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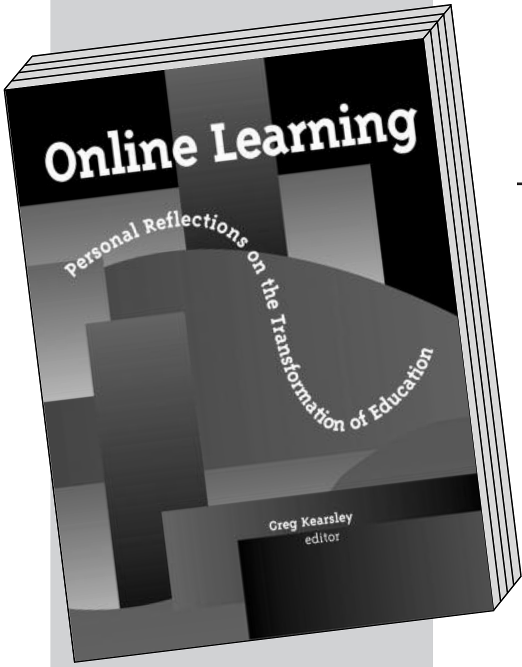


# ONLINE LEARNING

## *Personal Reflections on the Transformation of Education*

This book presents a comprehensive history of the field of online education as told by many of the pioneers who created it. In doing so, it fills in the background and provides a foundation for more recent efforts. Each of the contributors discusses their work in online education and presents a personal perspective of the field. Collectively, the chapters portray the major themes and issues that have characterized the past development of online education and will likely dictate its future. The 440 page volume consists of the following chapters:

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# contributing editors

# MOOCs: Let's Get REAL

**Thomas C. Reeves**
*Contributing Editor*

**John G. Hedberg**

Rising costs, perceived declining value, and weak evidence of quality outcomes bedevil contemporary higher education. One innovation intended to address these problems is the Massive Open Online Course (MOOC). This article recommends that the educational technology community and others get **REAL** about MOOCs by focusing more serious effort on **R**esearch, **E**valuation, and **A**ssessment for **L**earning. Unless this is done, MOOCs will not realize their potential to both extend higher education opportunities and enhance the quality of teaching and learning.

## Introduction

The ivory towers of higher education are being attacked on multiple sides. For starters, students, parents, legislators, and the citizenry at large are increasingly concerned about the rising costs of higher education. Worries about rising costs appear to be especially high in the USA, where the assumption that young people will go to college has risen steadily since the end of World War II. Students and/or their parents are borrowing and spending large amounts of money for what for many may be more about meeting a perceived social obligation ("of course, my child will go to college") than about pursuing a "higher" education per se. Setting aside the question of whether some people should go to college, the costs are alarming. According to the *Daily Finance* Website (Watson, 2013): "Over the last 30 years, tuition has increased 1,120 percent; by comparison, even the 'skyrocketing' cost of health care only rose 600 percent, and housing costs have gone up a paltry 375 percent." The average amount of debt per college graduate is approaching $28,000 and the total debt for US students exceeds 1.2 trillion dollars.

At the same time that the costs of higher education are rising, the perceived *value* of higher education degrees is declining (Selingo, 2013). *The Atlantic* (Weismann, 2012) reported that 53 percent of college graduates are unemployed or under-employed. *The Economist* (2012) presented clear evidence that the perceived value of higher education degrees is declining. For example, the percentage of Americans who believe that higher education is worth the value of its costs has declined over the past decade from 82% to a low of 57%. In the wake of the 2008 recession, the number of jobs demanding a higher education degree is lower than the number of graduates. In the USA, this problem has been exacerbated because of the inclination of so many students to pursue degrees in fields where opportunities for employment are relatively low, such as journalism and the entertainment industry (Vedder, Denhart, & Robe, 2013).

If rising costs and declining value were not bad enough, at the same time there is a paucity of evidence that the quality of learning outcomes is at desirable levels. Research shows that college graduates are underachieving in many areas critical to success in the 21st Century (Arum & Roksa, 2011). According to the Association of American Colleges and Universities (2008), today's college graduates are particularly weak in:

- Inquiry and analysis
- Critical and creative thinking
- Written and oral communication
- Quantitative literacy
- Information literacy
- Teamwork and problem solving

In addition, corporations hiring college graduates complain that they must spend tens of thousands of dollars on training before the new employees are minimally competent (Cappelli, 2012). Gawande (2009) wrote: "For nearly all of history, people's lives have been governed primarily by ignorance…But sometime over the last several decades…science has filled in enough knowledge to make ineptitude as much our struggle as ignorance" (p. 8). It is worthwhile to ask why are so many college graduates poorly prepared or even inept?

