seeking behavior, as 100% of those in the hybrid sections sought help with the Annotated Bibliography assignment compared with 25% of the participants in the face-to-face section. In this case, the hybrid section contained a significant online component and met face to face every other week. It is possible that the hybrid environment, with its lesser face-to-face contact, decreased the social threats to help-seeking that occur in a face-to-face classroom, allowing students to feel more confident and comfortable seeking help (Ryan et al., 2001).

Previous research has largely considered seeking help only in the face-to-face learning environments (Karabenick, 2004; Kozanitis et al., 2007) with few exceptions (Whipp & Lorentz, 2009; Kitsantas & Chow, 2007). In this study, the majority of those who sought assistance did so online (66%) across both assignments. These results show a clear overall desire for learners to find information online rather than to ask a classmate or an instructor for help. The reasons for this are likely varied. These assignments required extensive online work through database and internet searches. In addition, seeking help in an online format reduces traditional barriers to seeking help, such as fear, shame and avoidance of appearing incompetent (Ryan et al., 2001). The increase in privacy available online may have resulted in participants preferring to search for assistance and help online rather than contacting a peer or the instructor.

Based on the results of this study, students prefer to seek help online rather than in-person. Therefore, it is possible that a mastery-oriented student may choose to seek adaptive, that is, learning oriented, assistance online. Recognizing this preference, instructors and instructional designers should consider providing learners with high-quality adaptive online resources to assist them in completing their assignments. If seeking help by contacting peers or instructors represents a barrier, then providing learners with privately available information in an on-demand format may facilitate help-seeking behavior and persistence in learning.

Limitations and Future Research

The limitations of this study are many and evident. The most glaring limitations of the study are sample size, the nature of the assignments and the nature of the class. The small sample size limited the amount of analysis and resulted in challenges in interpreting the results. Therefore, many of the findings presented above are based on non-statistically significant results, which, nonetheless, are consistent with previous research. Future research should seek to incorporate more direct observation such as faculty logbooks of help-seeking bids from students as well as a larger sample size.

In light of the results showing a clear preference for students to engage in assistance-seeking behaviors online rather than with individuals they know, this is an area that should be further explored. A more focused investigation into the motivations of the learner for seeking help or assistance online as well as whether they are seeking adaptive or non-adaptive help would contribute to our understanding of help-seeking and self-regulated learning.

Conclusion

Overall, the environment appeared to play a role in student help-seeking behavior. Participants sought help online more frequently than from individuals known to them, including the instructor, who would appear to be the most knowledgeable source for help. In addition, it appears that the achievement orientation of the assignment influenced help-seeking behavior. Creating a performance-oriented assignment may influence learners to seek non-adaptive help, which previous literature has linked with lower academic achievement than those who seek adaptive help. While many of the results of the analysis were not statistically significant, perhaps due to the small sample size, the results do demonstrate that the instructor's wording on individual assignments, especially if performance based, can influence help-seeking behavior. Future research should investigate whether behavior typically understood as information-seeking can be adaptive or non-adaptive. Finally, the link between help-seeking and assignment complexity should be explored further in the literature. The complexity of the assignment may be a contributing factor which influences how and why students seek assistance.

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Appendix A

Type of Help Sought Scale (Adaptive/Performance)

This scale will be administered at the end of each assignment and will identify the type of help the learner the learner sought. Learners will select from an 8 point Likert type scale with the following instructions:
"Please use the following scale to answer the statements below. Circle the number that best describes how true or false each statement is for you in this class"
1 (definitely false) – 8 (definitely true)

Adaptive

1. When I asked my professor for help, I preferred to be given hints or clues rather than the answer
2. When I asked my professor for help, I didn't want my professor to give away the whole answer
3. When I asked the professor for help with something I didn't understand, I asked the professor to explain it to me rather than just give me the answer
4. When I asked the professor for help in this class, I only wanted as much information as necessary to complete the work myself
5. When I asked my professor for help in understanding the material in this class, I preferred that the professor help me understand the general ideas rather than simply tell me the answer
6. When I asked a student for help in this class, I didn't want the student to give away the whole answer
7. When I asked a student for help in understanding the material in this class, I preferred that the student help me understand the general ideas rather than simply tell me the answer
8. When I asked a student for help in this class, I wanted to be helped to complete the work myself rather than simply tell me the answer.
9. When I asked a student for help in this class, I preferred to be given hints and clues rather than the answer
10. When I asked a student for help with something I don't understand, I asked the student to explain it to me rather than just give the answer.

Executive

1. When I asked the professor for help in this class, I preferred that the professor do the work for me rather than explain to me how to do it.
2. When I asked the professor for help on something I don't understand, I preferred the teacher do it for me.
3. When I asked the professor for help on something I don't understand, I preferred to be given the answer rather than an explanation of how to do the work myself
4. When I asked the teacher for help with my work, I preferred the professor just give me the answer rather than explain it.
5. When I asked the professor for help, I wanted the teacher to do the work for me rather than help me be able to complete the work myself
6. When I asked a student for help on something, I didn't understand, I preferred the student to just give me the answer rather than to explain it
7. When I asked a student for help with my work, I preferred that the student do the work for me rather than explain to me how to do it
8. When I asked another student for help on something I don't understand, I asked that the student do it for me
9. When I asked a student for help in this class, I wanted the work done for me rather than be helped to complete the work myself
10. When I asked a student for help with my work, I preferred to be given the answer rather than an explanation of how to do the work myself.

Adapted from Parajes et al. (2004)

Appendix B

Perception of Assignment Goal Structure

This scale will be administered at the end of the semester and will be used to determine the learners' perception of the goal orientation of the assignment. Learners will select from a 7 point scale with the following instructions:

"Please use the following scale to answer the statements below. Circle the number that best describes how true or false each statement about this class."

Scale: 1 (not at all true of this class) – 7 (very true of this class)

"Please use the following scale to answer the statements below. Circle the number that best describes how true or false each statement is for you."

1 (not at all true of me) – 7 (very true of me)

1. On this assignment , it is important for me to do better than other students
2. On this assignment, the teacher stresses that it is important for me to do well compared to others in this class
3. On this assignment, it is important to get a better grade than most of the other students
4. The teacher stresses On this assignment to learn as much as possible
5. On this assignment, it is important to learn the content as thoroughly as possible.
6. On this assignment, it is important to master the material
7. On this assignment, it is important not to do worse than other students
8. It is important On this assignment to not do poorly
9. On this assignment, the teacher stresses to avoid performing poorly compared to other students.

Adapted from Elliot and McGregor (2001)

Appendix C

Help-Seeking Preference Survey

This survey will be a self-report instrument where students indicate whether or not they sought help and from whom they sought that help from. Learners will select from a pull-down menu with the following instructions:
"Please select the answer that best represents your behavior this week in this class:"

1. Did you seek help for this assignment?
    - Yes
    - No
2. Did you ask anyone for help with this assignment?
    - Yes
    - No
3. From whom did you seek help?
    - The professor
    - A fellow student in this class
    - A fellow student outside of this class
    - I looked online
        - Where?
    - Other:

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Instructor Perceptions in the Assessment of Student Digital Voice Reflections

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Abstract: The ubiquitous presence of technology with multimedia capabilities provides ample opportunity for innovative pedagogical strategies. Digital voice reflection is born out of a need for expediency, convenience, and multimodal forms of learning. It allows students to quickly capture reflective thought through the naturalness and primacy of the spoken word. It also allows an instructor to more easily examine the reflective thought process presented through voice inflection, manner of speaking, and relative conciseness of thought. To explore what elements or factors unique to vocally expressed and recorded reflection instructors notice and consider important for assessment, this study surveyed 60 instructors from 14 Midwestern universities and colleges of nursing and identified 15 unique factors falling within four broader categories to be used for assessment of voice reflections.

Keywords: reflection, voice reflection, assessment

Introduction

Reflection is an important part of higher education and is often used in the curriculum as a formational tool for teaching subject matter and for the development of professionalism.

Reflection is a personal, sometimes emotion-laden return to earlier experience; it is a narrative created internally through a process of expectation, active exploration, and critical resolution, which can then be held and used to influence action in future situations. It is creation of personal knowledge, an ongoing process in which critical thought processes influence and transform the individual (Meizirow, 1981; Schön, 1991). Becoming critically reflective is a key to transformation of frames of reference that are indispensable in the process of adapting to change (Mizerow, 1997). Reflective practice, specifically Schön's (1991) term "reflection-on-action," is central to professional practice, and refers to personal consideration of an experience after it has occurred.

Over time, the technology for the creation and sharing of reflective activity as part of pedagogical strategy has transformed and is continuing to change. Technology now permeates the world of higher education. Use of computers by students and instructors as tools for teaching and learning is ubiquitous and is shifting to include the use of mobile devices such as tablet computers and smart phones out of a student-perceived need for convenience. Young people are often skilled multi-tasking users of technology, and most rely on it for information gathering and communication (Bennett, Maton, & Kervin, 2008). A 2013 ECAR study of undergraduate students and information technology finds that "students are ready to use their mobile devices more for academics, and they look to institutions and instructors for opportunities and encouragement to do so" (Dahlstrom, Clark, & Dzuiban, 2013, p. 4). It is important that a primary teaching and learning tool such as reflection be adapted to fit technological changes and better serve the student and the instructor.

Digital voice recording applications are common to both regular computers and smaller mobile devices, and they are convenient and easy to use. Technological progress in educational settings, as well as students' desire to use convenient technologies, makes recording speech for reflection worthy of study. However it is important to consider that recorded reflections will include unique elements not seen in text-based ones. Thoughts that were once written in text will be replaced by the sound of the student's voice, and vocal elements such as inflection and the vocal manner of presentation will essentially replace text-based components such as punctuation, paragraph, and sentence structure. Therefore, instructor perceptions and strategies for assessing them will be somewhat different as well.

This study investigated what unique elements of voice reflections instructors noticed and what factors they found important for assessing those reflections. We focused on nursing instructors' perceptions here. Courses in nursing often include reflection as a key element, adding it to the course curricula by integrating it into activities, and using students' reflection-on- practice material as a part of a formal assessment strategy (Hannigan, 2001). Students in nursing are involved with active participation in simulation labs and also in clinical learning environments where they work as apprentice staff alongside supervising nurse instructors in a variety of healthcare settings. Assessment of those student activities comes through face-to-face debriefings with the instructor, as well as writing assignments such as reflections where the student is prompted to consider the experience, write meaningfully about it, and share it with the instructor. The time spent by students writing reflections can be lengthy and can occur relatively long after the experience, possibly leading to details being lost. The convenience of voice recording can make the process more expedient.

Reflection and Assessment

Reflective capacity is essential for professional competence. Integration of theory and practice by way of repeated reflective practice is an integral part of learning for students in the health professions (Hannigan, 2001; Mann, Jordon & MacLeod, 2009; Smith, 2011). It is assumed that reflection is positive, contributes to development, and increases the quality of practice (Asselin, Schwartz-Barcott, & Osterman, 2012), and without question it is a valuable part of the professional educational experience particularly for students of nursing.

Nursing students are assigned to reflect on many aspects of their educational experiences, which include classes, case studies, and mechanical patient simulations, as well as clinical experiences with real patients. Such considerable activities produce much scholarly writing and research. While all these writings closely circle the construct of reflection they appear to differ in their approach. Mann, Jordan, and MacLeod (2009) provided a comprehensive literature review of reflection used in health professions education and found the models of reflection to basically follow two general dimensions. They define one as being an "iterative dimension," where the process is caused by experience that creates new understanding and the reasoning to act differently in the future, as advocated by Boud, Keogh, and Walker (1985) and Schön (1991).

The other is a "vertical dimension," which considers a hierarchical level of reflection on experience from one of being simply descriptive to critical, as supported by Dewey (1910/2001), Hatton and Smith (1995), Kember, McKay, Sinclair, and Wong (2008), Mezirow (1991), and Moon (1999). These means of defining reflection provide the opportunity and criteria for developing some sort of assessment. Moreover, as nursing curricula frequently depends upon reflection as a necessary component, an educator must decide how to apply that assessment in a meaningful way to spur learning, but at the same time not inhibit students' learning processes.

