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SCAFFOLDING COMPLEX LEARNING: INTEGRATING 21st CENTURY THINKING, EMERGING TECHNOLOGIES, AND DYNAMIC DESIGN AND ASSESSMENT TO EXPAND LEARNING AND COMMUNICATION OPPORTUNITIES

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ABSTRACT

Enhanced ways of thinking about learners, learning, and communication in the 21st century across content areas coupled with technologies that can extend the outreach beyond text, time, and geography can accelerate learning and retention in higher education, professional organizations, and learning environments. However, many assumptions about time, situation, learning goals, and learner capabilities have been embedded in face-to-face and online approaches. Thus, when moving to the more dynamic designs available today, instructors, educators, and communicators must also carefully scaffold the environment to integrate effectively these emerging tools and understandings. Otherwise, what could be enriched learning can become confusion and frustration. This article outlines both ways to design and integrate content, learners, technology and communication tools, and assessment, thus enabling dynamic, 21st century learning and ways to scaffold and balance instructional supports, pacing, and interaction-planning thereby providing guidance for the rich learning that is possible in integrated, technology-supported environments.

Enriched learning and productive learning environments can be envisioned as resulting from the integration of three key components: the application of 21st century perspectives to the content and learners, the integration of existing and

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emerging technologies, and the use of a dynamic design and assessment process, thereby expanding beyond the content and expert focus of earlier approaches. However, these rich, complex learning environments require an attention to procedural scaffolding to ensure the designs and expectations are clear and workable for the learners. Although, for the purposes of this article, these aspects of 21st century complex learning are addressed in a compartmentalized way (see Figure 1), the components must be integrated by the instructor if students are to have the ultimate outcome of successful, meaningful learning.

Several prefatory notes:

(a) The development of a complex learning environment will be assumed to be under the leadership of a single individual or principal agent (instructor, educator, trainer, communicator) who spearheads the organization and integration responsibility. Thus, students will be expected to create elements of their own learning, while the planning of the course or program is under the purview of the instructor.

(b) Technology-mediation is assumed as a component of at least a portion of the learning process. Since 100% online environments can present the most creative and challenging areas, this exacting environment is often assumed within, but these frameworks can be applied to environments that only require technology-infusion for a portion of the environment.

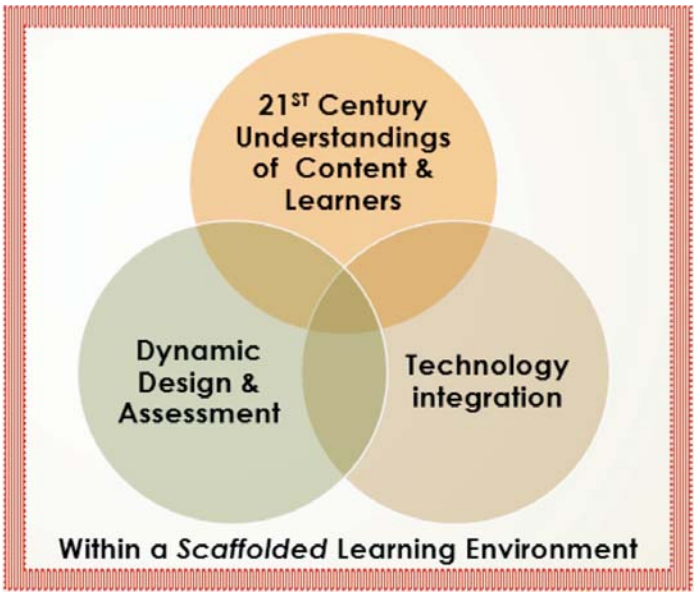

Figure 1. Overarching design framework.

(c) Since the framework and concepts presented can be applied to many scenarios where learning, communication, sharing, and instruction is intended, terms such as students, learners, and participants and, of course, learning environment, learning scenario, and the like will be used somewhat interchangeably to suggest and reinforce the breadth of possibilities.

21st CENTURY PERSPECTIVES ON CONTENT AND LEARNERS

When studying 21st century ways of planning for the desired learning, content and learners are coming into focus in ways that were not always considered in earlier design models when the base of knowledge and information within academic courses came from the instructor, textbooks, and readings. Before examining ways that emerging and existing technologies can facilitate a rich, complex learning environment, the instructor should envision the possibility of enhanced learning in the content area or learning environment that could result from new ways of thinking not only about content, but also about the communities that develop and use this content, about the cross-cultural interactions now possible, about environments built on trust, and about the learners and the background that they may bring.

Understanding the "Big Picture"— Placing Learning in Context

At the start, instructors should being with a renewed vision of the desired learning, looking to the professional activities and the communities that use this knowledge. This vision should remind them of the role and value of the content, knowledge, or learning and the larger world served by this content. They should ask: Why is knowing this content important—for government and infrastructure, for science and health, for cultural awareness and peace, for communication and dissemination, for education? And, to whom is it important—government, healthcare professionals, scholars, businesses, teachers . . . people? Once the importance of the field has been re-affirmed, instructors should understand how this knowledge is developed, communicated, enhanced, and shared. Then, using the community of practice framework from Lave and Wenger (1991) and a perspective of the learner within this community (Bransford, Brown, & Cocking, 2000), the instructor envisions a vibrant learning and practitioner community that supports this learning. Who are the practitioners and participants in the field? And, how do they gain new knowledge and understanding—from scholarship, case studies, field work, experimentation? Then how do they share this knowledge?

Using the answers to these foundational questions, the instructors should consider how this content could *ideally* be learned and assimilated. At this point, they should be thinking broadly and grandly, envisioning students and participants

as members of this community of practice. The instructor casts the type of learning activities they would create if not concerned about the limitations of time, travel, or funds. As suggested in Figure 2, instructors should move beyond the constraints of textbook and papers to construct rich learning scenarios: professional or client-level communications within the content area; applications of the content (field trips, activities, investigations, and conferences); abstractions of the content (virtual models of chemical compounds, a mathematical formulation of a traffic flow pattern, or diagrams of organizational power structures); or work with content itself (conduct experiments or screen intake-clients). By considering the challenging problems and concerns in the content area, instructors posit the complex explorations that might be embedded within a course or learning environment—the more learners are immersed in the context of a field, the more "authentic" and memorable will be the learning (Edelson, 1998).

With this refreshed understanding of the big picture of the purpose, interactions, and processes within a content area, instructors can then consider the "backwards design" principles expressed by Wiggins and McTighe (2005). Given this renewed perspective, what evidence would be required to ensure that students had grasped the value and importance of this aspect of the discipline? Would a well-constructed nursing report from a hospital visit suffice as

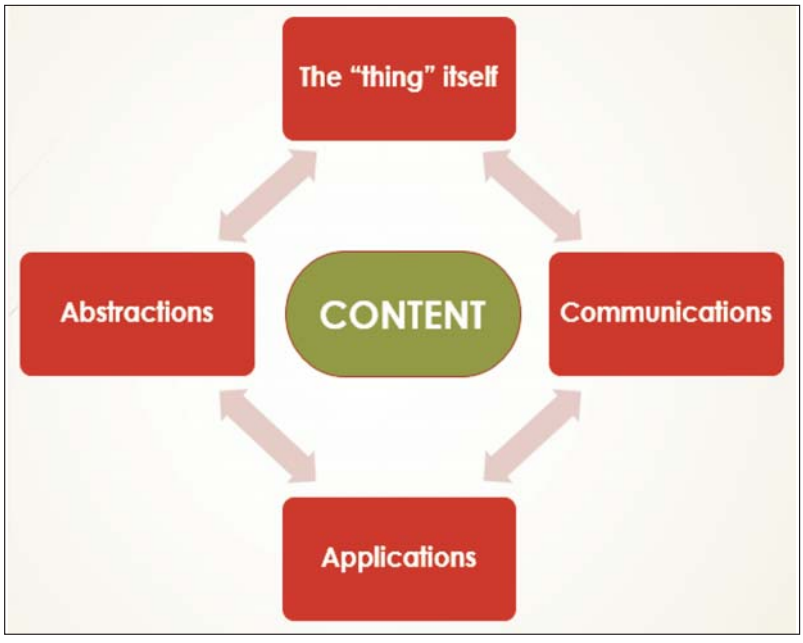

Figure 2. Possible areas to address when studying content.