Rising costs, declining value, and weak evidence of quality outcomes have created a "perfect storm" for higher education (Selingo, 2013). Innovation is clearly needed (Christensen & Eyring, 2011). As described in this magazine by Milheim (2013), one innovation that has captured considerable attention in the last few years is the Massive Open Online Course (MOOC).

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## Clarifying the Meaning of MOOCs

The astonishing growth of MOOCs has spurred a great deal of debate on the future of higher education (Waters, 2013). From the introduction of the MOOC concept in 2008 by a group of Canadian scholars to their more recent uptake by large-scale non-profit and for-profit ventures, such as edX, Udacity, and Coursera, MOOCs have come to be simultaneously viewed by some as the potential savior of higher education (Friedman, 2013) and by others as the harbinger of its ultimate demise (Vardi, 2012). But what do the words encapsulated in the MOOC acronym really mean?

MOOCs can be said to be "massive" in the sense that tens of thousands of people have signed up for selected MOOCs (Daniel, 2012). But many, perhaps most, MOOCs do not attract such high levels of participation. Instead, what is alarmingly massive about the MOOCs that do initially attract very high enrollments may actually be their *attrition rate*, often 90 percent or more (Waters, 2013).

Most MOOCs are labeled as "open" in the sense that fees are not required, although costs may be involved for specific "premium" services (e.g., Coursera's "Signature Track Verified Certificate" of course completion). But MOOCs are not open according to Wiley (2013), who maintains that that there are only two defining characteristics of an open educational resource:

1. Access to the resource is free and unfettered. That is, the resource can be accessed without the user being required to pay, provide personal information, or jump through any other hoops as a prerequisite to access.
2. All users have free 4R permissions with regard to the resource. That is, either by virtue of open licenses or the work being in the public domain, anyone and everyone has the legal permissions necessary to reuse, revise, remix, and redistribute the resource.

Given that virtually all MOOCs require some restrictions with respect to being "free and unfettered" and/or do not provide unlimited rights to "reuse, revise, remix, and redistribute" their content, the application of the term "open" to MOOCs is somewhat misleading.

MOOCs are almost completely "online," although in some cases, learners wishing to earn transferrable credits must take final exams and other assessments at proctored physical sites. Ironically, as Romiszowski (2013) argued in this magazine, most MOOCs to date have not been designed to take advantage of the affordances of sophisticated pedagogical designs or technological advances. Instead, as with so many previous educational innovations, most MOOCs emulate the traditional instructional approaches used in even earlier "innovations."

Whether MOOCs are "courses" in the traditional sense of this academic construct gets to the crux of the thesis of this article. The term "course" is a reflection of a curricular structure for higher education well past its prime (Christensen & Eyring, 2011). More importantly, amidst all the large financial investments various venture capitalists, universities, and philanthropists are making in MOOCs (Daniel, 2012; Milheim, 2013), one question remains inadequately addressed: "What is the evidence that high-quality learning is taking place on the part of those who enroll in MOOCs?" We think it is time to get REAL about this.

## Why REAL?

Whether MOOCs will have positive effects on the costs, value, and outcomes of higher education demands that academics, instructional designers, technologists, and their collaborators take three key processes (research, evaluation, and assessment) much more seriously than they have in the past. Concurrently, anyone involved in MOOCs must focus these processes as sharply as possible on learning. We have adopted the acronym **REAL** (**R**esearch, **E**valuation, and **A**ssessment for **L**earning) to encapsulate the significant changes we are espousing.

Research should be the first and foremost driver for maximizing the potential of MOOCs, but we are not recommending the type of educational research that has had little impact on actual teaching and learning over the past 50 years. Traditional educational research approaches have long been focused on comparing the relative effectiveness of one instructional method or strategy over another (e.g., classroom versus online instruction). The history of such comparative studies of innovations intended to enhance teaching and learning is largely one of "no significant differences" (Clark, 2012).

Instead, we advocate educational design research (McKenney & Reeves, 2012) for driving the development of effective MOOCs. Educational design research begins with a focus on a real-world problem, e.g., university students are not developing a robust mental model of the scientific process (Rapp, 2005), and/or a desire to enrich understanding of an important educational variable, e.g., self-regulated learning (Zimmerman, 1990). After a thorough analysis and exploration of the context in which the problem or knowledge gap exists, researchers and practitioners (e.g., educational researchers and university science instructors) collaborate in the design and construction of a prototype solution to the problem, e.g., a MOOC focused on genetics intended to enhance students' mental model of the scientific process. Educational design research requires subjecting a prototype innovation such as a MOOC to iterative cycles of testing and refinement accompanied by substantive reflection to guide the redesign and implementation of the innovation in situ. Concurrently with the development and refinement of the innovation, theoretical knowledge about the educational phenomenon is clarified, and design principles that may be applied to the development of future innovations are identified.