The assessment of reflection, however, can be a difficult task. Osborne and Walker (2013) state that current assessment models demand that the instructor translate his/her expertise into a set of rigid rules, but they go on to say "a rubric cannot begin to encompass everything a rater knows and utilizes when evaluating" (p. 40). They find that the practice of assessment should instead rely on a more fluid application in the use of an instructor's own expertise that is effective and meaningful. Assessment of reflection can be formative or summative in nature.

The instructor must consider whether the reflection's purpose is formative as a short, informal and personal collection of thoughts, or instead a summative formal professional reflective response. The notion of what is actually being assessed is additionally important: is it the student's demonstration of ability to reflect skillfully, or is it instead the student's response to learning and experience that is being assessed.

In many cases, assessment depends upon creation of a criteria framework built into the map of the curricular course design (Moon, 2004). Reflective prompts will be needed "to focus learning, motivate students to learn, shape or direct learning, and to require that student can apply or transfer their learning to unexpected situations" (p.150). Assessment may also be based upon depth as perceived by the instructor. Kember, McKay, Sinclair, and Wong (2008) developed and tested four hierarchical levels of assessment for measuring student reflection, ranging from "habitual action" to the "critical reflection" as defined by Meizirow (1981). The lowest level, "habitual action," is a simple regurgitation of fact, which is not considered reflection and does not necessarily involve or associate with any sense of meaning. The next higher level, "understanding," does not imply reflection; it is understanding of concepts or theories but does not make the connection to practice, practical situations, or personal experiences. The next level, "reflection," considers the application of a concept to personal functions. Personal insight becomes apparent at this level and experiential situations are related to what has been taught.

The highest level is "critical reflection," where personal deep-seated and embedded presuppositions are reassessed and reconstructed internally in the light of new experience or learning.

As described above, the assessment of reflection is not a simple task. It is important for instructors to read reflections not only for evidence of content but also for the experiential meaning. Pierson (1998) suggests that reflection is both a technique and a process related to the German philosopher Heidegger's notions of calculative thinking, that being an "abstract and practical process confined to organizing, managing and controlling," and the concept of contemplative thinking, that being "a natural and spontaneous process fundamental to the exploration of meaning" (p. 166). Reflection then as "technique and process" becomes a learned skill. Educators must find ways of providing the valuable time and means to reflect "in action" and "on action." In this regard, exploration into which unique vocal elements instructors consider when assessing a student's voice reflection is important. The understanding of what elements are noticed and which of these are important can assist an instructor in formation of a reflective prompting structure for the student, and can additionally help form an assessment strategy for these types of reflective assignments.

Instructor Perceptions on Digital Voice Reflections, Methods, and Results

To explore instructors' perceptions in the assessment of student digital voice reflections, we conducted a cross-sectional survey, which is usually used to collect data from a pre- determined group at a single point in time to help describe characteristic opinions and attitudes of a specific population (Fraenkel & Wallen, 2009). This survey design type was considered appropriate because the use of voice reflections in nurse education is a new application of technology, and perceived factors unique to voice reflections that nursing instructors can use for assessment has not been fully determined. The study was designed to be done in two consecutive phases. In the first phase we surveyed a sample of instructors from a small college of nursing, and in the second phase we surveyed a larger sample of instructors from several colleges of nursing. The aim of the first phase of the study was to identify a list of perceived unique factors or elements found in a voice reflection. The second larger phase of the study was designed to validate and refine the list of factors created in the first phase and then to ask instructors to rate the factors for importance to assessment.

Phase One

For the first phase, we recruited nine consenting instructors, eight female and one male, for a face-to-face survey session. The selection of recruited instructors was chosen because they teach both didactic and clinical classes, and are experienced nurses and instructors. This group's average number of years in nursing was 22.7 years, and years teaching was 9.4 years. These instructors had no previous exposure to voice reflections, so they had no pre-conceived notions or bias toward any factor or elements found there. This is important because they could begin by identifying what factors they might expect to be present. The instructors were asked to conduct three tasks. First, they were asked to list factors/elements they expect to notice when listing to the student's voice reflection; no minimum or maximum number of factors was required. After the instructors completed the first step, we played two random selections from a group of five voice reflections (ranging from 1 minute 57 seconds to 3 minutes 28 seconds) generated by nursing students after completing their required clinical experiences. Immediately after listening to the two reflections, they were asked to numerically rate the items from one (low) to five (high) for usefulness in assessment; they were allowed to add any others they noticed or felt important.

We found that many of the factors/elements listed by the instructors were very similar in terms of intent, theme, and ratings. Each respondent listed between 2 and 8 factors (M = 4.4).

Factors provided ranged from a single word to several word descriptions, (e.g., "overall learning experience/what the student will carry forward"). All those factors that had been rated three or more were developed into a list and similar items were combined based on theme. We then divided that list into four themed factor categories: a) care and meaningfulness, b) the student's orientation to tasks and learning, c) the student's manner of speaking, and d) the recording quality and the tone of the student's voice (inflection). Each category contained a number of discrete sub-factors ranging from two for "care and meaningfulness" to six for "student's orientation to tasks and learning" (see Table 1).

Phase Two

The second phase of the study used a larger online sample of nursing instructors. We surveyed 60 respondents, 53 female and 7 male, from 14 Midwestern universities and colleges of nursing. The study was taken to an online format where the sample respondent population could be easily targeted and recruited. The consenting respondents were first informed of the steps to complete the survey. The respondents were then shown a page with a survey-generated random order list of the five voice reflections. They were instructed to select only one reflection and then click on a "play" arrow next to it to listen. The respondents were prompted in the next step to check small boxes by the factors they noticed when listening. They were provided a textbox option to add any other factors they noticed should they desire. The respondents then moved to the last step where they were asked to suppose they were assessing a voice reflection and rate the items on a 5-point Likert scale from one ("not important at all") to five ("very important") in terms of its significance in their assessment. They were also asked to list any factors not listed that they felt might be important for assessing a student's voice reflection.

We had decided earlier, based on feedback from the first phase of the study, that including the factor category of "care and meaningfulness" would appear redundant when scoring importance ratings for its two sub-factors, "caring attitude/empathy for patient" and "reflection on experience (personal meaningfulness)." Consequently it was not included in the list when the online survey was created.

To gain additional information about the respondents' opinions and the choices they made, we gave them the option to write additional comments. These comments provided valuable qualitative data to help corroborate the quantitative data the survey provided.

The data collected were analyzed using descriptive statistical methods to yield mean and median scores for the factor importance ratings found in the survey. The qualitative data were also examined using grounded theory techniques to find common respondent observations and themes.

We found that a small number of respondents did not rate some items, thus the mean score for each item does not necessarily represent opinions from the entire population. Two of the items received a rating from the entire sample population, and the lowest response rate for any item was 53. The mean rating value for each of the items shows that the top 14 factors out of the total list of 18 were rated above a value of four, which is considered "somewhat important." Ten of this group had a mean value at or above 4.5, and 12 had a median value of five. The highest mean values were for "expression of what was learned/discovered" (*M = 4.8, Mdn = 5, SD = .6*), "evidence of critical thinking/ thought" (*M = 4.8, Mdn = 5, SD = .5*), "caring attitude/ empathy for patient," "the student's orientation to tasks and learning" (both *M = 4.8*, *Mdn = 5, SD = .5*), and "reflection on experience (personal meaningfulness)" (*M = 4.7*, *Mdn = 5. SD = .5*).

The lowest rated items were "presenting a simple list of tasks performed" (M = 3.4, Mdn = 3, SD = 1.1), "presence of background sounds/voices" (M = 3.4, Mdn = 3, SD = 1.2), and "informal tone in speaking" (M = 3.5, Mdn = 4, SD = 1). (see Table 2).

When asked to list any other factors they noticed or felt were important for assessing a student's voice-journal, they mentioned "HIPPA compliance." HIPPA stands for the Health Insurance Portability and Accountability Act enacted in 1996, which demands compliance with strict privacy for individuals concerning health information. This is an important factor in healthcare, and great effort to stay in compliance is always expected in nurses and nursing students. Other comments did not necessarily focus on factors, mostly aimed toward the theme of student guidance. Examples are "training or an expectation of what the instructor expects might be helpful to provide before the students' record their reflection," and "provide a list of expectations for the reflection rather than letting them just ramble on without direction." The instructors also commented on elements that should be included in guidance, e.g., "the mention of patient response to treatment or care," and "I think it would be interesting to have the students discuss areas of improvement or what they might do differently in their next clinical assignment."

Discussion and Implications

The qualitative data suggest that instructors should prompt students to be cognizant of the tone of voice used when recording a voice reflection, and be precise and focused in their manner of speaking. They should always attempt to not sound bored, superficial, or uninterested in their presentation. The students should make attempts to sound professional, on topic, and comfortable using terms appropriate to the profession. This is appropriate as reflection contributes to a student nurse's development and quality of practice (Asselin, Schwartz-Barcott, & Osterman, 2012).

They should be organized and verbally concise in their presentation, and use an appropriate amount of recording time. To this end, time limits should be included in the voice reflection guidelines. Students should be instructed, or somehow guided to go beyond providing only a simple list of tasks performed in their reflections. They should attempt to critically tie information from their classes to the clinical experience in a reflective manner that focuses on personal and professional improvement. The reflection should have an "iterative dimension" where the experience creates a new understanding and way of going forward (Mann, Jordan, and MacLeod, 2009). Students should also take care to present an attitude showing care and empathy for the patients they report on.

Table 1

Noticed Unique Factors

Factor Category 1	(C) Care and Meaningfulness (C1) Caring attitude/empathy for the patient (C2) Reflection on experience (personal meaningfulness)
Factor Category 2	(T) The student's orientation to tasks and learning (T1) Presenting a simple list of tasks performed (T2) Presenting evidence of task prioritization (T3) Comfort with nursing topics and terms (T4) Information connected between classroom/clinical experience (T5) Evidence of critical thinking/thought (T6) Expression of what was learned/discovered
Factor Category 3	(M) The student's manner of speaking (M1) Professional manner of speaking (M2) Informal tone in speaking (M3) Organized manner of presentation
Factor Category 4	(R) The recording quality and the tone of the student's voice (inflection) (R1) Enthusiastic tone (R2) Bored or frustrated tone (R3) Superficial or distracted tone (R4) Presence of background sounds/voices

Table 2

Instructor Responses by Categories and Sub-Factor

	All M/SD	*Female M/SD*	*Male M/SD*	*Total responses*
(C) Care and Meaningfulness	--	--	-- 4.4/.8	--
(C1) Caring attitude/empathy for the patient	4.8/.5	4.8/.5	4.7/.5	55
(C2) Reflection on experience (personal meaningfulness)	4.7/.5	4.7/.5		54
(T) The student's orientation to tasks and learning	4.8/.5	4.7/.6	4.9/.4	54
(T1) Presenting a simple list of tasks performed	3.4/1.1	3.4/1.1	2.7/1.	56
(T2) Presenting evidence of task prioritization	4.7/.7	4.7/.6	4.7/.8	58
(T3) Comfort with nursing topics and terms	4.6/.7	4.6/.7	4.7/.5	56
(T4) Information connected between classroom/clinical experience	4.7/.6	4.7/.6	4.5/.8	53
(T5) Evidence of critical thinking/thought	4.8/.5	4.8/.5	5.0/0	53
(T6) Expression of what was learned/discovered	4.8/.6	4.8/.7	5.0/0	54
(M) The student's manner of speaking	4.3/.7	4.3/.7	3.9/.7	60
(M1) Professional manner of speaking	4.5/.7	4.6/.6	3.9/.7	59
(M2) Informal tone in speaking	3.5/1	3.5/1	3.4/1	59
(M3) Organized manner of presentation	4.7/.7	4.7/.7	4.9/.4	59
(R) The recording quality and the tone of the student's voice	3.7/1	3.8/1	3.1/.7	60
(R1)Enthusiastic tone	4.3/.8	4.3/.8	4.1/.9	58
(R2) Bored or frustrated tone	4.2/1.2	4.2/1.2	4.0/1.4	57
(R3) Superficial or distracted tone	4.2/1.2	4.2/1.2	4.0/.5	56
(R4) Presence of background sounds/voices	3.4/1.2	3.5/1.2	2.7/.5	58

Perceptions of the communicative elements are subjective, and lacking a specifically designed rubric these elements may not be able to be assessed appropriately. Creating a rubric though, cannot include everything an instructor utilizes when grading (Osborne and Walker, 2013). Survey comments however show that these elements appear to shape the instructors' perceptions of a student's learning and development. Elements that are not necessarily unique to voice reflections, such as connecting the classroom and clinical experience, evidence of critical thinking, indications of personal reflection, and expressions of care and empathy for the patient were indicated as being perceivable in the survey. The respondents easily perceived and often had a consensus agreement on the presence of or lack of presence of the voice reflection factors provided. Also they overwhelmingly felt these unique factors to be important in their hypothesized assessment process. Therefore these unique factors can be considered valid elements that may play into an instructor's assessment. The instructors who responded to this survey found the ability of students to record a reflection interesting, viable, and possibly worth trying in a course of their own.