knowledge of patient needs? Would a summary debriefing from an education conference demonstrate integrated understanding? Would a spectrometric analysis that quantifies the amount of nitrates in a water sample give evidence of chemistry application? Then, the instructor could arrange the texts, reading, observations, field trips, activities, and videos within the learning environment to allow the learners to achieve these enriched, context-based final understandings.

When selecting what will serve as enriched evidence of learning, instructors should also consider the important associated, interdisciplinary skills that might be associated with deep learning, particularly when they are creating graduate or professional-level learning environments. Instructors should not simply address direct content knowledge but should also value communication fluency, use of global thinking, development of the report types that are used in the field, and the appropriate integration of communication technologies—the meta-literacies associated with the content area (Mackey & Jacobson, 2011).

Creating a Community of Practice or Inquiry Within the Learning Environment Itself

Particularly when higher- and professional-education is the focus area, learning environments can be constructed to integrate or simulate the "community of practice" that may be present in the field of study itself. Creating the elements of the authenticity noted by Lave and Wegner (1991) within the learning environment, instructors can find innovative ways to include practitioners. Readily available today are online discussions, webinars, live chats, and immersive, virtual locations, all of which can serve as points for presentations, interactions, and discussions. With the ease in which e-based interactions can reduce travel time, professionals in a field are often willing to share with students and to interact in these environments. For instance, in one online course, a superintendent from a school district hosted a discussion board about the ways the pre-service teachers could prepare for job interviews. The class community itself could be involved in the communications and problem solving that practitioners might employ; field professionals could join in evaluating presentation about topics and problems. These practitioners could also bring forward actual evidence and information about their field and seek to solve problems in their practice or apply new methodologies and approaches in a reflective way. Having a "fresh pair of eyes" on a problem might give the practitioners perspectives that could help their practice.

With the ubiquitous nature of internet and web-based communications, instructors could seek internships and partnerships that may be available for the higher-education or professional student. Professional organizations can be joined at a distance and many conference proceedings, presentations, papers, and slide-presentations are preserved through web-based means. Students may become involved in the questions of the field through these forms of lateral

participation (Osofsky, 2004). The learning environment can include actual field artifacts, and not simply resources in textbook.

Consider an example from teacher education. By designing an online courses where pre-service teachers creating learning environments that rely heavily on the use of technology, instructors can have these pre-service teacher students engage on a regular basis with the technology and can encourage them to think about the specific ways in which K12 learning activities can be enhanced through the use of technology. This technology evaluation can be couched within the context of a group activity. Koehler and Mishra (2005) note that when participants work in groups, they develop significantly in their ability to create learning environments that effectively implement technology in a way that preserves the relationship between content and pedagogy. According to Mishra and Koehler (2006), the lack of understanding that many teachers have about the relationship between technology, content, and pedagogy hinders the advancement and integration of technology in the field of education. Therefore, by creating learning environments that allow teachers to think about the relationship between technology, content, and pedagogy, the instructor can ensure that the use of technology in education will ultimately fulfill the requirement that K12 students are exposed to learning opportunities that ensure that they graduate with the necessary 21st century skills to be successful citizens. Thus, instructors can create online environments that address, study, and consider solutions to challenging field environments.

Accommodating Learning Across Cultures

Given today that instructors may need to integrate and accommodate learners from very different cultures (Parrish & Linder-VanBerschot, 2010), being able to integrate video case studies, common virtual experiences (as in Second Life), or live feeds to events or lectures could create shared experiences that could become the basis of a rich, cross-cultural experience. Also, in order to maximize these cross-cultural experiences, it is important to create learning environments that provide learners with an opportunity to interact with individuals across cultures. Although individuals are mostly able to resolve the cognitive dissonance that sometimes occurs when contextualizing their content knowledge within other cultures, the ability to do so effectively varies from person to person (Phelan, Davidson, & Cao, 1991). The inability to quickly resolve any perceived misalignment between their knowledge, couched in terms of their cultural experiences, and the same knowledge when viewed through a different cultural lens, may impede the learning process. Therefore, it is important to ensure that learners are provided with adequate opportunities to view their content knowledge through multiple lenses; for new teachers, this would help them create diverse learning environments for the students they serve.

While there are multiple vehicles that can be used to create these cross-cultural opportunities for learners, the use of technology provides the greatest amount of flexibility. Not only does technology allow for both synchronous and asynchronous opportunities, it also removes the physical barriers that exist within the learning environment; it allows the learner to participate in rich experiences with individuals from other cultures anywhere in the world.

Ensuring an Environment of Trust

When creating learning environments that move across practice and even cultures, instructors must establish an interactive and trusting environment within their classroom and among the participants, if they are to create a community of learners within the course. Developing a collegial and peer-supportive environment can be established in many ways. Consider the different climates that can be created based upon how discussions are structured and evaluated. For instance, if the instructor's presence is strong, immediate, and consistently-present throughout the discussion, then he or she may become the assumed authority and students may simply follow the trend established by the instructor and not be open to the ideas of colleagues in the discussion. Or, in a situation where the instructor mandates research-supported comments, this requirement establishes the more formal, external-authority approach to the learning. These approaches may be appropriate under certain circumstances. But, instructors can also encourage creative, brainstorming-level interactions before a new topic, problem, or scenario is approached, enabling students to learn about each other's ideas at a point when they are not concerned about aligning with the instructor's perspective. As noted by Parrish and Linder-VanBerschot (2010), when designing online and discussion-board like environments, the instructor needs to consider the implications of the interaction strategies and assessment techniques that are followed, which may differ greatly across courses, content areas, and cultures and can greatly impact the community-based aspects of the course.

Developing a learning-environment community, where students are empowered and encouraged to bring forth their ideas, can more closely emulate the professional environments in an era of global communications. As noted by the Partnership for 21st century learning (a consortium of business and education leaders; www.p12.org), even core academic subjects should have a 21st century interdisciplinary focus with: "global awareness; financial, economic, business and entrepreneurial literacy; civic literacy; health literacy; and environmental literacy." By creating classroom communities and by engaging students in the practices in the field, instructors can encourage this breadth of experience and understanding and can have students begin to understand the dynamic and interactive aspects of the content area which will no longer remain static (Davies, Fidler, & Gorbis, 2011). Integrating professional communities or at least initiating a professional-like classroom community, can help students and learners make

important connections and understand the non-academic aspects of a field of study as well.

Attending to the Core—The Content

As instructors plan for the "content" to be learned, experienced, or studied, they should examine the ongoing research into the types of learning becoming available through computer-extended interactions. Literature abounds on ways to structure and organize content from the perspective of well-presented and sequenced content and lectures (such as, Bligh, 2001); instructors should review these classic approaches since they are not addressed here. This section's focus will consider ways to integrate students and content, to reframe instructional sequencing, to integrate technologies, and to locate e-based resources. It begins with several possible arrangements for content presentation then, after providing some examples for expansive thinking, addresses ways to operationalize these approaches.