Evaluation, especially formative evaluation, should be a key component of any initiative involving MOOCs (Reeves & Hedberg, 2003). A primary reason that MOOCs are not reaching their potential is that they have not been adequately evaluated during their design, development, and implementation. Many MOOC developers and their collaborators (e.g., subject matter experts and instructors) appear unable to move their design efforts beyond slavish replication of traditional classroom practices. For example, the major pedagogical components of most MOOCs are based upon common classroom practices such as lectures, discussions, essays, and quizzes, thereby continuing the triumph of new technology over innovative pedagogy (*Chronicle of Higher Education,* 2012). Daphne Koller, co-founder of Coursera, proclaimed, "The progress of Coursera, and the MOOC adoption more broadly, has greatly exceeded my wildest expectations" (Cassidy, 2013, para. 18). However, an expert analysis of the MOOCs emerging from Coursera by Bates (2012) revealed over-reliance on traditional "transmissionist" (teaching by telling) pedagogy. Bates (2012) also concluded that these MOOCs are being designed by trial and error rather than through rigorous formative evaluation.

The collapse of a Coursera MOOC focused on Online Learning Design in early 2013 illustrated the lack of rigorous evaluation being applied to MOOCs before they are launched (Jaschik, 2013). The high attrition rates in MOOCs may stem from the fact that most MOOCs lack engaging interactions and primarily rely on rather simplistic behaviorist pedagogy with little specific feedback that addresses the precise learning challenges faced by the participants. Poor design and weak evaluation are at the root of these problems. Evaluation essentially involves collecting evidence to support decisions that need to be made about the design, development, and implementation of MOOCs to make them engaging and effective (Reeves & Hedberg, 2003).

High-quality assessment is critical to the process of determining what people are learning in a MOOC as well as the extent to which they are learning. Traditional assessments include tests and essays, whereas alternative assessments include portfolios of cumulative products and completion of authentic tasks (Oosterhof, Conrad, & Ely, 2008). Assessment is the issue most closely linked to the question of evidence of learning occurring. Ideally, the learning accomplished through MOOCs won't merely match the outcomes of traditional higher education, weak as they are (*cf.* Arum & Roksa, 2011; Bok, 2006). Instead, MOOCs should enhance outcomes across the board. It is not enough to be just as good. Ebersole (2013) highlighted this challenge: "At a time when evidence of learning is increasingly demanded by accreditors and the federal government, a determination of equivalency in instruction alone is no longer sufficient. Valid, secure learning outcome assessment must now be part of the equation as well" (para. 3).

The primary strategies (e.g., quizzes and peer assessment) employed to assess learning in MOOCs are similar to those that can be found in other delivery systems for higher education, such as face-to-face courses, blended courses, or totally online courses. Regardless of the type of delivery system, assessment strategies must be carefully aligned with other components of the learning environment, specifically, the objectives, content, learning design/learning activities, the roles of the instructor, the roles of the learners, and the technological affordances inherent in the delivery system (Reeves, 2006). Misalignment of these factors is a frequent criticism of higher education programs because, although most programs and courses will state lofty goals and objectives, they rarely match these with relevant, reliable, and valid assessment strategies. A more systematic approach to assessment is needed to ensure that there is strong alignment among the primary components of MOOCs.

Achievement of learning outcomes should be the bottom line in any form of higher education. The meaning of learning in contemporary higher education is contested. The broad lines of disagreement are represented by those who view higher education primarily as a vehicle for preparing people to fit into the 21st Century workplace and those who consider the primary goal of higher education as preparing people to self-actualize themselves for a future that cannot be predicted. We lean toward the latter perspective, while acknowledging the importance of preparing people to successfully navigate the demands of a career or profession. Kuh, Cruce, Shoup, Kinzie, and Gonyea (2008) sum up a more inclusive position on learning in higher education:

> *The college degree has replaced the high school diploma as a mainstay for economic self-sufficiency and responsible citizenship. In addition, earning a bachelor's degree is linked to long-term cognitive, social, and economic benefits to individuals—benefits that are passed onto future generations, enhancing the quality of life of the families of college-educated persons, the communities in which they live, and the larger society. (p. 540)*