This study represents a small early step in the process of integrating digital voice recording as part of a pedagogical strategy. It builds upon a commonly used tool, reflection, but adapts that tool to the technical capacities and time demands of the present day. Text dissemination of reflective knowledge can be scored based on the objective and subjective assessment of a student's writing skills, which are skills that lay outside of the realm of reflection, the true purpose of the assigned task. The score does not truly mirror whether the reflection was meaningful or transformative if the writing skill of the student is a strongly considered part of the assessment. The subtle emotional nuance of discovery or personal revelation becomes subject to the ability of the student to write well, and subsequently it may not translate to text in a manner that can be readily or meaningfully perceived by an instructor looking for deeper learning.

Limited vocabulary skills may also hinder accurate representation of their expression and reflective emotional overtones. The instructor reading the reflection has no choice but to examine, take into account, and possibly be biased by the writing and vocabulary skills of the student, as it is the only representation of their experience. These are prerequisite factors that may overshadow the meaning of what the student was actually trying to relate.

As computer technology becomes smaller, more powerful, and portable, educators will likely rely more heavily on multimedia for communication and dissemination of learning from students, and students rely on technology for gathering information and communication (Bennett, Maton, & Kervin, 2008). If this is the case, it is important to learn how instructors might consider a technical modality such as digital voice reflections as a useful means of learning. Though voice reflections also will be assessed both objectively and subjectively, they will offer different assessment challenges to an instructor. The student may follow the recipe-like prompting rubric, but their vocal quality and skills such as vocabulary, manner of speaking, and tone of voice will come into the assessment process much as their writing skills currently do. Voice reflections will provide additional rich material such as vocally inflected emotional cues from which the instructor can gauge learning and a student's attitude. It is important then to know what instructors perceive, and how important those perceptions are to their assessment, which was the aim of this study.

In summary, reflection is an important part of education. Recording reflective assignments gives an instructor the opportunity to review the student's spoken word, such as their manner of speaking and voice inflection, and assess their learning, personal relationship and experiential transformation. Though instructor perceptions of manner of speech and inflection are largely subjective in nature, these unique factors by virtue of their mere presence can be an element in shaping an instructor's assessment. Personal and professional transformation in education involves reflection, and technologies such as digital voice reflection can assist an instructor's assessment by providing not only evidence of learning but also some insight into the student's personal and professional view of the experience and their transformation.

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Advancing Virtual Patient Simulations and Experiential Learning with InterPLAY: Examining How Theory Informs Design and Design Informs Theory

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Abstract: Design-based research examines the role of theory in informing design, and the role of design in advancing theory. During the last year of a five-year NIH grant, a team of physicians, software engineers, and instructional designers at three public universities completed a series of iterative design studies to produce the first public release of NERVE—A virtual patient (VP) simulation created to give medical students standardized experiences in interviewing, examining, and diagnosing patients with cranial nerve disorders. The last year of the project, including the results of two cycles of expert reviews, one-to-one and small group evaluations, and a field test with 119 second-year medical students are reported by Hirumi et al. (2016a, 2016b). This article augments the previous papers by examining the pedagogical foundations of NERVE in greater depth. Specifically, we detail how the InterPLAY instructional theory was applied to design NERVE, and how the development and testing of NERVE lead to advancements in InterPLAY during the last year of research and development.

Keywords: virtual patient simulations, medical simulations, design research, instructional theory, experiential learning, instructional design.

Inadequate practice and evaluation are two of the primary reasons reported by medical students for limited knowledge and confidence in conducting neurological exams (Moore & Chalk 2009; Schon, Hart, & Fernandez, 2002). Learning how to diagnose patients with Cranial Nerve (CN) disorders is particularly challenging because they are rarely seen and difficult to imitate. Supervised encounters with real patients are hard to schedule because CN disorders are uncommon and standardized patients cannot readily reproduce disorders that affect motor nerves. Virtual patient (VP) simulations, one of five types of simulations used to facilitate medical education (Eder-Van Hook, 2004), give students substantive opportunities to gain knowledge and confidence in interviewing, examining, and diagnosing patients with CN palsies. VP simulations also give medical educators a tool for presenting clinical variations and providing standardized experiences with CNs and CN palsies.

Fueled by its potential and a five-year, $1.8 million grant from National Institute of Health (NIH), an interdisciplinary team of faculty, staff, and students specializing in medicine, software engineering, and instructional design from three universities in the southeastern United States set out to achieve two goals: (a) to develop a virtual environment that enables medical students to rehearse their interviewing, examination, and diagnostic skills with patients presenting with cranial nerve (CN) disorders, and (b) create a tool that would enable researchers to study different aspects of VP simulations research and development (R&D).

To discuss the range of studies completed by the team during the five-year initiative is beyond the scope of this paper. Kleinsmith et al. (2015), Rivera-Gutierrez et al. (2014), Lyons, Johnson, Khalil, and Cendan (2014), and Johnson et al. (2014, 2013) report findings from controlled experiments completed during the first four years of R&D that compared various aspects of VP simulations to inform the design of the system and advanced VP simulation research, such as individual versus small group use of the system, use of the system under competitive versus non-competitive conditions, the use of reflective questions embedded during versus after the simulation, instructor-led content delivery versus independent self-study of the content prior to use, and the use of an open-chat versus closed menu user interface.

In addition, in Parts I and II of a two-part series published in Educational Technology Research and Development, we detailed the design and development, and the testing and integration of the Neurological Exam Rehearsal Virtual Environment (NERVE)—the first public release of the VP simulation that resulted from the final year of R&D now available at http://nervesim.com (Hirumi et al., 2016a, 2016b).

In this article we examine the pedagogical foundations of NERVE in greater depth by discussing how the Inter*PLAY* instructional theory was applied to design NERVE, and how the development and testing of NERVE led to advancements in Inter*PLAY* during the last year. This article augments Parts I and II by allowing us to further demonstrate the interactive nature of applied and basic research by highlighting the role of theory in informing design, and the role of testing in refining theory (Collins, 1992). Specifically, we review literature and the method used to generate NERVE, and examine how the last year of R&D helped answer two basic design research questions:

1. How were the principles of experiential learning and the Inter*PLAY* instructional theory used to design NERVE?
2. How did the design and testing of NERVE advance the experiential learning principles and Inter*PLAY* theory?

Review of Literature

Eder-Van Hook (2004) distinguishes five types of simulations used to facilitate medical education: (a) low-tech simulators (e.g., models or mannequins used to practice simple physical procedures); (b) simulated standardized patients (i.e., actors trained to role-play as patients); (c) screen-based computer simulators (e.g., programs used to train and assess clinical knowledge and decision making); (d) complex-task trainers (e.g., computer-driven physical models of body parts and environment); and (e) realistic patient simulators (e.g., computer-driven, full-length mannequins that simulate anatomy and physiology, clinical reasoning and decision making). Virtual patient (VP) simulations use interactive computer technology to integrate instructional features before, during and after key interactions with screen-based computer simulators to foster clinical reasoning and enhance learners' diagnostic capabilities.

Synthesis research comparing the effectiveness of VP simulations with alternative instructional methods supports the efficacy of VP simulations. Based on a meta-analysis of 48 studies, Cook, Erwin, and Triola (2010) conclude that VP simulations are associated with higher learning outcomes than are conventional educational methods used in medical schools. Similarly, in a meta-analytic review of 14 studies, McGaghie, Issenberg, Cohen, Barsuk, and Wayne (2011) found that simulation-based medical education is more effective than traditional, lecture-based methods (ES=0.71). More recently, a meta-analysis of randomized controlled studies also showed a clear positive pooled overall effect for VP simulations compared to other educational methods (Consorti, Mancuso, Nocioni, & Piccolo, 2012). Yet, we cannot simply give students access to VP simulations and assume that they will learn. Studies report low acceptance, usage and satisfaction among medical students when learning resources, such as VP simulations, are poorly designed or not well integrated with other curricular components (Berman et al. 2009; Fischer et al. 2007).

A growing body of research now emphasizes the importance of design for facilitating medical education. "Apparently, learning outcomes depend on the quality of instructional design methods rather than on the medium used" (Huwendiek et al., 2009, p. 581). Based on a systematic review of literature, Issenberg et al.'s (2005) identified ten design features of high-fidelity medical simulations that lead to effective learning, including (a) providing feedback, (b) repetitive practice, (c) curriculum integration, (d) range of difficulty level, (e) multiple learning strategies, (f) capture clinical variation, (g) controlled environment, (h) individualized learning, (i) learning outcomes, and (j) simulation validity (e.g., realism, authenticity). By analyzing focus group interviews of Year 5 medical students who worked through eight VP simulations, Huwendiek et al. (2009) also found ten similar VP design features for fostering learning, including (a) relevance, (b) appropriate level of difficulty, (c) interactivity, (d) specific feedback, (e) appropriate use of media, (f) focus on relevant learning points, (g) recapitulation of key learning points, (h) authenticity of the design of the web-based interface, (i) authenticity of the learning task, and (j) questions and explanations tailored to the clinical reasoning process. Issenberg et al.'s and Huwendiek et al.'s findings, along with 18 additional VP design studies published since 2006 provided insights into the nature and range of key features for designing VP simulations (Reyes & Hirumi, 2016). To provide further context for this study, we also examined the pedagogical foundations (the learning and instructional theories, models and strategies) that were used to ground the design of key features included in the reported VP simulations.

In a review of VP design studies published since 2006, Reyes and Hirumi (2016) found that 10 out of 20 (50%) of the authors cited models of how physicians critically reason through clinical cases, and 15/20 (75%) referred to the use of instructional strategies for developing clinical reasoning skills to guide the design of VP simulations. Table 1 depicts the frequency in which the authors referred to the application of clinical reasoning

Table 1

Frequency of learning theories and instructional strategies posited to guide the design of VP simulation

Pedagogical Foundation	Publications																					
	Cook & Triola (2009)	Huwendiek et al. (2009)	Botezatu et al. (2010)	Botezatu et al. (2010)	Cook et al. (2010)	Huwendiek & de Leng (2010)	Adams et al. (2011)	Gormley et al. (2011)	Bateman et al. (2012)	Borda & Norcini (2012)	Cendan & Lok (2012)	Consorti et al. (2012)	Wilson (2012)	Bateman et al. (2013)	Huwendiek et al. (2013)	Georg & Zary (2014)	Huwendiek et al. (2014)	Kononowicz et al. (2014)	Posel et al. (2014)	Salminem et al. (2014)	**Total**	**Percent (%)**
Reasoning Strategy	X	X			X	X	X		X		X	X	X		X	X	X	X	X	X	**15**	**75**
Reasoning Model		X				X						X	X	X	X	X	X		X	X	**10**	**50**
Experiential Learning											X							X		X	**3**	**15**
Cognitive Multimedia					X			X						X							**3**	**15**
Cognitive Load											X			X	X						**3**	**15**
Activity Theory												X									**1**	**5**
Situated Cognition													X								**1**	**5**
Blended Strategy															X						**1**	**5**

as well as other pedagogical foundations to design VP simulations, including experiential and cognitive multimedia learning theory, cognitive load and activity theory, situated cognition, and a blended instructional strategy (Reyes & Hirumi, 2016).