Considering Various Approaches to Organizing Content

Depending upon the content requirements, instructors may need to break-down larger problems within a learning space. When structuring the learning process for a complex problem, instructors could use cognitive task-analysis approaches (such as those of Clark & Estes, 1996) to guide them when considering student prior-knowledge and sequencing the problem presentation. Sometimes the technologies available can help with *problematizing* the learning environment (Reiser, 2004), breaking down the components of a complex problem. Readily-available e-tools allow instructors to map, sequence, arrange, and connect concepts and ideas as they consider how best to integrate this complexity into their content preparation. Instructors should be mindful too of research into instructional approaches that provide more ill-structured problems (Ertmer, Stepich, Flanagan, Kocaman, Reiner, Reyes, et al., 2008). These ill-structured approaches rely upon the concept of cognitive dissonance, where the learner becomes naturally challenged to seek an answer for such problems (Piaget, 1950). In science education, researchers consider the need to have the leaners "inquire" into the phenomena and observations if the students are to gain appreciation and mastery of the science content (Anderson, 2002). Instructors should also think beyond overly structured approaches and sequencing, valuing also the problem-solving challenges that can be inherent in well-chosen, complex scenarios. For instance, trying to explain the shape of a water drop verses an oil drop on a piece of waxed paper can generate more interest in and understanding of molecular bonding than can well-parsed statements about molecular and iconic bonding (a video could share the experience in a distance environment). Inquiry can raise the questions that "facts" can later answer. With the availability of video case studies

and events, instructors should consider ways to offer challenge and problem-scenarios for students before simply providing answers and information.

Applying Theory to Situations and Scenarios

Particularly in areas where there is socially-oriented learning (education, psychology, business, etc.), students can often attain higher levels of learning by applying their growing understanding to real or simulated experiences and moving the learning to higher and more memorable levels within Bloom's taxonomy (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). An instructor could ask students to apply their emerging understanding of marketing principles to help boost the sales of a well-known older product or to create a market for a product that they would like to sell someday. Even in quantitative areas, scenarios can be devised that could encourage application—equations studied by students reporting on the morning traffic patterns at a busy intersection. Consider and enumerate ways where peer interactions and sharing might benefit the learning environment—and begin to trust the learners too. Particularly with college-level and adult learners, instructors may find that students have experiences in the area. Or, they may have the ability to judge your proposed situations from the transfer of their prior knowledge and thinking approaches. For examples, when students were asked to purchase and use data-gathering devices (www.vernier.com) during an online class about science teaching, an initial talk-aloud discussion board provided the open-ended brainstorming space where students considered and shared ways that the devices could be used.

Developing a Story Line

A possible way to conceive more globally of a learning environment—and, thus generate ongoing and related scenarios—is to determine a key problem in the field and make it a focus with the learning environment (or over a range of modules within an online course). Then create a storyline/or narrative to express the learning journey, moving toward the level students should achieve by the end of the course. Empower the learners to be problem solvers within this field. In K12 environments, web-quests (where students are given web-based resources and a problem to be solved or presented) have provided useful and rich contexts for learning (Yoder, 2005). A recent type of "reality show" has professionals competing around a complex scenario—clothing designers creating an evening gown for a very-pregnant woman; chefs cooking for a finicky audience using a limited amount of ingredients. In a similar way, an informatics course could use authentic, redacted data on various health scenarios where learners could weigh their diagnosis against professional judgments. Creating a reason for knowing and applying knowledge, from problem solving to competing interests can provide greater motivation for learning.

Using Technologies to Expand Content Exposure and Reduce Distance

Integrating technologies as ways to locate, share, and present content knowledge and understanding can greatly expand content-learning options. Veletsianos (2010) noted that technologies have often supported learning and applications in various and often-unintended ways. Instructors should remain open to new, learning-supportive applications even from existing technologies. For instance, having students create a YouTube of a weather forecast in the target language can allow a foreign language instructor to encourage and evaluate the students growing understanding of the target language. A class-developed spreadsheet-like-tool (such as available in Google Drive Spreadsheets) could store and codify key historical events and could lead to rich discussions and analysis from data gathered by the students themselves. A visual shared experience, such as a video-shared classroom scenario (O'Connor, 2008), can encourage conversation, communication, and nuanced-analysis of a complex, human interaction that would not be possible, or possible with the frequency needed, without such technology-based communication tools. Technologies can remove or at least reduce the restrictions created by travel or time. In what ways could students ideally be engaged that involve the scenarios and complexities of the field? Would a visit to an archeological dig generate questions about the history and the times of ancient Egypt? Well then, would talking to the archaeologist via Skype or listening to a tape suggest the real questions that these researchers and scholars ponder? If instructors back-into the field of study, they may find new, engaging, and memorable ways to engage learners, which could then be designed into the learning objects and experiences (as considered later).

Understanding and Valuing the Learners

With the sophistication of communications and experiences that students may have when coming into a study, when planning curriculum, instructors should be mindful of the learner and his or her contribution to the learning environment. Earlier conceptions of instructional design, such as those expressed by The Herridge Group (2004), considered instruction primarily from the perspective of content and sequencing. And, although in the past, lecture predominated in higher education, researcher have found that integrating more interactive and technology-based approaches can enhance the learning environment, as when Prezi and Twitter were studied as ways to work with the various *intelligences* in an instructional environment (Virtanen, Myllärniemi, & Wallander, 2012). Learning is no longer simply content passed along through textbooks, although the organizational structure of a text and the integrated wisdom of content experts can be an integral component in the development of more learner-centered approaches.

Incorporating the Learner's Prior Knowledge

Research emphasizes the importance of understanding and valuing the learner, particularly when adults may be part of the student population (Argote, McEvily, & Reagans, 2003). The *prior knowledge* of any learner should be challenged and called into the learning scenario. Adults may also have other experiences that can be related to the new knowledge to be gained, and encouraging a transfer of this prior knowledge into the new learning environment can enrich the experience (Huang, 2002). Even younger learners often have factual (albeit not connected) knowledge of a content area from media exposure. This understanding or interest can be tapped as a way to establish connections to the new knowledge or process. Learners can always gain more understanding when they see the connections to knowledge and their lives.

Engaging the Learners in a Transformative Experience

Instructors should also be mindful of possibilities for *transforming* the perspective of students, asking them to envision the world in new ways. According to Palloff and Pratt (1999), "the goal of transformative learning is to understand why we see the world the way we do and to shake off the constraints of the limiting perspectives we have carried with us into the learning experience" (p. 129). Given the need for citizens and employees in the 21st century to move ideas forward and be active contributors to their communities, this ability to maintain connections and move past possible limiting beliefs is, according to Davis, Edmunds, and Kelly-Bateman (2008), what is needed to facilitate continual learning. The creation of transformational learning experiences has shared responsibility between the instructor and the learner. Instructors must provide opportunities for learners to create connections between themselves and content, between other colleagues in the learning environment, and with the instructor. With attention to creating this support and learning space, students will become active and participatory learners, create relationships, and join in as members of a community of learners.