## Expanding the MOOC Vision

Educational technologists know that there is an important relationship between different models of instruction (or pedagogical design dimensions) and

| Type of MOOC | cMOOC | xMOOC | pMOOC |
|---|---|---|---|
| Learner Role | Active | Passive | Active |
| Instructor Role | Co-learner | Sage on video stage | Guide on the side |
| Learning Theory | Connectivism | Behaviorism | Constructivism |
| Primary Pedagogy | Knowledge integration | Knowledge duplication | Knowledge production |
| Metaphor | "We link movies" | "We watch movies" | "We make movies" |
| Development Approach | Learning design | Instructional design | Educational design research |
| Primary Type of Assessment | Self Assessment | External and/or Peer Assessment | Self and Client Assessment |
| Funding Source | Seat of the pants funding | Large external funding | Moderate client provided funding |

**Figure 1.** Differences among three types of MOOCs.

learning outcomes. At present, there are two primary types of designs for MOOCs—cMOOCs and xMOOCs (Siemens, 2012). Although they originated in Canada, the cMOOC moniker does not refer to their geographic roots, but reflects their connectivist (Downes, 2012), constructivist, and collaborative pedagogical origins. By contrast, the MOOCs offered by Coursera, edX, and Udacity and other entities associated with elite U.S. universities (such as Stanford, MIT, and Harvard) have been referred to as xMOOCs to reflect what some see as their roots in behaviorist or "transmissionist" (teaching by telling) pedagogy and/or their stated goals of making profits (Bates, 2012).

New MOOC designs are needed. During the first quarter of 2013, the Open University of the UK offered an innovative type of MOOC focused on Learning Design for the 21st Century Curriculum (Cross, 2013). Within the design team, it was referred to as a "pMOOC" because it was conceived as a project or problem-based learning environment. In this MOOC, participants (primarily teachers) were called upon to develop open educational resources that could be used by themselves and/or other teachers. ***Figure 1*** outlines the differences among cMOOCs, xMOOCs, and pMOOCs.

New MOOCs should also be designed to dispel the myth that learning online is effortless. Carey (2013), an American expert on higher education policy from the New America Foundation, recently wrote a detailed description of what it is really like to learn in a MOOC. Carey enrolled in MIT 7.00x, an introductory biology course, one of the first courses offered by the Harvard-MIT venture edX. Professor Eric Lander, a leader of the Human Genome Project, taught the course. Carey describes how he invested 15 hours per week for 15 straight weeks in intensive studying, managing to earn a respectable 87% score on the rigorous exams.

Few of today's undergraduate students make this level of effort in their courses (Hersch & Merrow, 2005). In the USA, a typical three-credit semester length course should involve three hours per week in class or labs, and another 9–12 hours per week in studying and other learning activities. But the reality is that university students are investing much less time in their academic studies than this. According to Babcock and Marks (2011), "Full-time students allocated 40 hours per week toward class and studying in 1961, whereas by 2003 they were investing about 27 hours per week" (p. 468). Ten years on, it is likely that the number of hours spent studying has declined even more, and as Carey (2013) concluded, "For many students, full-time college has become a part-time job." What is especially ironic about this is that while the time invested in learning has steadily declined, the grades awarded to students have steadily increased (Rojstaczer & Healy, 2012). Clearly, the professoriate, at least in the USA, is expecting less effort and giving more rewards to students than ever before. This is not surprising given that, first, the reward systems for the professoriate generally value research and external grants above teaching, and second, curricular alignment is rarely scrutinized in any serious way. Developing rigorous, academically sound MOOCs through a REAL agenda may provide a mechanism for turning these imbalances around.

## Time to Get REAL

MOOCs could be a flash in the academic pan, and may follow a trajectory such as "learning objects" did nearly a decade ago (Wiley, Padron, Lambert, Dawson, Nelson, Barclay, & Wade, 2004). New and more effective MOOCs will emerge if and only if a REAL agenda is pursued by all involved. Educational technologists should play a major role in this agenda. If we in the field of educational technology get REAL, MOOCs may begin to attain the enormous potential they appear to offer to dramatically change the nature and impact of learning and teaching in higher education.

The two most defensible rationales for MOOCS are first, extending learning opportunities for those who would not otherwise have them, and second, enhancing the quality of learning and teaching. MOOCS may indeed extend opportunities to learners around the globe, but unless REAL strategies are maximized, these opportunities will be substandard, weaker than the already inadequate designs of higher education instruction of today (Hersch & Merrow, 2005). With respect to the second rationale, progress on enhancing the quality of learning and teaching through MOOCs is unacceptably slow given the large investments and the power of learning analytics (Siemens & Long, 2011). Poorly developed and weakly refined MOOCs will not enhance the generally weak state of the methods and outcomes of higher education (Selingo, 2013). Only a REAL approach will. □

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# Research on Education in the Knowledge Creation Paradigm

**Seng Chee Tan**
**John Ow**
**ChingSing Chai**
**Chew-Lee Teo**
**Jennifer Yeo**

To better prepare learners for the "knowledge society," educators in Singapore have embarked on a journey in experimenting with knowledge creation pedagogy in classrooms. The Knowledge Creation and Innovative Design Centre was set up to further coordinate this effort. In this article, the authors give an account of the historical development of effort in sustaining and scaling knowledge building pedagogy in the past decade, and present two recent research efforts of this Centre.