Considering their primary purpose, the use of clinical reasoning models and instructional strategies as predominant frameworks for designing VP simulations is to be expected. However, we posit that in a relatively nascent field, it may be beneficial to explore alternative theories, principles, and strategies to optimize the design of VP simulations. This is not to say that VP simulations that are grounded in clinical reasoning are insufficient or inappropriate. Rather, exploring competing theories and models from other fields and disciplines, such as the psychology of learning, instructional systems design, cognitive work analysis, and adult learning, may also be useful for designing VP simulations (AHRQ, 2013).

In an early attempt to form a prescriptive theory for the design of computer-based simulations, Reigeluth & Schwartz (1989) presented a general model and variations of the model that include recommendations for designing the instructional overlay that facilitates the introduction, acquisition, application, and assessment stages of simulations, and addresses system versus learner control issues. More recently, de Jong and van Joolingen (1998) present principles for designing simulation-based discovery learning environments based on an in-depth analysis of characteristic problems faced by students challenged with directing their own learning, and techniques for providing instructional support to facilitate and regulate key stages of the discovery learning processing, including hypothesis generation, design of experiments, and making predictions. Gredler (2004) also prescribes strategies for designing interactive, discovery learning exercises that center on modeling research skills and teaching metacognitive skills to limit extraneous cognitive load. Building on the works of Reigeluth and Schwartz, de Jong and van Jollingen, Gredler, and others, Gibbons, McConkie, Seo, and Wiley (2009) proposed theory for designing instructional simulations comprised of an array of principles for facilitating seven basic functions, including: supplying model content, implementing instructional augmentations, providing user controls, generating message units, assembling elements, executing computations, and managing data.

Organizational and educational psychologists also emphasize the importance of the instructional features embedded into training and educational simulations, and propose principles and procedures for optimizing simulation-based training (SBT). For instance, Sales and Gregory (2011) propose seven steps for maximizing the effectiveness of SBT systems based on their understanding of the science of learning, including analyzing performance history and skill inventories, deciding what tasks and competencies to address, determining the training objectives, designing scenarios with key trigger events, determining how to measure the events, observing and diagnosing performance, and giving diagnostic feedback. In contrast, Quinn (2007) distinguishes nine principles for designing engaging computer-based simulations, founded on his interpretation of learning theories and synthesis of common elements for effective entertainment and education, including: an integrated theme to contextualize learning, clear goals, appropriate challenges, evident links between learners' actions and goal achievement, learners' interest in goals and world, active choices and exploration, direction manipulation, appropriate feedback, and gaining attention.

Together, the models of clinical reasoning, the strategies for developing critical reasoning skills, and the principles for designing computer-based simulations provide alternative frameworks for grounding the design of VP simulations. In the following subsections, we illustrate the primary design features of NERVE and review the method used to design and field-test NERVE.

Primary Design Features

NERVE is made up of three primary components: (a) a series of introductory screens that "frame the experience" according to one of the three universal principles of experiential learning (explained later in the paper), (b) a Learning Center which contains basic information on cranial nerve (CN) anatomy, physiology, symptoms, and pathology, and allows students to practice the use of relevant physical examination tools, and (c) an Exam Room that presents students with 10 cases of virtual patients presenting with CN disorders. To see and experience the entire system, we encourage you to access NERVE at http://nervesim.com, set up a free account, and take it for a test drive. We illustrate key design features of the Exam Room and Learning Center here to provide further context for answering the two research questions posed in this article.

Figure 1 illustrates how students may access the 12 VP cases contained in the NERVE Exam Room using either the menu-driven selection or the open-ended chat user interface.

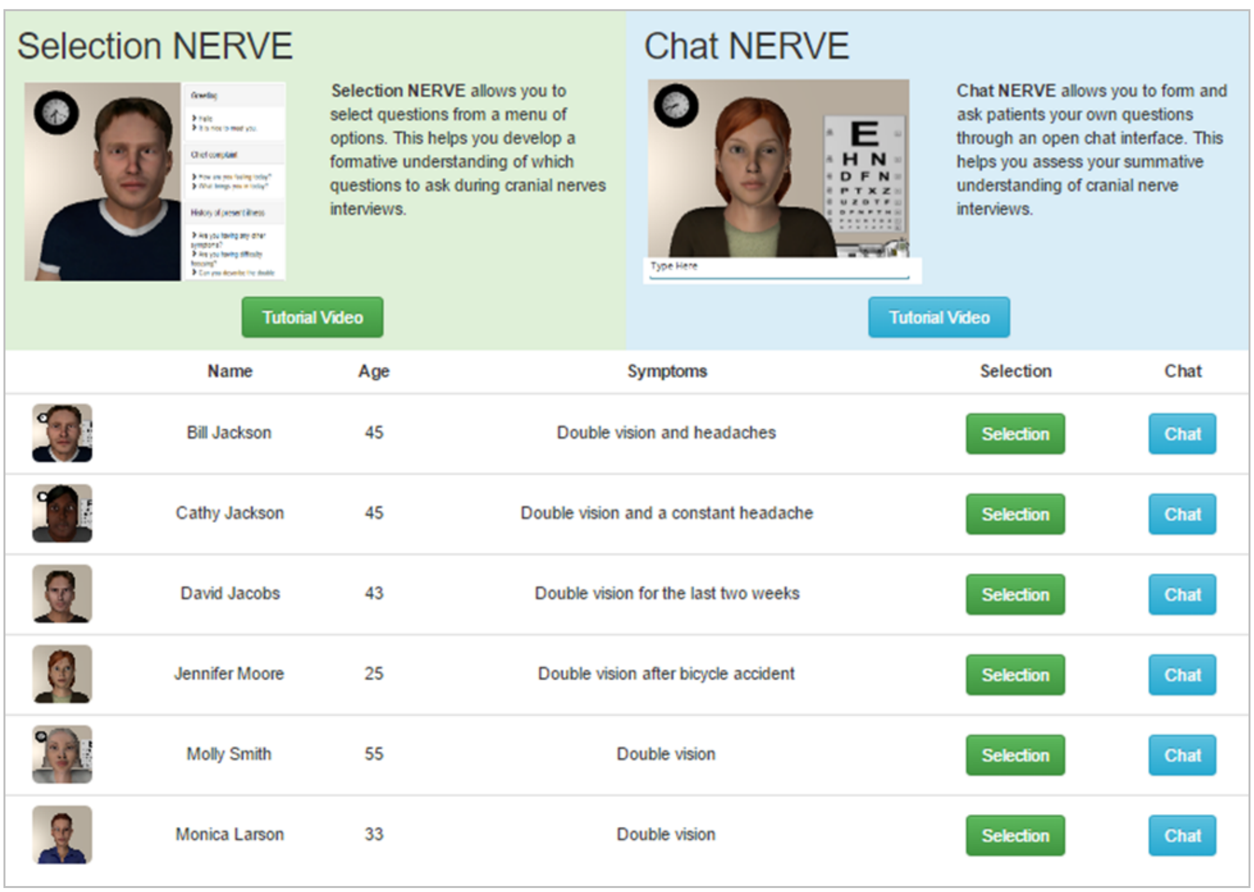


Figure 1. Screenshot of NERVE Exam Room providing access to virtual patients through two user interfaces.

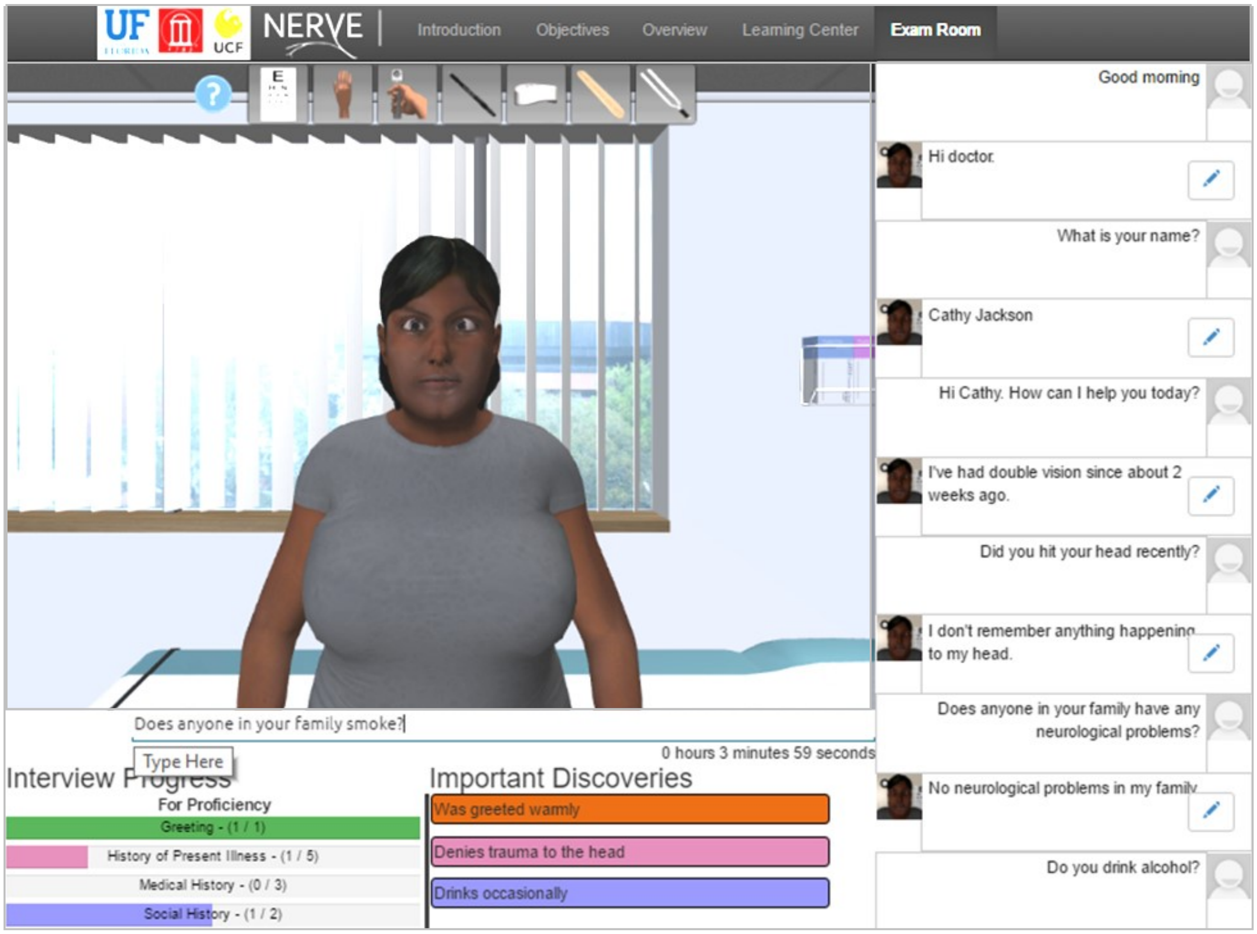


Figure 2. Screenshot of interactions with virtual patient using the open chat user interface.

Most VP simulations are based on a problem-solving (PS) approach, presenting learners with multiple -choice actions to advance through different scenes that depict various provider-patient interactions (Bearman, 2003; Huang, Reynolds & Candler, 2007). However, by limiting responses to a defined set of choices, PS designs neither simulate authentic communications with patients, nor foster students' ability to formulate questions. The PS approach feels scripted and students have little control over what to do next (Bearman, 2003). To address the limitations associated with the problem-solving approach, we designed NERVE with an open-ended, chat-driven interface, further illustrated in Figure 2, that allows students to interview the virtual patients following a relatively authentic, conversational narrative approach to uncover enough relevant information to make a diagnosis.