Addressing the Learners Technology Background

Although many educators take issue with Prensky's (2001) division of digital immigrant versus digital native and their comfort level with new technologies, instructors can still benefit from considering that students, particularly if there is a mix of adult and youthful learners, may have different skills levels regarding technology usage. Planning that some learners may require technology support can ensure positive experiences for all students given the technology-mediated aspects of learning available today. It is important though not to restrict practice because some students may be less comfortable or able with technologies; instead, the instructor must have plans for preparing the less tech-savvy students. The

many online tutorials and resources can be provided for the less-skilled learner, peer-support can be integrated into discussion sections, and institutional support may be available. Note, too, the instructor must have the right perspective (*attitude*) toward using emerging technologies (O'Connor, 2012-2013) and should not stymie the learning possibilities by insufficient willingness to learn about technologies and features. An effective practice when approaching new technological-tools within an online environment is to have an open-ended discussion area in each course module so that students can put forth (and solve collectively) issues that may surface with technology used. This establishes an environment of openness, sharing, vulnerability, and growth that can encourage students to reach out to each other with their experience and it communicates that the instructor is willing to learn new approaches during the course as well.

By first integrating these more expansive ideas about the content and learners, instructors can then approach the development of their goals and objectives from a 21st century perspective. Having these inclusive end-goals in mind (Wiggins & McTighe, 2005), instructor can be more ensured of memorable learning.

EMERGING TECHNOLOGIES AND LEARNING OBJECTS

Although the considerations above addressed the larger areas of content and learners and the *overarching* ways that technologies could mediate aspects of this learning, when selecting materials, transaction, interactions, and techniques for the actual learning environments, instructors can choose from a rich, growing wealth of e-tools, e-devices, and e-systems. Whether referring to these communication technologies as emerging technologies or web 2 and web 3 features (with more technology-based interactivity), instructors can invigorate learning environments: (a) by understanding how technologies can individualize and strengthen instruction (Moeller & Reitzes, 2011); (b) by realizing that learners will have different *intelligences* (Gardner, 1983) by which they most-optimally assimilate ideas and information; and (c) by valuing the aspects of time, distance, culture, simulation and reality, and interaction that have now been extended and sometimes transcended through internet and technology tools. New e-mediated instructional practices are rapidly emerging. With the internet-based simplification of access-to-the-public, instructors can readily implement, evaluate, and improve an instructional practice, sharing their challenges, struggles, and triumphs with other educational practitioners. Instructors can gain suggestions and refine their instructional environment through reviews of publications, presentations, blogs, and open forums. The plethora of tools challenges any overview classification process, therefore reflections are included within the categories below to encourage more expansive thinking.

Interactions and Communications

Interactions and discussions are available within Learning Management Systems/ Course Management Systems (LMS/CMS), wikis, websites with comment features, and social networks—any web-based system with sharing areas. Within an educational/learning environment, the instructor can orchestrate and delineate: (a) the types of interactions by the participants invited (students, visitors, the public); (b) the methods of assessment (are all interactions allowable or must certain criteria be met to attain suitable grades?); and (c) the timeframe and parameters of the interactions. The use of social platforms outside the LMS/CMS are now readily available through suppliers such as Facebook that have institutional and private posting areas too. These platforms are easily learned by the students, who may already have used these services. Social networks can allow information to be shared through texts, links, video, and visuals—often a useful way to document comments and to share understanding. Students might also be required to join professional communities or discussion boards to learn more about a content area or to consider and study different cultures and cultural nuances (Kourova & Modianos, 2013).

- Reflect on the community that might be created within the learning environment and on the communities of practitioners that may have been identified (see earlier parts of this article). Find ways to integrate authentic "conversations" among these participants into the learning scenarios. What questions, scenarios, problems-to-be-solved can be brought into these forums? What projects can be initiated, developed, launched, and/or completed within such environments? What discussions might prove sufficiently fruitful to extend beyond a course or particular learning environment?

Visual, Audio, and Video Materials

Text and textbook images need no longer have the hegemony over learning and communication of content and factual information. The challenge of sharing knowledge and understanding was greatly reduced with the invention of the printing press, bringing about the emergence of text and publication venues as means of preserving, vetting, and disseminating information. Images were available but were costly. With text, image, and video/audio now being ubiquitous and readily available to educators in industrialized countries, and becoming rapidly available to developing nations as well, instructors need to consider their own production of such learning and instructional materials. And, they need to value and encourage the legitimacy of contributions made by their students using e-tools—K12 environments are starting to understand the value of technologies in helping to engage and include all students (Hodgood & Ormsby, 2010).

Today, instructors can design their own learning objects and experiences in ways that integrate media, video, visual, and schematics with questions, challenges, and explanations. Consider that the foundation of most all content areas lies in an experience, event, abstractions from events and relationships (mathematics), measurements of phenomena and objects, the instructor should value and explore the numerous ways that visuals, schematics, and videos can enhance the learning within these complex systems. Instructors can create images, schematics, videos, and pictures easily and can save these resources for ongoing use across time, geography, courses, and learning environments. In determining the appropriateness of these visual resources, the instructor needs to weigh the quality, appropriate usage, and source of these materials (if they are using the works of others). For instance, as Zhang, Zhou, Briggs, and Nunamaker (2006) found with interactive video, a well-developed video can enhance and enrich learning. However, individually-made video clips can often be too long, too tedious, not focused—in general, poor quality. Although long-standing research (Paivio, 1971) has supported the use of visual images since they can create a dual coding of the information to be learned, instructors should be mindful of the rigors of properly sequencing animated segments (storyboarding), timing, and integrating any visual, schematic, or video into the goals of the course or the learning scenario.

When bringing visual resources into a complex environment, the instructor has many ways to acquire, use, or develop visual experiences. Just as text has been the way to communicate ideas because print was the primary distance form of communication, present instructors can work with existing images and video and/or they can create their own media. As stated above, being attentive to the value of dual coding and designing visual/video segments carefully can create learning resources that can engender a strong and more-retained mental image for the learner.

- Reflect on the content and the learners. Where can a visual, a schematic, an audio segment, a visual case study or event serve to explain a process (a chemical reaction), show an invisible phenomena (a virus replicating), demonstrate a process sequence (a factory assembly line), illustrate a historical artifact (the Great Wall of China; a work of art), or become a shared instructional experience? What questions can be posed to integrate the use of the video or visual by the learner into the sense-making schema of the student? For any such visual materials to become educationally-useful, the media must become an integral part of how the learner understands and explains the phenomena the media represent (O'Connor, 1997).

Public Postings, Peer Reviews, and Privacy Options

Instructors can design activities where student-created objects and artifacts can be used within the course and learning environment and can also "live"

beyond the course or the course envelop (the CMS/LMS). With the ease of creating websites (Google Sites; www.wix.com; www.weebly.com), social websites (i.e., www.facebook.com), video (i.e., www.YouTube.com), images and presentations (www.prezi.com, www.slideshare.net, Google Drive Presentations), students can be required to demonstrate their emerging understanding using means that extend beyond the paper or report. These web-based artifacts can serve as possible starting points that could launch extended investigations by the students in their future. Furthermore, with the ready availability of blogs and journaling programs, instructors can mandate reflection on the content area and on the learning process itself. Since most of these tools and devices can have either a public or private setting, the instructor can protect the students from exposure to the public review before he or she has demonstrated suitable depth and analysis. Although the final evaluation for a course will most-likely reside with the instructor, the emerging area of peer review and badging can provide additional support and learning as students evaluate the work of their co-participants. In a study by O'Connor and McQuigge (2013-2014) awards were given by peers based on criteria met by their colleagues in their posted course-assignments; findings indicated that students' work was thoughtful and showed evidence of learning beyond specific course objectives. Websites can also be used as ePortfolios that can extend the work beyond a particular class or course. Again, instructors can use the different permission levels to safeguard students work during their development periods.