## Introduction

There is a clarion call for changes in education as we move further into the 21st Century. Reports such as "enGauge 21st Century skills: Literacy in the digital age" (North Central Regional Educational Laboratory, 2003) and "Results that matter: 21st Century skills and high school reform" (Partnership for 21st Century Skills,

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2006) recommend inclusion of 21st Century skills in school curriculum. There are also calls to revolutionize education in response to the opportunities and challenges from the rapid advancement in technologies (Collins & Halverson, 2009) and the new culture of learning (Thomas & Brown, 2011). Collectively, the calls for change in education seek to better prepare learners for living, working, and learning in a knowledge society.

The "knowledge society" is characterized by the transformation of information into resources that benefit society. Peter Drucker, one of the most influential and far-sighted thinkers in management, introduced the concept of "knowledge worker" in a book published in the sixties (Drucker, 1969). A knowledge worker has a vital role to play in transforming information and creating knowledge in a knowledge society. In such a society, knowledge, rather than physical resources, is regarded as a more important asset for the health and wealth of an economy. Drucker's conception of a knowledge worker and the related notion of a knowledge society are closer to realization with the arrival of tools that enhance individuals' ability to "work" with information and knowledge to benefit society.

The Internet technologies, coupled with mobile devices, immensely enhance communication among people and facilitate sharing of information. The recent proliferation of Web 2.0 tools further breaks the provider-consumer divide and allows us to capitalize on collective intelligences and distributed expertise.

While technologies facilitate sharing of and access to information and data, it is the effective use of information and data that could result in productive actions. This highlights the importance of knowledge workers who could adaptively apply information in a new context to innovate and create new ideas or products. It is for this reason that skills like communication, information and communications technology (ICT) literacy, information and media literacy, and critical thinking are commonly listed as 21st Century skills (Anderson, 2008). That said, however, there are new challenges in the knowledge societies (UNESCO, 2005): hegemony of techno-scientific knowledge, suppression of local and indigenous knowledge, digital divide, digital immigrant–native divide, and excessive commoditization of knowledge.

UNESCO takes a more integrative, pluralistic, and developmental perspective on knowledge societies. Knowledge is not only for economic growth, but also for empowering and developing all sectors of a society. A knowledge society is also a learning society, which has a culture of innovation and continual renewal and is characterized by learning through multiple modes and means, learning to learn, recognition of multiple intelligences, and lifelong learning for all.

In response to these calls for changes in education, Singapore, a small Asian country that relies mainly on its human resources for economic survival and growth, has also embarked on her journey in experimenting with knowledge creation pedagogy in the new millennium. To further coordinate our effort in this aspect, the Knowledge Creation and Innovative Design Centre was set up in June 2013 at the National Institute of Education (Singapore). Before we discuss the agenda of this Centre, we first provide an account of the historical development of this line of research in Singapore, which documents our effort in sustaining and scaling the pedagogy in the past decade.

In this article, knowledge creation is used as the inclusive term to refer to all practices that aim at creating new knowledge products, whereas knowledge building refers to the specific pedagogical approach pioneered by Scardamalia and Bereiter (2006).

## Introducing Knowledge Creation Pedagogy to Singaporean Classrooms

The introduction of knowledge building pedagogy to Singaporean K–12 classrooms could be traced to the beginning of the 21st Century. The initial introduction of the pedagogy into schools in Singapore took place with researchers leading pedagogic and curriculum innovation in schools. Tan (first author) started a trial with three schools between the years 2001 to 2004. Two of the schools dropped out after one semester because of technical issues and lack of students' motivation to continue. A modest success was achieved in the third school, where the researcher co-taught a science inquiry class and an after-school enrichment program for selected students. Focusing on developing science inquiry skills among the Seventh Grade students, the students were found to perform better in some aspects of scientific inquiry skills and in achievement test scores (Tan, Hung, & So, 2005).

Coinciding with the establishment of the learning sciences research lab at NIE in 2005, more researchers joined the effort in integrating knowledge building pedagogy into Singaporean schools. This phase of intervention was characterized by a collaborative effort between researchers and school teachers to co-design lessons and improve the lesson implementation through iterative cycles.

The work to introduce a knowledge building pedagogy during this phase happened roughly between 2005 and 2009 at two research sites (see Ow & Bielaczyc, 2008; Tan & Seah, 2011; Yeo & Tan, 2011), one working with Fourth Grade students and another with 11th Grade students. We saw more significant changes in schools and more substantial evidence of students' progress during this phase of intervention.