During the first several years of the project, students expressed significant concerns for the system's inability to recognize all forms of open-ended student input. The resulting feelings of frustration when the system did not respond in a meaningful fashion led us to develop a menu-driven user interface. The menu-driven interface presents all possible utterances recognizable by the virtual patient in a tree-like structure. During a virtual exam, a student navigates the tree by clicking on topic areas. Clicking on a topic expands that branch of the tree, revealing sub-topics and topic utterances. Selecting a question from the topic menu triggers a response from a database of possible patient utterances, as illustrated in Figure 3.

When we tested both chat and menu-driven interfaces during year four of the project, we found that some students preferred the realism of the open-chat interface, while others preferred the efficiency of the menu-driven interface, and the majority wanted the option to use either or both interfaces. Considering that the system is designed for both first-year medical students, who may need more scaffolding and structure to develop interviewing skills, and second-year students who may need or want the freedom of the open-chat interface to work on their ability to formulate and organize interview questions, we decided to give students access to both the open-chat, and menu-driven user interface to interview, exam, and diagnose the virtual patients.

During the first four years of R&D, prerequisite knowledge of basic cranial nerve anatomy, physiology, and pathology was covered by medical school faculty in conventional lecture style format before students were given access to NERVE. Following the typical medical school curriculum, first-year medical students were presented with content related to the anatomy and physiology of the central nervous system outside of brain stem (gross anatomy) and second year students were presented with content on neuro-anatomy and physiology

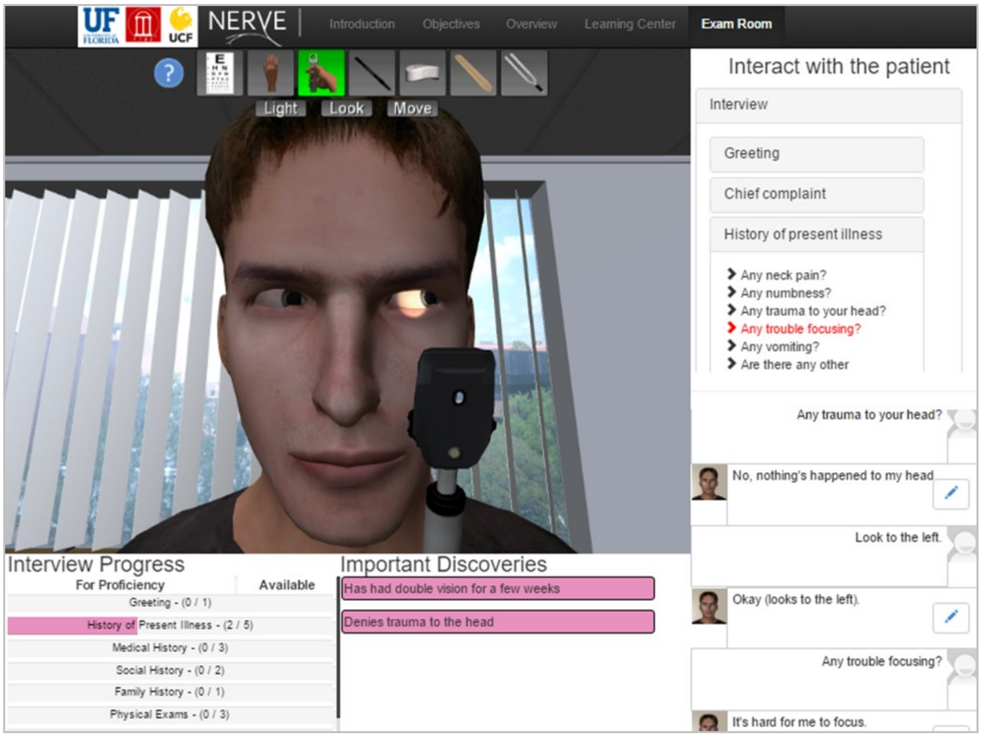


Figure 3. Screenshot of interactions with virtual patient using the menu-driven selection interface.

(inside the brain stem). The Learning Center represents a major addition to NERVE, made during the last year of the project. It helped make NERVE a self-contained, independent learning platform, giving students the opportunity to: (a) learn how and when to use the physical examination tools for diagnosing patients with potential CN disorders, (b) review relevant information about CN anatomy, physiology, symptoms and pathology, (c) explore published case studies about CN disorders, and (d) take a series of multiple choice quizzes. Figure 4 depicts the initial frame of the Learning Center that highlights key aspects of each of the 12 cranial nerves.

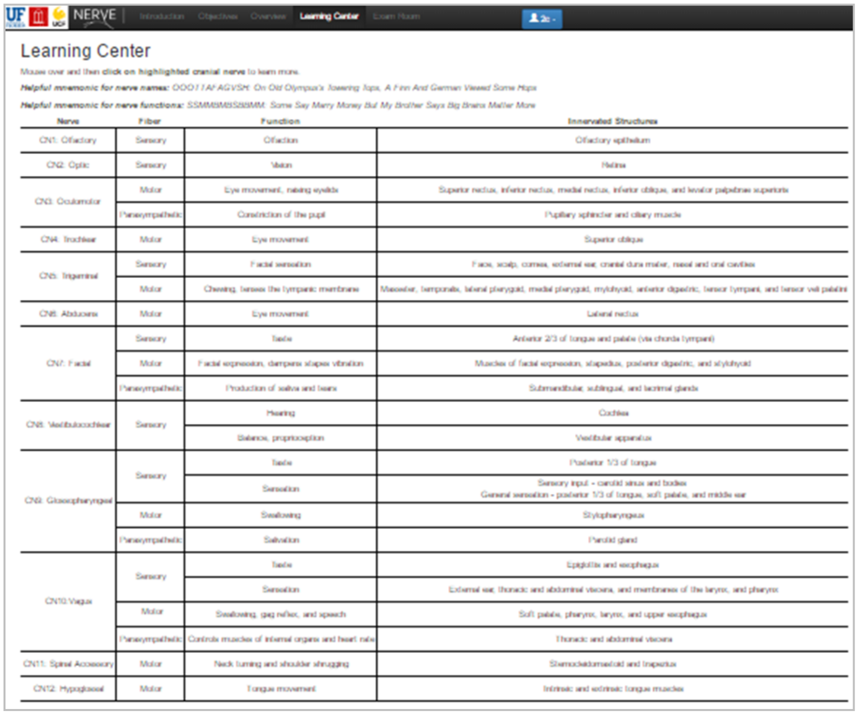
Selecting any one from the overview of all 12 cranial nerves provides access to further details about each nerve. Figure 5 illustrates how information about the anatomy and physiology of CN 1 (the Olfactory Nerve) is presented to students.

In addition to providing information about anatomy and physiology, symptoms and pathology, cases studies, and a quiz, the Learning Center also includes an Interactive Tool section for each CN. Figure 6 shows how the Interactive Tools provided for CN 4 (the Trochlear nerve) allow students to use a slider to induce varying levels of trauma to the nerve and see the relative effects on the patient, as well as give students the opportunity to practice relevant physical examinations.

Method

To develop the latest version of NERVE that was made accessible to the general public in year 5, we conducted a series of design-based research studies during the final year of the project to formulate both theoretical insights and practical solutions with stakeholders in a real-world context, as suggested by McKenney and Reeves (2012). During the last year of R&D, we worked with medical-school students, staff and instructors to address five features of design experiments posited by Cobb et al. 2003, p. 9–11), including: (a) the development of, "a class of theories about both the process of learning and the means that are designed to support that learning," (b) investigating, "the possibilities for educational improvement by bring about new forms of learning in order to study them," (c) testing a hypothesized learning process and fostering, "the emergence of other potential pathways," (d) being pragmatic in addressing practical problems faced by practitioners, and (e) containing iterative cycles of invention and revision. The design and development (Hirumi et al., 2016a) and the integration and testing of NERVE (Hirumi et al., 2016b) focused on investigating the possibilities of educational improvement, testing a hypothesized learning process, being pragmatic, and detailing the iterative cycles of invention and revision. For the purposes of the present article, we review the iterative design method followed during the last year, and discuss the development of a class of theories about learning and instructional design to examine the role of theory in informing design, and the role of testing in refining theory (Collins, 1992).

Like Hmelo and Day (1999), we gathered and analyzed computer logs and students' responses to the system throughout the final year of R&D. We also completed two cycles of expert reviews, one-to-one and small group evaluations, along with a field test. During the first cycle, a subject matter expert (SME) and four second year medical students helped identify the most obvious errors in the initial alpha prototype of NERVE. The SME and students also evaluated the clarity of the instructional objectives, content information, and tutorials, and the usability of the user interface and physical exam tools. Comments and observations were recorded by two team members, who compiled the results, formulated and ranked recommended revisions based on



NERVE | Introduction Objectives Overview Learning Center Exam Room

Learning Center

Mouse over and then **click on highlighted cranial nerve** to learn more.

Helpful mnemonic for nerve names: *OOOTTAFAGVSH: On Old Olympus's Towering Tops, A Finn And German Viewed Some Hops*

Helpful mnemonic for nerve functions: *SSMMBMBSSBBMM: Some Say Marry Money But My Brother Says Big Brains Matter More*

Nerve	Fiber	Function	Innervated Structures
CN1: Olfactory	Sensory	Olfaction	Olfactory epithelium
CN2: Optic	Sensory	Vision	Retina
CN3: Oculomotor	Motor	Eye movement, raising eyelids	Superior rectus, inferior rectus, medial rectus, inferior oblique, and levator palpebrae superioris
	Parasympathetic	Constriction of the pupil	Pupillary sphincter and ciliary muscle
CN4: Trochlear	Motor	Eye movement	Superior oblique
CN5: Trigeminal	Sensory	Facial sensation	Face, scalp, cornea, external ear, cranial dura mater, nasal and oral cavities
	Motor	Chewing, tenses the tympanic membrane	Masseter, temporalis, lateral pterygoid, medial pterygoid, mylohyoid, anterior digastric, tensor tympani, and tensor veli palatini
CN6: Abducens	Motor	Eye movement	Lateral rectus
CN7: Facial	Sensory	Taste	Anterior 2/3 of tongue and palate (via chorda tympani)
	Motor	Facial expression, dampens stapes vibration	Muscles of facial expression, stapedius, posterior digastric, and stylohyoid
	Parasympathetic	Production of saliva and tears	Submandibular, sublingual, and lacrimal glands
CN8: Vestibulocochlear	Sensory	Hearing	Cochlea
		Balance, proprioception	Vestibular apparatus
CN9: Glossopharyngeal	Sensory	Taste	Posterior 1/3 of tongue
		Sensation	Sensory input - carotid sinus and bodies General sensation - posterior 1/3 of tongue, soft palate, and middle ear
	Motor	Swallowing	Stylopharyngeus
	Parasympathetic	Salivation	Parotid gland
CN10: Vagus	Sensory	Taste	Epiglottis and esophagus
		Sensation	External ear, thoracic and abdominal viscera, and membranes of the larynx, and pharynx
	Motor	Swallowing, gag reflex, and speech	Soft palate, pharynx, larynx, and upper esophagus
	Parasympathetic	Controls muscles of internal organs and heart rate	Thoracic and abdominal viscera
CN11: Spinal Accessory	Motor	Neck turning and shoulder shrugging	Sternocleidomastoid and trapezius
CN12: Hypoglossal	Motor	Tongue movement	Intrinsic and extrinsic tongue muscles

Figure 4. Screenshot of the introductory frame of the NERVE Learning Center illustrating how information about twelve cranial nerves is initially presented to learners