- Reflect on the works, projects, artifacts, and resource-location that students might create within a learning environment. How can you create a culture (and a technology-process) where such materials are assembled and vetted by the instructor and the students? How and when might an instructor deem these materials appropriate to be released for public display—through instructor direction or through peer-review (O'Connor, 2010)? Or, should the option of making work public reside with the learner alone? And, what would be the policy or disclaimers that the instructor or an institution would need for a student self-release of his or her work?

Simulations and Virtual Environments

With present and emerging capabilities, instructors can now create and/or use virtual and simulated environments to create interactive, authentic, social, and complex environments—depending on the choices they make and the designs that they employ. Webinars and synchronous environments such as Google Hangouts and Skype are spanning distance and geography and expanding learning and instruction opportunities. Although instructors must guard against turning these environments into simply extensions of the lecture, by requiring creative, student-centered assignments and by using interactive polling and emotion sharing (via emoticons—emotion icons), students can be actively integrated into

the synchronous webinar-environments. Simulated, virtual, and immersive environments can allow the instructor to create, deliver, and evaluate novel learning scenarios, role-playing environments, and communities of learners—all at a distance. For some learning situations, existing simulation software could be used within a curricular framework to simulate and study difficult areas for teaching—such as learning the use of the mathematics of GPS-navigation tractor operations through the integration of appropriate assignments into SimTractor (http://www.simtractor.com/). In other situations, virtual learning environments can be used for meetings, discussion areas, classrooms, and replica of world and extra-worldly environments. These environments bring with them the promise of creating an immersive, pseudo-realistic facsimile of a face-to-face meeting, field trip, or experience and allows for a sense of *presence* among student participants that is not possible through other venues (O'Connor, 2012).

- Reflect on the type of environments that could serve as a facsimile of your ideal learning environment. What if you could develop or share such an environment? And, what would you do or create in these spaces? And, what expectations could you have for the students in that environment or from shared experiences they have in that environment, as found in language studies within World of Warcraft games (Rama, Black, Van Es, & Warschauer, 2012)? Could sociology students visit existing, public virtual island to observe active groups and the community bonds within these groups? Could engineering and art students study virtual designs and then develop virtual realities of their own? Might drama students as a group talk to the actors in the Globe Theater Second Life simulation to gain perspectives on the life and times of Shakespeare?

As the possibilities with technology multiply and the need for an educated population that is *digitally-literate,* a meta-literate approach to integrating learning, instruction, and technology (Mackey & Jacobson, 2011) is required. As instructors become aware of the affordances (the ways a technology can be implemented) and the applications of these tools, they can exploit and expand the capacity of these tools, as Petrović Petrović, Jeremić, Milenković, and Ćirović (2012) observed about uses of Facebook in language instruction. Emerging technologies can construct learning environments that extend experiences well beyond the concrete and physical.

DYNAMIC DESIGN AND ASSESSMENT

Coupling advanced perspectives on learning and learners within the content and context of 21st century approaches with the ability to use instructional tools, devices, approaches, simulations, and virtual environments provides rich enhancements to online and face-to-face instructional design. Learning environments can

be dynamic, informing the instructor about the ongoing development of student understanding. Instructors can design beyond the constraints of face-to-face instruction where a classroom discussion might become dominated by a few students. Well-planned and monitored assignments and interactions can also be modified as required to meet the particular needs of the evolving learning environment, without being confusing or disconcerting to participants. The integration of content and content communication with the world through web-based publishing and through interactions with practitioners (available now at a distance) can encourage students to experience the value, merit, and purpose of a content area. The actual integration of these understandings into a reflective and responsive instructional practice, even when the learning environment is 100% online, can create learning environments with vitality and responsiveness.

Orchestrate Ongoing Communications

Face-to-face instruction can often integrate the voice and perspective of the students; however, the dynamics of classroom interactions can lead to the domination of teacher and content with the integration of the ideas and opinions of only the more outspoken students. Even when group discussions are integrated into such a class, it is challenging for the instructor to monitor meaningfully the flow of the discussion. Older design approaches (Dick & Carey, 1990) seldom considered the learner as an integral part of the design model, leading to problems with some early adaptations of e-Learning into corporate training settings. The design fields moved to considering how ancillary and resource-like knowledge was presented, but still the focus was on putting information in the right places and not on empowering learners.

With the advent of online discussions, comments and postings, webinar interactions, and immersive environments, more options have become available to the instructor. Discussions and interactions can be integrated within and looped among the various learning activities and project threads; the learners' *voice* can now be active and participatory.

- Begin by planning interactions in a segmented, student-responsive way and not as a rigid construct that is identical across all course sections or modules. Although instructors may want to indicate in a syllabus or course overview that interactions will be expected with a pre-defined frequency, they can leave the details of the interaction and topic until after understanding the student population and their needs in relationship to the course goals and objectives. And, remember building a peer network or collaboration can be a legitimate course goal.
- Learn about the student population that is actually joining the learning environment or course. Use content-imbued ice-breakers and introductory exercises to understand the prior knowledge and experience of the students. Particularly in programs or courses that include adult learners, instructors

should prompt conversations and discussion where students bring forth their experience—in an open-ended way or in light of literature and readings. With adult students, by having them bring forward this prior knowledge (Argote et al., 2003) student learning improves and classroom discussion is enriched. Online courses too can bridge geographies and cultures; well situated discussions can give all students opportunities to consider and weigh their thoughts and understanding before posting. This can enhance the instructional experience for students who may not be native speakers within primary language of the learning environment.

- Thread, loop, group, and re-group distance and synchronous interactions. Avoid falling into a pattern of routine interactions in a course or learning environment; consider ways that varied approaches and strategies might enrich the interactions. Although reading a report or study and responding with ideas validated by the research literature is a useful, valid form of discussion, also consider ways to empower the students and have them become a more integrated part of the developing learning experience that designed into the learning environment. For instance, in advance of having online science-education students develop a lesson with a data-probe (www.vernier.com), an instructor had a talk-aloud where students used a discussion board to brainstorm how they might use their data probe and where they expressed their concerns about setting up the apparatus. In a statistical analysis course, an instructor could have a shared-space where students suggest data-studies that they might use. In the following module, there could be a webinar where the instructor addresses and summarizes the benefits and challenges to the types of data that the students put forward. In an cultural anthropology course, students could post digital photos of the local culture; then meet with a team to discuss their observation within an immersive virtual environment (such as Second Life); then report-back their teams' discussion points using a posted slide presentation into an discussion online.

Instructors can create rich, evolving, caring communities through designing interactions dynamically as the course progresses. They also have the flexibility to integrate various media, meeting places, and even student groupings. When teams or groups are assigned, a more cohesive and caring classroom environment can be encouraged by creating mixed groups, changing the groupings over the time frame of the course, and assigning different roles to the members of the groups. The ready accessibility of webinars and virtual environments makes the development of a class community quite possible even within distance, online environments.