Since 2010, our approach to introduce knowledge building pedagogy in schools focuses on engaging teachers from different schools in a knowledge creation community. Coordinated by researchers from the Ministry of Education and NIE, teachers from five different schools participate in school-based professional learning teams (PLT). Each week, about four to six teachers meet to discuss implementation of knowledge building pedagogy in their respective schools and to spread the practice to more departments within the schools. Each PLT is led by a teacher who has more experience in the knowledge building pedagogy. Monthly, leaders (and sometimes teachers) from each school meet with the researchers to share their experience and to discuss issues. Special events are also organized for the teachers to advance their professional practice. For example, a study trip to Hong Kong schools was organized, and a one-week workshop facilitated by Marlene Scardamalia and Carl Bereiter was conducted.

Incidentally, tracing this historical development could be a worthy research study on sustaining and scaling knowledge creation practices. Our initial approach could be characterized as the dissemination approach (Rogers, 2005), where the researcher champions the innovation, with school teachers acting mainly as recipients. The mid-term approach could be regarded as the collaborative learning approach (Tenkasi & Mohrman, 1995), where teachers and researchers work collaboratively to design and implement lessons. The latest approach, incidentally, leans toward a situative knowledge building community through which the teachers not only take up the main responsibility of enacting effective pedagogical practices in their classrooms, but also assume the agency of spreading the practices to other classrooms and schools. This piques our interest in widening the scope of research on education in the knowledge creation paradigm, for example, in developing teachers' epistemic agency in creating professional knowledge. In the next section, we discuss a few potential areas of research that could be explored.

## Potential Areas of Research

Currently, there exist a few major perspectives of knowledge creation that are different along several dimensions, including contexts of knowledge work, experiences of participants, epistemic tools used by the participants, and goal orientation towards knowledge outcomes. Each of these differences could be examined to explain the variation in practices and outcomes. For example, Knorr-Cetina (1999) studied the epistemic cultures of different scientific communities, where creation of knowledge new to the world is their key mission. Nonaka and Takeuchi (1995) examined knowledge creation in commercial organizations (e.g., Honda) where innovation and new ideas are critical to the survival of the organizations. From the lens of cultural-historical activity theory, Engeström and Sannino (2010) uncovered the mechanism of expansive learning as workers, in ordinary work settings, attempted to resolve the tensions that arose from the contradictions within or between their activity systems. Scardamalia and Bereiter (2006) have been working on knowledge building pedagogy that aims to develop knowledge creation capacity in students to prepare them for knowledge societies.

While a fair amount of research work has been conducted, there are still some apparent research gaps on knowledge creation in education. First, there is still resistance to the notion that K–12 students could engage in knowledge creation, even though research studies have shown that students could engage productively in idea improvement (Scardamalia & Bereiter, 2006). It is important to study ways to sustain and scale up knowledge building practices in schools. Second, beyond formal learning, do people engage in knowledge creation in informal learning environments? For example, in an online community of interest (e.g., interest group on photography), is there a place for knowledge creation? If so, what is the mechanism? Third, in the sector of continuing education, where workers engage in professional development or are reskilled for other jobs, is there a place for knowledge creation?

Within a learning organization, we could also examine knowledge creation of different groups of participants and how they work as a system. In a school, for example, we have school principals, administrators, teachers, and students. While knowledge building pedagogy could be introduced in a classroom, what about the teachers' capacity to conduct the lessons? More critically, could teachers also assume epistemic agency in creating professional knowledge about teaching? While there are advocates for schools to be knowledge creation organizations (e.g., Hargreaves, 1999), and models have been proposed for research and development (Harris, 2008) and for a teachers' community (Tan 2010), research reports in this area are still lacking. Extending the study on knowledge creation to different groups of participants in a learning organization, we could also take a systemic view to examine the organizational conditions and strategies that facilitate or encourage knowledge creation within an organization. This requires a systemic view of the relationships among many variables—for example, leadership, policy, infrastructure, teacher's actions, teacher's capacity, and student's learning processes.

Within a classroom environment, we could expand the epistemic repertoire of knowledge creation. For example, besides a dedicated technological platform like the Knowledge Forum, could we leverage various Web 2.0 tools as different modes of knowledge representation? An elementary pupil, for example, could use VoiceThread to talk about his ideas instead of using text to compose a note. Expanding the epistemic repertoire could also mean engaging students in different ways of thinking. For example, the topic of electricity could be discussed from the perspectives of a physicist, a chemist, a historian, or an environmentalist.