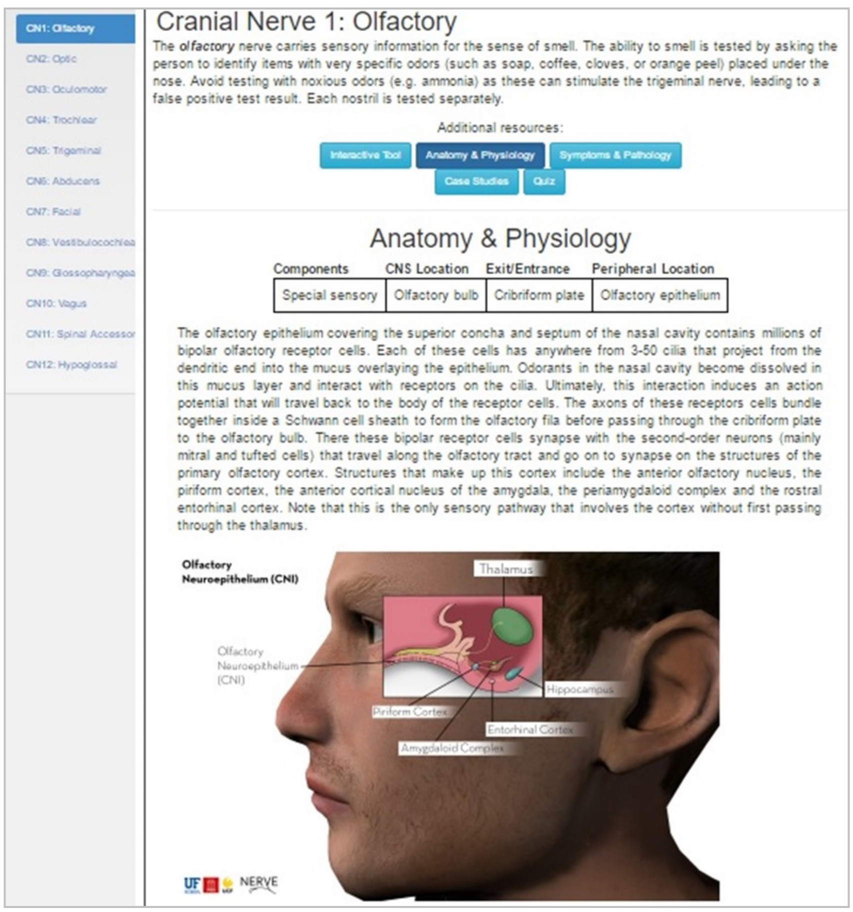


Figure 5. Screenshot illustrating how information on CN anatomy and physiology is presented to students

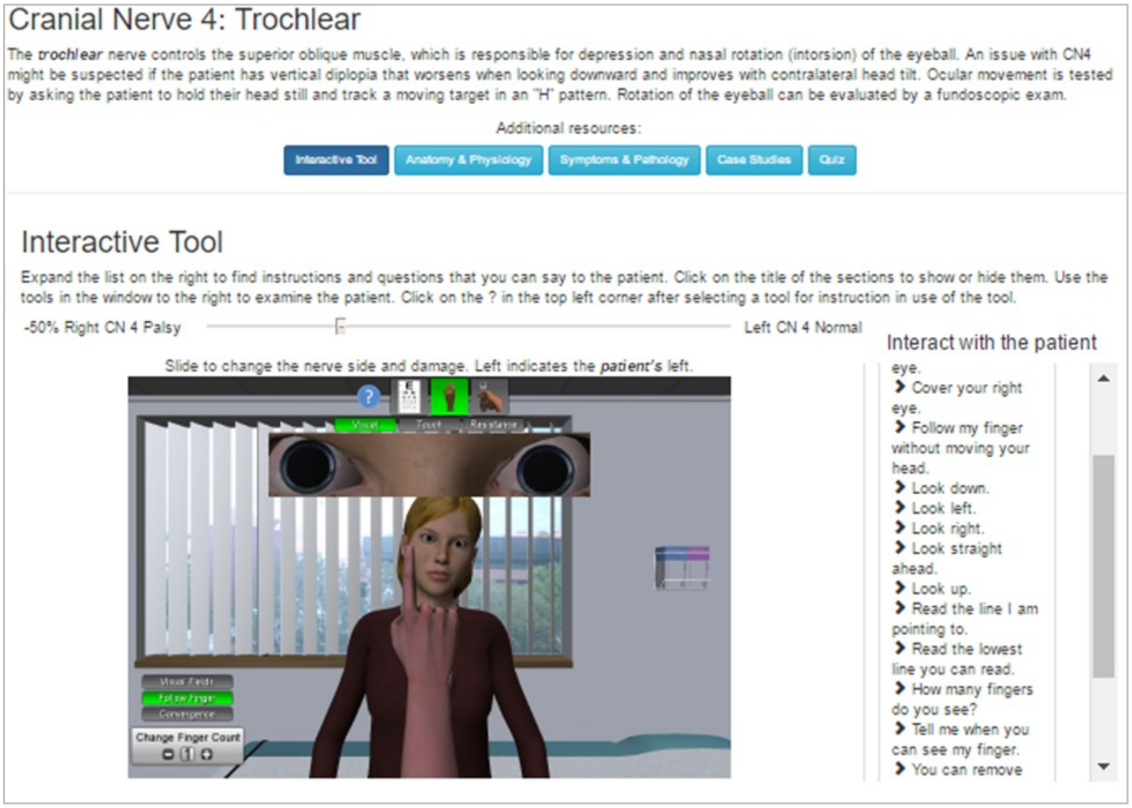


Figure 6. Screenshot depicting how students are given the opportunity to practice using relevant physical examination tools in the NERVE Learning Center

perceived impact and cost, and presented the recommended revisions to the entire R&D team. The entire R&D team then discussed and reached consensus on what revisions to make and when during weekly teleconferences.

During the second cycle of design studies, two SMEs, four first year medical students, and a small group of instructional design graduate students evaluated version Two of the alpha prototype. The experts and students evaluated the revisions made based on the findings for Cycle One, and again reviewed the objectives, content, and tutorials for clarity and validity, and the interface and exam tools for usability. During the second cycle, the feasibility of implementing the VP simulation, given available time and resources, was also considered along with the impact of the VP simulation on students' attitudes and achievement. Again, the team members who facilitated the studies compiled the results, formulated and ranked recommended revisions, and presented their recommendations to the entire R&D team members, who then decided what revisions to make and when. Revisions based on Cycle Two findings led to the development and testing of the beta version of NERVE.

The beta prototype was field-tested with 120 medical students enrolled in a second-year neurology course as illustrated in Figure 7.

Patterned initially after Huwendiek et al.'s (2013) preferred sequencing of VPs and educational activities, we used existing VPs integration research, input received from the instructor, and the universal principles of experiential learning to hone our strategy for integrating NERVE into the medical school curriculum. The strategy included (a) a lecture on neurology, (b) a demonstration of NERVE with explicit expectations and requirements, (c) VPs interactions within NERVE, (d) an instructor-led after action review with the entire class, and (e) a standardized patient/virtual patient (SP/VP) hybrid encounter, as depicted in Figure 7.

Findings and Discussion

We detailed the design and development of NERVE in Hirumi et al. (2016a) and report students' use, reactions, learning and transfer of NERVE in Hirumi et al. (2016b). Here, we focus on examining the pedagogical foundations of NERVE and answering the two design research questions specified for this article.

Question 1: How were the principles of experiential learning and InterPLAY instructional theory used to design NERVE?

The diversity of approaches for designing instructional stimulations in general, and VP simulations in particular is evident. But while some may lament the lack of consensus, we believe that studying alternative perspectives and fostering variance at this time may lead to innovation in a rapidly developing field. Inter-*PLAY* in an instructional theory that integrates experiential learning principles with elements of story, play and game to optimize what other have referred to as instructional augmentation, support, and overlay for facilitating simulation-based learning. Here, we examine how we applied the Inter*PLAY* instructional theory to design key pedagogical features of NERVE during the last year of research and development.

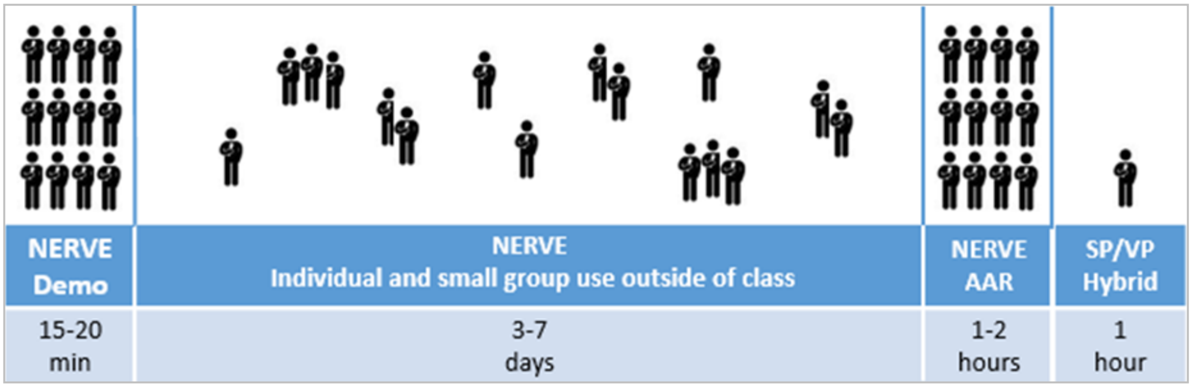


Figure 7. Figure depicting key events of the strategy used to integrate the NERVE virtual patient simulation into medical school curriculum

Note. From "Advancing virtual patient simulations through design research and interPLAY: part II – integration and field test," by A. Hirumi et al., 2016, *Educational Technology Research and Development*, DOI 10.1007/s11423-016-9461-6. Copyright 2016 by A. Hirumi. Reprinted with permission.

Experiential approaches to teaching and learning are based on two central principles posited originally by Dewey in 1920s and 30s: (a) continuity (the idea that students learned from their experiences), and (b) interaction (the notion that students' experiences were derived from their interactions with the environment and other individuals) (Dewey, 1938, p. 25). Advocates of experiential learning also believe that children, adolescents and adults learn best when presented with relevant, meaningful, and interesting challenges, and skill development and the learning of facts, concepts, procedures, and principles occur in context of how they will be used (Schank, Berman & Macpherson, 1999). The merits of experiential learning are evidenced by the number of models that have been developed in its name over the past 50 years (e.g., Kolb & Fry, 1975; Kolb, 1984; Schank, Berman & Macpherson, 1999; Clark, 2008).

However, experiential approaches to teaching and learning do not explicitly address the role of human emotions and imagination during the learning process (Hirumi, 2013a). They neither explain how human emotions and imagination may affect experiential learning, nor suggest methods for stimulating human emotions and imagination during the learning process to enhance student engagement and achievement. As a result, the application of experiential learning principles may not realize the potential of emerging technologies to facilitate individual and team performance.

The Inter*PLAY* instructional theory advances experiential learning by addressing the role of human emotions and imagination during the learning process. More specifically, Inter*PLAY* integrates the elements of three primary conventions of interactive entertainment (i.e., Story, Play and Game) with existing experiential learning principles to evoke emotions, spark imagination, and create engaging and memorable learning experiences (Hirumi, 2013a, 2013b; Stapleton & Hirumi, 2014, 2011).

Historically, human emotions and imagination have been ill-defined and hard to measure, making it difficult for educational researchers and practitioners to systemically address either construct in the development of learning theories and systems. Now, psycho-physiological measures and neurobiological studies are providing meaningful insights into how emotions and imagination affect learning. Eliot and Hirumi (2015) present a critical review of research on human emotions and learning. Reyes and Hirumi (2015) review neuroscience research on methods used to stimulate and measure human imagination. Detailed discussion of the neurobiological dimensions of experiential learning, including human emotions and imagination are presented by Hirumi (2013a; 2013b) and discussed Atkinson & Hirumi (2010).

Key findings from cognitive neuroscience studies of human emotions that drive Inter*PLAY* are: (a) the strength of our emotional reactions to an experience determines how well and long we remember that experience (Labar & Cabeza, 2006); (b) the valence of our emotional reactions (+ or -) determines whether we choose to return to or avoid similar experiences (Hare et al., 2005; Nieh, Kim, Namburi & Tye, 2013); (c) the changing of emotions throughout an experience, in terms of both strength and valence, is what keeps us engaged with the experience over time (Li et al., 2014); and (d) physiological measures of basic human emotions (i.e., anger, fear, joy, sadness, disgust) may yield better predictors of human behavior than psychological measures of complex multi-dimensional conceptualizations of human emotions (Eliot & Hirumi, 2015).