Extend Concepts of Assessment

Instructors are well aware of the role of assessment in evaluating the projects and assignments associated with any instructional setting. Within e-mediated learning environments and scenarios, instructors can construct assessments and

evaluation that go beyond the traditional documentation of learning, that consider and value the learning environment itself, and that emerge from an understanding of the richness of 21st century communications and interactions. Below are considerations for learning environments with technology-mediation components that look beyond the *time-honored* approaches to assessment; classic evaluation approaches that align papers and reports with the instructional of objectives in the course or learning should be included *but are not addressed specifically here*:

- Use templates that can structure and guide perspectives on complex readings and can encourage the type of synthesized understanding that represents the learning to be evaluate. Working through the development of a paper or a report may be an important aspect of the analytical skills to be developed, but, at times, instructors can get to the heart of the required learning more directly by having students express their learning within a template that focuses the learning and evaluation on the targeted understandings to be acquired, more than on the communication and writing skills.
- Integrate a required peer review of student-produced artifacts, particularly if the artifacts are displayed in a public forum like the web or YouTube. Although the instructor may not choose to use the peer evaluation in the grade for the course, a mandated peer review, which can be graded as a participation score, could lead to badges that are announced within a course and that may further learning and extend collegial interactions (as found by O'Connor & McQuigge, 2013-2014).
- Use grading sheets or rubrics to explain clearly how any complex project, report, artifact, or assignment will be evaluated. In fairness to the learners (and often to serve as a check-list for their project completion), the instructor should delineate the expectations embedded within your assignments, preferably assigning weighting value to the different criteria. Enumerate all the items that are valued and will be evaluated addressing all important areas from content, to the quality of the writing or presentation, to the citation formats, to the number of references and resources, to any interaction requirements (if appropriate), and to the timeliness of the submission.
- Evaluate knowledge gained using evidence from multiple sources, including video, audio, schematic, and image. As the understanding of the multiple ways that people learn (Gardner, 1983) has emerged, educators need to find new ways that students can demonstrate understanding. Abendroth, Golzy, and O'Connor (2011-2012) found that self-taped videos of micro-teaching lessons (mini lessons used to prepare pre-service teachers for eventual K12 practice) provided a rich perspective on a student's teaching abilities; however, these researchers reported the need to establish new evaluation practices and policies to address the nuances that were available and preserved in the video that was captured.

- Expand the purpose and evaluation of the e-interactions. Although at times an instructor may want reference-citing discussion postings, instructors should also require, value, and assess more informal interactions—a student comment on a classmate's proposal idea, the digital picture of a tidal estuary as a contribution to an aquatic study, a link to live-feed of an economic summit. Consider also when and how to have students and participants interacting with the instructor. Although ultimately instructor participation will be essential to having meaningful interactions and discussions, early intervention by the instructor may limit discussions and interactions. Consider and monitor your own role in the discussion movement and adjust as appropriate to meet your goals.

In 21st century learning, assessment can play a rich role in supporting the new types of learning communities that could be established. By requiring and validating interactions, synthesized thinking (and not simply papers and assignments), and creative interactions, instructors can understand, value, and adjust (when necessary) the learning that is occurring.

Ensure a Valuing of the Content

As instructors move to operationalize their broadly-cast professional perspective of their field and the content that should be addressed, they should start with active conceptions of how students might engage, act within, and care about the content area or profession.

- Using principles of "backwards design" (Wiggins & McTighe, 2005) consider initial ice-breaker activities (where the students get to know each other as well as the course purposes) where, if possible, a dialog within the field might exist. Remember that, particularly in college-level and professional learning environments, instructors should expose the students to the professional community of practice to the greatest extent possible. Could a reading, a webinar, an immersive experience launch the course and engage the participants in the context of the field? Maybe start with a video of an archeologist explaining the findings at a new dig, then generate a discussion-board like dialog about what students might need to prepare in their life and in their understanding if they were to join the next expedition? Open-ended dialogs that encourage students to share their ideas and backgrounds can also help instructors understand prior knowledge, the personal experiences of the students, and possible learning styles and *intelligences* (Gardner, 1983) of the students—as well as setting the stage for some of the challenges, concerns, and problems within the content area.
- Moving into the activities, readings, and assignments within the course or learning environment, articulate the learning goals and supportive objectives in ways that make the emerging understandings as relevant and applied as

possible and that value the contributions of the community of practitioners as well as valuing peer-reviewed and editorially-vetted texts. Minimize isolated assignments that simply have students reading and reporting on literature or textbooks. Not only can instructors reduce plagiarism with more customized assignments, but students will move to more advanced level of learning (Bloom et al., 1956) if they synthesize and apply their learning (from readings, videos, texts) to actual situations in their experience or to situations supplied by the instructor from the field. A foreign language lesson where the learners create a self-video (www.YouTube.com) of their broadcasting an important cultural event in the target-language country (Cinco De Mayo, for example) can encourage the acquisition of proper language, intonations, and cultural understanding. A science lesson can include the professional video libraries (such as http://figshare.com/) where scientists present their own work in video formats. The students' review could launch a discussion of actual practices in the science community and could encourage students to join or observe the forums among the scientists themselves who review the video research-publication.

- Building complex assignments and collaborations can move students toward deep, integrated learning but within online or web-based spaces this also requires planning diligently for the process and the interactions required. Often instructors (face-to-face or online), although valuing and specifying projects, practicums, or reports, lament that the work does not meet their standards. Instructors need to consider *all* the process steps that surround an effective implementation, particularly if they are developing a multi-stage project that may have reading and literature reviews coupled with field experiences, laboratory study, data-gathering, or other explorations. Design into the learning experience or course the steps, feedback to instructors and peers, and the ongoing reviews and checkpoints that can ensure that work is progressing effectively. In online courses, this can mean integrating process checkpoints across a number of the course modules, along with other assignments, interactions, and readings.
- Considering if there is value to making the outcome of complex projects be open to the public—easily done through websites and wikis. Work that can have a public face (have instructor and peer voting for what is ready for public display) can solicit more pride and perfectionism in the students and student teams (O'Connor, 2012). Furthermore, the experiential, integrated understanding that students can gain during the project development where constructivist principles are active and integrated (Piaget, 1950) can be extended through public viewing. When Papert and Harel (1991) articulated the principle of constructionism they found that publically viewable, applied work could increase the learning in students.
- Using open-education resources, practitioner forums, MOOCs (massive open online courses), and conventional resources, can "flip" the instructional

experience so that students have prepared in advance of the interactions (DesLauriers, Schelew, & Wieman, 2011; Hake, 1998). However, instructors must attend to the legitimacy and stability of these *volatile* resources. Online instructors frequently have students read or study in advance of entering into discussion boards, webinars, and synchronous meetings; discussion boards often are structured around questions relating to the meaning of readings, case studies, and articles. Jig saw methods (where a team of students each take and then present part of an assignment) can be threaded into discussion boards as well. When having a webinar, instructors can ask students to prepare in advance of the class or session, submitting their ideas or talking-points in a slide that they will present during the webinar session. Anecdotal evidence attests to the value and the preparation that students apply to such webinars when they have an active stake in the participation and presentation of the webinar. As true of all publically-accessible web-based content, if an instructor decides to use a prepared course (such as a MOOC or an open-education resource), a web-based report, or an online professional forum, it is important to check the credentials, accuracy, stability, availability, and costs of such resources.

Instructors can design rich environments that require interactions and assignments and that embed assessments of all the valued learning in ways that create a community of learners and elicit higher levels of learning. Courses and learning environments can now extend into and integrate the real-world that the content area examines.