In addition, current research has been focusing on the cognitive outcomes and social interaction processes of knowledge creation, and we could explore other aspects of impact, for example, the ontological transformation of students' identities towards a knowledge builder. There exists some anecdotal accounts of students who began to realize their capacity in knowledge building and to see themselves as legitimate participants in knowledge building works (Scardamalia & Bereiter, 2006). This identity transformation could be a critical success factor in communities where participants' readiness and intentionality for knowledge creation are low. Other aspects of impact that have not received much attention include the emotional factors and outcomes related to knowledge creation pedagogy. A review by Sutton and Wheatley (2003) reported the potential influences of teachers' emotions that could affect teachers' cognitions, motivation, and their impact on students. Likewise, students' emotions and outcomes of their learning could be important areas of concern. Currently, a few knowledge building principles (Scardamalia, 2002) could be linked to emotional factors and outcomes, for example, epistemic agency of the learners, collective cognitive responsibilities, and democratizing knowledge building practices. Research that specifically uses the lens of emotion to study these factors is relatively silent.

We recognize that education in the knowledge creation paradigm offers vast research opportunities and, given the imperatives of the knowledge societies, such research would have potentially great impact on our societies. We believe that an alliance could be formed with researchers and educational professionals who share similar interest (e.g., Institute for Knowledge Innovation and Technology, ***www.ikit.org***) to advance research in this field. At a local level, the Knowledge Creation and Innovative Design Centre is extending research on two fronts: (1) promote design thinking and develop epistemic repertoires among teachers and students in schools, and (2) advance knowledge creation practices with teachers.

## Developing Epistemic Repertoire Among Students with Technologies

Paavola, Lipponen, and Hakkarainen (2004) proposed a new metaphor of learning—learning as knowledge creation—by reviewing three prominent knowledge creation models that include the knowledge spiral (Nonaka & Takeuchi, 1995), expansive learning (Engeström, 1999), and the knowledge building community (Bereiter & Scardamalia, 2006). Building on the metaphor of knowledge creation, we see value in the ideas about "the designerly ways of knowing" (Cross, 2007) associated with the knowledge creating work that takes place in the field of design and technology. These ideas suggest an epistemic turn for pedagogy that prepares learners for participation in a knowledge society. To develop epistemic repertoire for knowledge creation, we propose an approach for developing in learners a gamut of ways of knowing that they could use to make sense of the problems they are investigating or the phenomenon that they encounter.

This approach has a few characteristics. First, we leverage experiences of the learners to generate inquiry questions that demand explanation. It could be what the learners encounter through their daily experience (e.g., how does a light bulb work?) or an intentional learning experience (e.g., a demonstration, a field trip). Second, we require learners to create knowledge artifacts or epistemic artifacts as an important part of learning. The artifacts could be as simple as a note in an online forum, a drawing, or even a voice message (e.g., in VoiceThread). It is essential that these epistemic artifacts contain ideas to represent understanding of the phenomenon under investigation. We view the students' initial ideas as a display of their epistemological resources (Hammer & Elby, 2002) or knowledge elements (e.g., p-prim theory by diSessa, 1993) that are activated with the learning activities. Third, we recognize the dialectical relationship between individuals and group in the process of knowledge creation. As individuals contribute to the group, reciprocally, they benefit from collective intelligence. We hope to capture knowledge creation through group interaction processes, as well as to track development in an individual's changes. Fourth, to develop epistemic repertoire in learners, besides the use of multiple modes of knowledge representation, we also plan to introduce the approach to a range of subjects and topics in the school. The same topic (e.g., electricity) could be approached from different discipline perspectives (e.g., chemistry, physics, and social sciences) either concurrently or at different points in a school curriculum. Finally, although traditional forms of technologies (e.g., paper and pencil) could support the learning process, we prefer digital technologies because they could support multiple modes of knowledge representation (e.g., an online note, a voice message, a concept map), facilitate sharing and communication, allow access across time and locations, and record a trajectory of idea development. More importantly, we envision future development of learning analytics that could provide real-time data to teachers and learners as formative feedback to improve the learning processes. Using digital technologies also enables us to track the learners' patterns of resource activation

(Hammer & Elby, 2002) and advancement of the ideas in their knowledge artifacts.

Our approach is founded on the belief that emerging problems and phenomena in the current world originate from all aspects of our lives, and they are better addressed through multiple ways of knowing. These ways of knowing, which may also be associated with discipline-specific or inter-disciplinary approaches of knowledge creation, could offer different perspectives and solutions to the problems. Building epistemic repertoire among learners enhances their adaptive ability to adopt multiple perspectives to the same phenomenon. In addition, we believe that an epistemic repertoire is more effectively built through collaborative knowledge creation, that is, working on improving ideas supported by a range of technologies that function as cognitive, metacognitive, and epistemological tools.