Findings from neurophysiological studies of human imagination that motivate Inter*PLAY* suggest that (a) on-going emulations of cause and effect relationships mediate human behavior and decision-making (Colder, 2015); (b) imaging task performance enhances memory and our ability to complete the task (Borkin et al., 2013); and (c) if we can't imagine ourselves performing a task, our chances of engaging in and successfully completing the task are slim (Madan & Singhal, 2014; Tia et al., 2010).

Figure 8 depicts the key concepts of Inter*PLAY* and their related elements. In short, the theory posits the integration of story (characters, worlds, and events), play (stimulus, response, and consequences), and game (goals, rules and tools) with three principles of experiential learning described by Lindsey and Berger (2009) (i.e., framing, activating and reflecting on the experience) to enhance learner engagement, and the design of memorable and meaningful learning experiences. To answer research question one, we first describe how we applied the three principles of experiential learning to design NERVE. We then discuss how we applied the conventions of story, play and game to advance experiential learning and the design of the VP simulation.

Applying Principles of Experiential Learning, In 2012, the Principal Investigators (PIs) of NERVE suggested that interactions with virtual patients can leverage experiential learning theory to motivate learners, and referenced Kolb and Fry's (1975) four-stage cyclical model as a strategy for students to become more active participants in the learning process (Cendan & Lok, 2012). Since then, no further references or explicit attempts were made to address experiential learning principles until the last year of the project.

During the first three to four years of the initiative, team members focused on examining tools and techniques used to interview, examine and diagnose patients presenting with CN disorders. In essence, they formulated a model of clinical reasoning to help drive the design of the VP simulation. The need to adequately represent the visual and communicative effects of the injuries drove the team to create authentic representations of CN palsies and study different ways to optimize simulated interactions with VPs.

Entering the final two years of the project, the team began to consider the design and delivery of the final product. The original grant proposal called for the development of a virtual environment that enables medical students to rehearse interviewing, examination, and diagnostic skills. The team also wanted to produce a stand-alone product—a system that students (with some direction) could access on their own to gain basic skills and knowledge about CNs and diagnosing patients with CN disorders so that medical educators could spend

Figure 8. Conceptual elements of the InterPLAY Instructional Theory.

Note. From "Advancing virtual patient simulations through design research and interPLAY: part II – integration and field test," by A. Hirumi et al., 2016, *Educational Technology Research and Development*, DOI 10.1007/s11423-016-9461-6. Copyright 2016 by A. Hirumi. Reprinted with permismore precious time in class addressing clinical variations or other curricular issues. For over three years, the team experimented with different tools and techniques, and gained insights on how to simulate CN palsies and the interview/examination process.

Tasked with helping design a standalone system, the instructional design (ID) expert refocused the team's attention on the pedagogical foundations of NERVE. He characterized the evolution of experiential learning theory, briefed team members on published experiential approaches, and encouraged team members to apply the three universal principles of experiential learning described by Lindsey and Berger (2009) during the last year of R&D. He chose to focus on the three experiential learning principles for two reasons: (a) the team adopted experiential learning as a foundation for design earlier in the design process (Cendan & Lok, 2012); and (b) applying a smaller, parsimonious set of principles seemed more feasible than addressing larger sets, such as Bergin and For's (2003) twelve pedagogical features for designing ISPs.

When the potential for improving NERVE became apparent, the R&D team adopted and worked to apply the three universal principles. It became evident that the team was already applying Principle 2. Principles 1 and 3 were not previously addressed and became particularly important for integrating key instructional events before and after the VP simulations to facilitate learning.

Principle 1 – Framing the Experience. To frame the experience, Principle 1 includes, "communicating the instructional objectives, assessment criteria, expected behaviors, and social structure with peers, instructors and the environment beyond the class" (Lindsey & Berger, 2009, p. 124). During the initial four years of R&D, objectives varied based on goals of the researchers and the specific study under investigation. For our project, an explicit set of measurable performance objectives for medical students were specified for NERVE during the final year of development.

Application of Principle 1 informed an important discussion between those involved in technical/computing development and those responsible for the medical content. In short, they had to agree on the core outcomes to be presented and assessed. The team had to strategize how much simulation was enough to demonstrate certain pathologies; for example, after early attempts to incorporate haptic (force) feedback, no effort was made to simulate examination tools and techniques that required a sense of touch or motor perception to limit the scope of the simulation. The learning objectives had to be met with the understanding that there would be reasonable technical boundaries for the modeling and simulation of the palsies.

Cognitive task analysis of the goal (to give medical students a standardized experience in examining, interviewing, and differentially diagnosing patients with CN palsies) revealed essential subordinate skills and knowledge that were transformed into performance objectives (such as to recognize the pathology and symptoms of cranial nerve dysfunctions, perform appropriate physical examinations, identify damaged nerves, and formulate hypotheses about the cases of identified palsies) and made explicit in the introductory screens of NERVE during the last year of R&D. The recommended social structure, also communicated with the initial introductory screens, encourages students to explore NERVE individually or "learn best by working in teams of two or more students" as suggested by earlier research findings (Rivera-Gutierrez et al., 2014, p. 697). To further frame the experience, students are shown the two basic components of NERVE, a Learning Center (where they can practice the use of physical examination tools and learn about cranial nerve anatomy, physiology, symptoms and pathology) and the Exam Room (where they are tasked with diagnosing virtual patients presenting with symptoms of CN disorders). The initial pages also mention the benefits of the experience - learning, practice, and a safe place to explore - to frame what students should gain from the experience. In reality, much of what has become nervesim.com is related to framing the experience.

However, the assessment criteria and expected behaviors were left to the instructor to define and communicate when the system is first demonstrated to students. Performance assessments in the form of quizzes and students' diagnoses of virtual patient cases are included in NERVE, but the system does not specify requirements for examining specific CNs and patients and completing certain quizzes so faculty at different medical schools may establish performance criteria and expectations for their own students.

Like others (c.f., Lindsey & Berger, 2009), we believe that framing the experience is important. However, until we conducted multiple studies focused on the usability and implementation of the system, team members thought the experience was adequately framed, but in reality, we found out during testing that users were still confused as to what exactly they were to be learning from the experience. NERVE was simply an application that was run to interact with a virtual patient with a particular cranial nerve disorder. The nervesim.com website now frames these experience and provides a way for an individual to learn without the direct assistance of an instructor (although instructors are certainly part of the overall process).

Principle 2 – Activating Experience. To activate both prior and newly initiated experiences, Principle 2 recommends: (a) providing authentic experiences to facilitate transfer; (b) making decisions that have authentic outcomes; (c) orienting learners so they see the relevance of the specific learning activities in relation to the larger problem; and (d) presenting challenges with optimal levels of difficulty to keep them engaged (Lindsey & Berger, 2009).

Principle 2 was the initial driver for the project that was most consistently addressed prior to formally adopting the three universal principles of experiential learning. From the beginning of the project, team members constantly sought to facilitate transfer by providing the most authentic experiences possible with VP simulations that ask learners to make decisions that have realistic outcomes. Throughout the five-year project, team members also sought to orient learners so they could see the relevance of the VP simulations in relation to the problem of interviewing, examining and diagnosing patients with CN disorders, and to present cases with optimal levels of difficulty to keep medical students engaged.

For the final year of development, we reexamined each tool and the user interface for authenticity and ease of use, making a few significant changes. For example, in previous versions of NERVE, students performed a funduscopic examination by moving a virtual ophthalmoscope towards the patient's eye, which showed the entire retina. Simply moving the virtual ophthalmoscope, however, did not match well with the real examination. We simplified the interface so that with a couple of clicks, students could perform all the actions necessary to complete the physical examination with an ophthalmoscope (e.g. moving the ophthalmoscope to a particular eye, turning on the light, and maneuvering it to examine the retina). Other tools that were streamlined by automating their use included a hand (to test eye tracking), eye chart, tongue depressor, tuning fork, bar of soap, and a ballpoint pen.

Case histories were also generated and made accessible for each VP that oriented learners to the specific learning activities within context of a larger problem being experienced by the patient. To provide optimal levels of difficulty, students were encouraged to use either the open chat or the closed menu interface to examine and interview the virtual patients based on their level of experience.

Principle 3 – Reflecting on Experience. Principle 3 suggests that, "Experience must be analyzed to learn from it. Reflection should involve students answering the questions, "What happened?" "Why did it happen?" "What did I learn?" and "How would I apply this knowledge to future experiences?" (Lindsey & Berger, 2009, p. 129).

Prior to the final year of development, the R&D team conducted one study that examined the effects of student reflections during the learning process (Rivera-Gutierrez et al., 2014). Students were prompted with questions to reflect on specific topics, actions or responses during specified interactions. Three raters appraised the learners' responses according to a scale developed by Mezirow (1990). Results showed that 58% of the learners demonstrated evidence of reflection in at least one of the reflective moments. Critical reflection was harder to achieve; only one learner showed critical reflection in her response. Given that the interactions were limited to 20 minutes (including answering the reflective prompts) in this prior study, we felt that meaningful reflections would increase if time constraints were removed. So we made reflective learning a formal part of NERVE during the last year of R&D.

To address Principle 3, we planned and implemented an AAR for the field test of the beta prototype based on strategies recommended by Salem-Schatz, Ordin and Mittman (2010). In short, we followed guidelines for planning and conducting an AAR, including allocating time, organizing the discussion by issues, introducing and "setting up" the AAR prior to using NERVE, presenting and following ground rules, asking key questions (i.e., What went well and why? What can be improved and how?), and following facilitator tips. We did ask an additional question at the beginning of the AAR; namely, what did you learn from the system? We added the additional question to enable the instructor to diagnose and correct misconceptions, fill in gaps, and elaborate on key points.

As a recognized component of best practice, we prescribed an AAR to address Principle 3 when integrating NERVE into the curriculum. However, we have yet to fully develop the possibilities of AARs, primarily because students are not asked to complete an AAR in other learning exercises. Introducing an AAR as a specific step in learning after interacting with NERVE led to an additional process for the students. With no prior recognition of its importance, and no equivalent follow-up, the AAR and application of Principle 3 lived in a vacuum. To realize its potential, we need to consider how to better apply Principle 3 within and after the use of NERVE as well as how to facilitate AARs across the curriculum.

Applying the Conventions of Story, Game and Play. One of the primary reasons we adopted Inter*PLAY* to guide the design and development of NERVE was the separation of the game and play components of the theory. The distinction made between game and play clearly illustrated the role of the VP simulations in the NERVE Exam Room (that enable students to test and refine their diagnostic skills) and CN content information provided in the NERVE Learning Center (that learners may want or need to inform the diagnostic process).

As we noted earlier when we described the application of experiential learning principles, Principle 2 – Activating the Experience was the initial, primary driver for the project that led to the development and experimentation of the VP simulations throughout the five-year project. During the last year of R&D, the virtual patients presented to learners in the NERVE Exam Room represented the game component of the Inter-PLAY theory, presenting students with authentic, simulated experiences to test and refine their diagnostic skills with specific goals, rules and tools.

During the first four years of R&D, prerequisite knowledge of basic cranial nerve anatomy, physiology, and pathology were taught by medical-school faculty in a conventional lecture-style format before students were given access to NERVE. Inter*PLAY* illustrated how the addition of content information to the system could enable NERVE to become an independent learning platform that medical schools and students could use to cover both the acquisition and application of relevant CN skills and knowledge.

With the adoption of Inter*PLAY*, we added a Learning Center to NERVE during the final year of the project that gave students the opportunity to: (a) learn how and when to use the physical examination tools for diagnosing patients with potential CN disorders, (b) review relevant information about CN anatomy, physiology, symptoms and pathology, (c) explore published case studies about CN disorders, and (d) take multiple-choice quizzes about each CN to help them self-assess and monitor their own knowledge acquisition. A link allowed students to access the Learning Center at any time; before, during and/or after interacting with the VP cases in the Exam Room.

The addition of the Learning Center also made NERVE complete from a student's perspective. After making a mistake, students can find it very frustrating to hunt for a reliable source of information to correct the misunderstanding. This is especially true in medicine where misinformation is easily available and where reliable texts on specific topics can be too in-depth or difficult to understand. The Learning Center serves as an easily accessible, easy to understand resource that can be used both to teach the information and as a quick reference for students to reinforce knowledge and correct errors in knowledge.