SCAFFOLDING AND INTEGRATION—PROCESS

Online learning or technology-threaded aspects of many types of learning scenarios, particularly when moving beyond reading assignments and papers, can provide deep, complex learning opportunities. But these environments can be *severely handicapped* by lack of attention to details, assumptions, pacing, beyond-course requirements, and complexity. This section addresses areas that should be monitored if the learning environment is to be productive, enriching, and not-too-frustrating. It also compiles research-reported and author-experienced best practices in technology-mediated design. The instructional elements that may require scaffolding should be integrated into the assignments and interactions themselves, as addressed above. This section focuses on the process and mechanics of the instructional envelope itself. Consider the complexity of face-to-face instructions when a detailed project or learning is required—even with the long-understood interactions and checkpoints available to students and instructors. Thus, it becomes clear that particularly careful design is required for online or distance components. Blended formats may be more *forgiving* since the instructor can be present to make modifications and offer additional information as questions arise; however, when designing for the more rigorous online environment, be sure to address the following.

Check Assumptions and Directions

Instructor must clearly communicate all the relevant understandings about timing, sequencing, documentation, and events. Instructions that might have been given verbally need to be codified into written instruction and bulleted lists. The instructor must always establish the balance between giving sufficient background information and overloading the students with too much detail. In the text directions, consider using images and schematics that can overview process and connections and develop audio and video explanations of signup and technology-usage processes, particularly if there are selections that must be made from web-based menus. Reflect on the "voice" used when providing directions, a familiar voice may be more comforting and easier-to-write but a more formal voice can be more concise and universal—particularly if more than one instructor will be using a tutorial or set of instructions. Consider all the supportive tasks that may be needed in completing projects and in procuring approvals and permission. Ensure that the steps and procedures are enumerated in the course and any timelines are integrated into the appropriate modules or segments within the course. Ideally, the instructor would conduct a usability study of a course or learning environment before its implementation; a time when another individual checks procedures, links, and directions. Since this cannot always be feasible, instructors should be thorough and careful with their directions.

Use an Ongoing Development and Improvement Process

When initially developing a course, take time to be deliberate and concise with the instructions—for the content and the process. It can be useful to develop the course within a word-processing document, using the helpful outlining features that are embedded in such applications. With the outline feature, instructors can easily view the organization of a course and can move around sections, before moving to the tedious process of cutting-and-pasting sections into the Learning Management Systems/Course Management Systems (LMS/CMS). Keep a running procedural and instruction log of what should be improved in later revisions. Many good mapping programs are available (such as www.MindMeister.com) that let instructors plan a process in a quasi-visual way that can allow them to see the organizational big picture. The color coding or icon-coding of sections can make it easy to distinguish between content and process and among the different types of assignments and interactions.

Apply Scaffolding During and Within the Course

Even if the learning scenario is constructed within the linear format of a CMS/LMS, instructors can support students' success by providing weekly

succinct reminders—it can be especially useful when instructors create an ongoing blog of these e-mails. Given the complexity of students' lives and tasks, a weekly reminder can help them stay organized and on-task. Be sure though to just send reminders, preferably with links into the assignments themselves. To avoid getting into a situation where a student simply wants to be given a summary of the assignment in the e-mail, students should be politely encouraged to send instructors any specific questions about assignments referring to the unclear aspect of the assignment directly. Of course, be sure that the dates and internal timetables in the course are clear too. It can be helpful at the start of each module or learning-scenario segment to have an overview of the tasks involved, the instructional objectives for the course (which are associated with the assignments and their assessment), and the timetable for that module. Having a consistent due-date and time can reduce the mental task of remembering and monitoring dates—such as, all major assignments are due by Saturday midnight.

Test Signons, Views, and Permissions

When working within a CMS/LMS, generally the educational institution maintains the responsibility of giving students permissions and passwords. If an instructor is using emerging technologies and/or their own websites, he or she may need to ensure that everyone has the appropriate permission level and signons. Instructors may need to require students to use a particular e-mail account with some products—for instance, Google has many useful products, but there can be problems if students do not have Google Mail accounts. Remember too that there can be different "views" with a CMS/LMS so instructors should be sure they have tested any setup in both the instructor and the student view.

Use Care When Working Across Courses, Policies, and Interactions

Particular care must be given in instructional design and scaffolding if the learning or interaction process requires that information, evidence, reports, and the like are integrated within the learning scenario. Instructors must be mindful of issues with access, permissions, and notifications. Instructors must also ensure that any and all participants, co-instructors, or supportive professionals understand the purpose and evaluation process within the course or learning environment, even if only for the section when they will be involved.

Design with Updating in Mind

As instructors construct the logic, flow, assignments, and interactions in course and learning environments, they should consider too the eventual process for updating and improving. Even if working within a CMS/LMS, instructors

may want to place resources and components that will not change in external websites or the like, thereby avoiding the loss of this content between semesters or when there is a change in instructors. Instructors should comply with the intellectual property ownership conditions relevant to their terms-of-employment, but it may be well to keep non-assignment content outside the course and then link this material into the CMS/LMS.

Participate in Ongoing Research, Evaluation, Learning, and Review

The nature of online and web-based interactions often provides instructors with opportunities for an examination of their courses that goes beyond student assessment or even students' evaluative comments (in post-course evaluations often conducted by educational institutions). With the procurement of informed consent of the students (beginning with the policies and procedures of the Institutional Review Board), instructors can study interactions and can conduct and publish research on student learning because of the readily-available interactions preserved within online interactions or taped webinars and virtual-sessions (O'Connor, 2012-2013). The often-cited ADDIE model with Analyze, Design, Develop, Implement, and Evaluate (Branson, Rayner, Cox, Furman, King, & Hannum, 1975) emphasizes the importance of the ongoing evaluation and improvement of the instructional program and the components of the program as well. As well as staying abreast of their content area, instructors should plan on continuous improvement of the instructional design, by studying changes in technologies, and assimilating reports on new ways to foster learning and social communities. As posited by Hacker and Niederhauser (2000), instructors will continuously need to grow in their learning about technology-based teaching to create an effective social environment.

As reminded by Davis (2006): "Creating scaffolding for the procedures of online teaching and learning is just as demanding as creating instructional scaffolding for the course content." However, given the expansive, 21st century learning possible with enriched perspective on content, content communities, and engaged learners; with the emerging tools for sharing, visualization, storage, and interactions; and with interactive, dynamic ways to design and assess a student's and a course's progress, instructors can expand the borders of learning in ways that were never before possible.

REFERENCES

Abendroth, M. A., Golzy, J., & O'Connor, E. A. (2011-2012). Self-created YouTube recordings of microteachings: Their effects upon candidates' readiness for teaching and instructors' assessment. *Journal of Educational Technology Systems, 40*(2), 141-159.

Anderson, R. (2002). Reforming science teaching: What research says about inquiry. *Journal of Science Teacher Education, 13*(1), 1-12.

Argote, L., McEvily, B., & Reagans, R. (2003). Managing knowledge in organizations: An integrative framework and review of emerging themes. In special issue on Knowledge Management: *Creating, Retaining and Transferring Knowledge. Management Science, 49*, 571-582.

Bligh, D. (2001). *What's the use of lectures?* San Francisco, CA: Jossey-Bass.

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain.* New York, NY: David McKay Company.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

Branson, R. K., Rayner, G. T., Cox, J. L., Furman, J. P., King, F. J., & Hannum, W. H. (1975). Interservice procedures for instructional systems development (5 Vols.) (TRADOC Pam 350-30 NAVEDTRA 106A). Ft. Monroe, VA: U.S. Army Training and Doctrine Command, August 1975.

Clark, R. E., & Estes, F. (1996). Cognitive task analysis. *International Journal of Educational Research, 25*(5), 403-417.