As much as the distinction between game and play led to the addition of the NERVE Learning Center to the VP stimulations in the NERVE Exam Room, we did relatively little to formulate a story and apply story elements to NERVE. The team felt that, with limited time and resources, priority had to be placed on creating the Learning Center. Each character has a back story that is portrayed in real time during the interactions with the VP. Otherwise, the use of story is limited to text-based case histories, pictures and simulated interactions of each VP in the exam room, and an AAR at the end of the experience that encourages reflection and the sharing of students own experiences with NERVE to enhance learning, retention and transfer.

Question 2 - How did design and testing of NERVE advance experiential learning principles and the InterPLAY instructional theory?

We detailed the design and development of NERVE, including findings from the two iterative cycles of design studies and improvements made to NERVE based on the findings in Hirumi et al. (2016a). We also reported the results of implementing and field-testing NERVE, including data on students' use, reactions, learning and transfer in Hirumi et al. (2016b). To answer the second research question posed in this article, we discuss specific findings from the design, development, testing and implementation of NERVE that led to recommended refinements to universal principles of experiential learning posited by Lindsey and Berger (2009), and the Inter*PLAY* instructional theory.

Recommended refinements to the principles of experiential learning. The primary recommendations for refining the universal principles posited by Lindsey and Berger (2009) revolve around Principle 3 – Reflecting on the Experience. Specifically, based on field-test data, team members felt that Principle 3 could be improved by expanding on the questions, and by providing both examples and non-examples of the responses sought during the After-Action-Review (AAR).

To reflect on the learning experience, Lindsey and Berger (2009) suggest asking four fundamental questions: What happened? Why did it happen? What have I learned? How would I apply this knowledge of future experiences? (p. 129). As we applied Principle 3, we decided to use alternative questions recommended for facilitating AARs for reasons noted earlier. In short, we asked students to reflect on what they learned, what experiences and resources they found useful, and what they thought should be done to improve NERVE and the learning experience during the prescribed AAR.

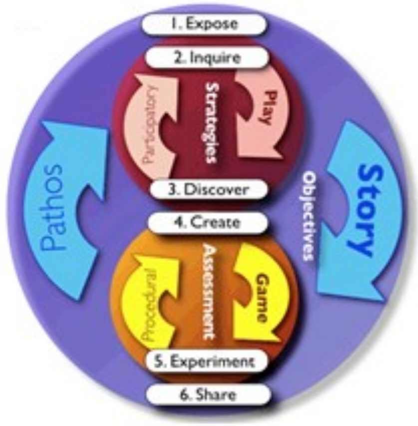
Based on students' reflections reported during the AAR, we recommend two specific refinements to Principle 3 as described by Lindsey and Berger (2009). The first improvement is to puts the onus on the students to take advantage of the opportunity to learn using NERVE. Specifically, asking the students "what steps could you take to improve your own learning using NERVE?" NERVE is not a perfect system with 100% recognition of questions asked of the virtual patients (VPs). What we continually encountered throughout the project was that when system problems occurred (e.g., incorrect or no responses from the VPs), students became frustrated and lost motivation. We suggest that if the students were asked to look past the system's limitations and identify specific ways that they could make better use of the system to improve their own learning, their reflections and the application of Principle 3 would lead to more meaning and useful results.

The second recommended refinement to Principle 3 is to prescribe examples and non-examples of desired responses to the reflective questions. During the AAR, we found that many students would immediately begin to identify problems with the system and provide recommendations for improvement even though they were prompted to reserve such comments for the last part of the AAR. Apparently, students were eager to vent. As soon as we noted the problem, we highlighted non-examples given by students as well as gave several proper examples, and soon found that students were able to provide appropriate responses to the question, "What did you learn?" Following suit, we verbally presented students with good examples of what we were looking for in response to what was useful and what could be improved, which appeared to prevent issues with the nature of students' reflections.

Advancing InterPLAY. Application of the three conventions of interactive entertainment (ie., story, play and game) facilitates six instructional events that form the Inter*PLAY* instructional strategy. Figure 9 illustrates how insights gained during the design of NERVE advanced the strategy. Prior to NERVE, Inter*PLAY* was conceived to facilitate the six events in a relatively linear fashion as illustrated in Figure 9A (Stapleton & Hirumi, 2014). Learners were first exposed to a story to capture their attention by answering the question, "Why should I care?" The story would then naturally drive learners through cycles of inquiry and discovery to acquire the fundamental skills and knowledge associated with the desired outcome(s), that would then propel them to apply what they learned to create and experiment with different solutions to beat the game. At the end, students would then be asked to share their story of what they learned to complete the Inter*PLAY* experience.

While applying Inter*PLAY* instructional strategy to NERVE, it became apparent that learners may neither need nor want to review resources posted in the Learning Center before attempting to diagnose the cases in the Exam Room. Like most gamers, they may only want to look up supporting information if they get stuck and have difficulties beating the game. Similarly, some medical students may want to first go to VP simulations to create and experiment with different solutions to the cases and only PLAY with various educational re-

Figure 9. Advances to the InterPLAY Instructional Strategy



A. Original conceptualization of the InterPLAY instructional strategy

B. New conceptualization of the InterPLAY instructional strategy

sources to inquire and discover key facts and information about CN anatomy, physiology, symptoms and pathology when needed. Others may want to inquire about and discover information about CN anatomy, physiology, symptoms and pathology, and practice using the physical examination tools in the Learning Center before venturing to experiment with the VPs in the Exam Room. Figure 9B depicts that latest version of the strategy based on insights gained from the design of NERVE that indicates that learners may PLAY with learning resources before, during or after they attempt to solve problems and overcome authentic challenges posed by the system. Allowing students to access learning resources at any time during the simulation is particularly helpful in sustaining the motivation and positive emotions of expert learners that would otherwise feel frustrated by having to review information they feel they have mastered. Providing access to important facts, concepts, rules and principles within the context of how they are to be used as learners work to overcome authentic problems is also more consistent with experiential learning principles.

Concluding Thoughts and Reflections

The last year of R&D demonstrated the interactive nature of applied and basic research. We emphasized the role of theory in informing design, and used testing to refine theory. Specifically, we applied three universal principles of experiential learning and the InterPLAY instructional theory to guide the design of NERVE, and the design and testing of NERVE advanced the InterPLAY theory by revealing recommendations for improving the principles.

From the beginning, software engineers and medical experts focused on activating the experience (Principle 2). Application of Principle 1 (Framing the Experience) and 3 (Reflecting on the Experience) resulted in the design of key instructional events presented before and after interactions with the VP simulations. The separation of game and play distinguished the role of knowledge acquisition versus knowledge application in clinical reasoning that led to the development of the NERVE Learning Center.

In turn, the design and testing of NERVE, including expert reviews, one-to-one and small group evaluations, and field testing led to improvements to the Inter*PLAY* instructional theory and recommended refinements to the principles of experiential learning. We learned that it may be better to give learners direct access to the simulations (aka game) and allow them to "play" with the content information to acquire fundamental skills and knowledge when needed or desired, rather than to require them to go through basic content information first and then use the simulations to diagnose patients, as the theory originally prescribed.

The team believes that story and game aspects of NERVE could be greatly enhanced. We looked at designing vignettes within scripts to help students understand patient concerns better. More time and effort could also be placed on formulating a plot that better ties the VPs encountered in the exam room together to increase empathy, interest and engagement. More resources could also be directed toward advancing the game component of the system. In earlier experiments with NERVE, we explored the use of leader boards that identified students earning highest points for their diagnoses, and the creation of avatars for students to establish their own presence as game elements that appeared to have potential. None of these story and game features are presently in nervesim.com, though we think some would probably increase learner engagement and voluntary time-on-task. In conclusion, reflections by the Principal Investigator and Chief Engineer may best capture the essence of the final year of R&D and the application of learning principles and instructional theory:

> *NERVE used the InterPLAY theory [including the 3 principles of experiential learning, and the elements of story, play and game] to transition from a stand-alone simulation where users were expected to use*

the system to demonstrate knowledge acquisition, to a system that provided motivation, learning, and evaluation. The resulting experience impacted students, faculty, students, and researchers. The InterPLAY-driven version of NERVE was evident to faculty on how they would use the system in their classroom. Because the system now more clearly positioned itself in the curriculum, faculty's evaluation of the system went from how to use NERVE to when and where to use NERVE. Students were able to develop expectations both of the software and their performance in NERVE due to the Game and Play components. Finally, researchers were provided a blueprint of how to develop simulation, education, and instructional design as to have end users more quickly identify benefits and consider adoption.

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Publish! Categories of Articles for the *Journal of Applied Instructional Design*

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Introduction

At the *Journal of Applied Instructional Design (JAID)* we realize that many practicing designers are put off by the idea of publishing. We also realize that the wide-open options for publishing can be daunting. So, in an effort to make publishing with JAID more approachable, we are introducing some new categories of articles. This short article describes the different article types we desire.

To be perfectly candid about our agenda here, one group of practitioners we are trying to attract are those designers who are so busy doing great, creative and effective things, that they don't feel they have the time to publish. Not only that, they aren't incentivized for publishing. If you are one of these people, please consider our Instructional **Design/ Performance Design Innovation Report**—it is aimed at you. The idea here is to tell other practitioners what you are doing before the idea gets old and stale.

Thank you for contributing to JAID. Together we can do some amazing things!

Instructional Design Practice. This is an *applied* journal serving a practicing community. Our focus is on what practitioners are doing in authentic contexts and their observed results. These observed results may vary in quality and detail, but the more convincing (i.e., rigorous) the processes and outcome measures, the greater the likelihood the paper will be published in this journal. These articles cover topics of broad concern to instructional design practitioners. The articles should represent issues of practical importance to working designers (Specific Categories of design and practice challenges are outlined below). **(Sub-categories include Analysis Processes, Design Methods, Instructional Strategies, Development Processes, Evaluation Methods, and Performance Technologies)**

Instructional Design/Performance Design Innovation Report. An Innovation Report introduces a new, preliminary approach to a challenge facing the instructional design community. The goal of an Innovation Report is to highlight first steps toward a solution to a common challenge. The report may highlight an innovative pilot or early-stage initiative at a single institution or preliminary research that defines the challenge and/or lays the groundwork for larger-scale approaches to the stated problem. It must also provide enough information to allow the replication of the innovation or continuation of the research in other settings.

Reported innovations must be based in the context of a theoretical framework. Efficacy data is strongly preferred, but not always required, contingent upon the potential generalizability or value of the innovation.

Design Community Challenges. Similar to the Design Practice and Challenges category, these articles focus on practice, but also the unique challenges of a specific instructional design community. These articles address challenges common to practitioners within a specific design community. Examples include an article that addresses common challenges to medical education instructional designers, or another might address common challenges related to user field performance in the EPSS development community.

Perspectives. Perspectives are short invited articles (generally about 750 words in length). They may respond to an accepted article, or may explore two or more sides of an issue. They generally have few tables or figures, if any.

Opinion Essays. Similar to the perspectives category, these more detailed opinion essays comment on or set the context for an article or articles that have been accepted for publication. They can also be essays framed as calls to action to major challenges. Essays generally have few references and rely heavily on the author's perspective and experience to support the argument. Essays may present supportive graphics or images.

[Letters to the Editor guidance on next page]

Letters to the Editor. Letters can be responses to articles in the journal, replies to other letters, or about issues of importance in instructional design. They may not be reports of research or programs, although these may be mentioned briefly if germane to the letters' issues. They must not duplicate other material that has been published or submitted for publication. Letters will be published at the discretion of the editor and are subject to abridgement and editing for style and content.

Letters should be tightly focused and no longer than 400 words (including references). They have no tables or figures and no more than three authors. Submissions do not require an abstract. The cover letter that accompanies submissions must include the full citation of the article or letter being commented upon.

Authors whose published articles are the subject of a Letter to the Editor will be provided the opportunity to respond.