Davies, A., Fidler, D., & Gorbis, M. (2011). *Future work skills 2012.* Institute for the Future for University of Phoenix Research Institute.

Davis, C., Edmunds, E., & Kelly-Bateman, V. (2008). Connectivism. In M. Orey (Ed.), *Emerging perspectives on learning, teaching, and technology.* Retrieved from http://projects.coe.uga.edu/epltt/index.php?title=Connectivism

Davis, M. T. (2006). Using procedural scaffolding to support online learning experiences. *International Professional Communication Conference, 2006 IEEE,* (pp. 144-147).

DesLauriers, L., Schelew, E., & Wieman, C. (2011). Improved learning in a large-enrollment physics class. *Science, 332,* 862-864.

Dick, W., & Carey, L. (1990). *The systematic design of instruction* (3rd ed.). Glenview, IL: Scott, Foresman and Company.

Edelson, D. C. (1998). Realising authentic science learning through the adaptation of scientific practice. *International Handbook of Science Education, 1*, 317-331.

Ertmer, P., Stepich, D., Flanagan, S., Kocaman, A., Reiner, C., Reyes, L., et al. (2008). Ill-structured problem solving: Helping instructional design novices perform like experts. *AERA*. http://www.edci.purdue.edu/ertmer/docs/AERA08_ExpertNovice.pdf

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. New York, NY: Basic Books.

Hacker, J., & Niederhauser, D. (2000). Promoting deep and durable learning in the online classroom. *New Directions for Teaching and Learning, 84*, 53-63.

Hake, R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics, 66*, 64-74.

Huang, H. (2002). Toward constructivism for adult learners in online learning environments. *British Journal of Educational Technology, 33*(1), 27-37.

Hodgood, B., & Ormsby, L. (2010). Inclusion in the 21st-century classroom: Differentiating with technology. *Reaching every learner: Differentiating instruction in theory and practice.* Retrieved from http://www.learnnc.org/lp/editions/every-learner/6776

Koehler, M. J., & Mishra, P. (2005). What happens when teachers design educational technology? The development of technological pedagogical content knowledge. *Journal of Educational Computing Research, 32*(2), 131-152.

Kourova, A., & Modianos, D. (2013). Inter-cultural awareness and its role in enriching students' communicative competence. *The International HETL Review,* Special Issue, 2013.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* New York, NY: Cambridge University Press.

Mackey, T. P., & Jacobson, T. E. (2011). Reframing information literacy as a metaliteracy. *College & Research Libraries, 72*(1), 62-78.

Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *The Teachers College Record, 108*(6), 1017-1054.

Moeller, B., & Reitzes, T. (2011). http://www.nmefoundation.org/getmedia/befa9751-d8ad-47e9-949d-bd649f7c0044/integrating

O'Connor, E. A. (1997). *Students' use of atomic and molecular models in learning chemistry.* Ann Arbor. United States. Dissertations & Theses, Copyright UMI – Dissertations Publishing 1997. Document URL. http://search.proquest.com/docview/304395277

O'Connor, E. A. (2008). Initial study of pre-service teachers' comments on a reality-based, urban-student video streamed within an online course. *Journal of Educational Technology Systems, 37*(2), 139-157.

O'Connor, E. A. (2010). The use of a wiki in teacher education: How does learning and instruction change when work can go public? In D. Gibson & B. Dodge (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2010* (pp. 2822-2829). Chesapeake, VA: AACE.

O'Connor, E. A. (2012). Developing effective online collaborative science projects by using course scaffolding, a virtual world, and web 2.0 technologies. In the proceedings of the *Society for Information Technology & Teacher Education* (pp. 728-735). Chesapeake, VA: AACE.

O'Connor, E. A. (2012-2013). Next generation online: Advancing learning through dynamic design, virtual and web 2.0 technologies, and instructor *attitude. Journal of Educational Technology Systems, 41*(1), 3-24.

O'Connor, E. A., & McQuigge, A. (2013-2014). Exploring *badging* for peer review, extended learning and evaluation, and reflective/critical feedback within an online graduate course. *Journal of Educational Technology Systems, 42*(2), 87-105.

Osofsky, M. (2004). Beyond the classroom: Increasing student participation in professional organizations. *Observer: Association for Psychological Science, 17*(2).

Paivio, A. (1971). *Imagery and verbal processes*. New York, NY: Holt, Rinehart and Winston. (Republished in 1979 – Hillsdale, NJ: Erlbaum.)

Palloff, R., & Pratt, K. (1999). *Building learning communities in cyberspace: Effective strategies for the online classroom.* San Francisco, CA: Jossey-Bass.

Papert, S., & Harel, I. (1991). Situating constructionism. *Constructionism.* New York, NY: Ablex Publishing Corporation.

Parrish, P., & Linder-VanBerschot, J. (2010). Cultural dimensions of learning: Addressing the challenges of multicultural instruction. *The International Review of Research in Open and Distance Learning, 11*(2). Available at http://www.irrodl.org/index.php/irrodl/article/view/809/1497

Petrović, N., Petrović, D., Jeremić, V., Milenković, N. and Ćirović, M. (2012). Possible educational use of Facebook in higher environmental education. *International*

Conference on Information Communication Technologies in Education 2012 Proceedings (pp. 355-362). Available at http://www.icicte.org/Proceedings2012/Papers/09-1-Petrovic.pdf

Phelan, P., Davidson, A. L., & Cao, H. T. (1991). Students' multiple worlds: Negotiating the boundaries of family, peer, and school cultures. *Anthropology & Education Quarterly, 22*(3), 224-250.

Piaget, J. (1950). *The psychology of intelligence*. New York, NY: Routledge.

Prensky, M. (2001). Digital natives, digital immigrants. Retrieved from http://www.nnstoy.org/download/technology/Digital%20Natives%20-%20%20Digital%20Immigrants.pdf

Rama, R., Black, R., Van Es, E., & Warschauer, M. (2012). Affordance for second language learning in World of Warcraft. *European Association for Computer Assisted Language Learning. ReCALL, 24*(3), 322-338.

Reiser, B. (2004). Scaffolding complex learning: The mechanisms of structuring and problematizing student work. *The Journal of the Learning Sciences, 13*(3), 273-304.

The Herridge Group Inc. (2004, December). *The use of traditional instructional systems design models for e learning.* Retrieved from http://www.herridgegroup.com/pdfs/The%20use%20of%20Traditional%20ISD%20for%20feLearning.pdf

Veletsianos, G. (Ed.) (2010). A definition of emerging technologies for education. In, *Emerging technologies in distance education* (pp. 3-22). Edmonton, AB: Athabasca University Press.

Virtanen, P., Myllärniemi, J., & Wallander, H. (2012). Diversifying higher education: Innovative tools to facilitate different ways of learning. *International Conference on Information Communication Technologies in Education 2012 Proceedings.* Available at http://www.icicte.org/Proceedings2012/Papers/03-2-Virtanen.pdf

Wiggins, G., & McTighe, J. (2005). *Understanding by design—Expanded 2nd edition.* Association for Supervision and Curriculum Development, Alexandria, VA.

Yoder, M. (2005). Inquiry based learning using the internet: Research, resources, WebQuests. *19th Annual Conference on Distance Teaching and Learning.* Retrieved from http://www.uwex.edu/disted/conference/Resource_library/proceedings/03_57.pdf

Zhang, D., Zhou, L., Briggs, R., & Nunamaker, J. (2006). Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness. *Information & Management, 43,* 15-27.

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