## Advancing Knowledge Creation Practices with Teachers

Despite our experience and effort in bringing knowledge building pedagogy into classrooms, we still face challenges in introducing this pedagogy to schools and teachers who are new to this pedagogy. There are several possible reasons for the high inertia towards acceptance of this pedagogy. First, the design and implementation of knowledge building is different from the predominant modes of instruction that are highly structured and predictable. For example, 5E inquiry science (Bybee *et al.*, 2006) suggests five phases of instruction, whereas knowledge building requires principle-based design that teachers are less familiar with. Second, the manifestation of students' learning outcomes in discourse (e.g., improvement in ideas) compared with measurements using tests is again something teachers are less comfortable with. Third, there is a commonly held belief that knowledge production work is for the high-ability students and that the constraint of curriculum time does not allow such practices. In addition, the integration of technologies to support knowledge creation work could aggravate apprehension of some teachers who are less inclined towards the use of technologies in education. In other words, designing and implementing knowledge building demands not only changes in instructional practices, but also epistemological beliefs about students' learning.

Ironically, the factors that have impeded educators to implement knowledge creation practices are precisely the factors that will help a business organization to thrive (Nonaka & Takeuchi, 1995). Two key characteristics of flourishing business models are (i) the intangibles as the source of progress and inspiration of creativity, and (ii) innovative ideas as the true force behind productivity improvement.

Borrowing these business concepts, and drawing the parallel between knowledge building practice as one that mimics the fluidity of the real economy, we have initiated a research study that aims to investigate knowledge building practices, with dual foci. First, we aim to identify the source of intellectual productivity in a knowledge building environment. That is, among the many ideas that students generate in the initial phase of knowledge building, how do teachers identify promising ideas to advance and provide relevant scaffolds to the students. Second, what design principles and strategies do teachers employ to engender a knowledge building environment?

We leverage the expertise of a group of teachers experienced in knowledge building to tackle the complex problem within the real classroom setting. These teachers work as designers to iteratively improve their lesson design. In this process, newcomers sit in on the discussion as apprentices. As a newcomer is ready to try the pedagogy, the support structure is ready to support the iterative improvement in lesson design and implementation. With the researchers, lead teachers from different schools form a community of practice to discuss practices across different school contexts and subjects. The teachers assume the epistemic agency in improving their professional practices and creating professional knowledge; they also act as agents to influence other teachers. On the other hand, the researchers study the discourse of the teachers to develop a profile that characterizes the specificity of knowledge building practices and to identify factors and sources of knowledge that could be introduced to more teachers for better adoption. This teacher community, incidentally, also leverages technologies to record their idea generation and track the development of ideas. In other words, parallel to the students' knowledge building effort, we are developing a knowledge creation community among the teachers to advance knowledge building practices in schools.

Our approach is also a departure from the predominant methods of advancing teachers' epistemic agency. Commonalities with other methods of teacher professional development, for example, the lesson study approach, are apparent. Our approach hence shares similar strengths of fostering a sense of community and the creation of meaning and meaningful artifacts to the community. Consistent with our beliefs in the importance of developing the epistemic repertoire of learners to enable knowledge creation, our approach builds on the strengths of existing models of professional development by developing teachers' adaptive expertise (Hatano & Inagaki, 1986) and capacity to create knowledge.

## Concluding Remarks

The arrival of the knowledge society disrupts the entire education ecology, including K–12 education, higher education, adult education, and workplace learning. Educators and researchers are convinced of the need to prepare learners to be productive citizens in knowledge societies, and many initiatives have been launched worldwide. In this exciting time, although a fair amount of research has been initiated, research on education in the knowledge creation paradigm is still in its infancy stage.

In Singapore, despite a decade-long journey to bring knowledge building pedagogy into K–12 classrooms, sustaining and scaling these pedagogical practices are still a challenge. In addition, we see the potential to expand this line of research in different contexts and at different levels in an organization. The establishment of the Knowledge Creation and Innovative Design Centre at the National Institute of Education (Singapore) represents only a small step taken by a small group of researchers towards achieving our goals. We hope our community will grow in strength locally, and create alliances with larger international communities. □

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# Imagineering in Education: A Framework to Enhance Students' Learning Performance and Creativity in Thinking

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Imagination is a powerful engine that can drive people to bring their ideas, dreams, and desires to reality. The imagination constructs stories that lead people to create. Combining imagination with engineering knowledge creates inventions which initially might seem fantastic. The authors provide in this article a brief overview of a successful working paradigm, beginning from imaginative stories to reality. They provide an illustration of a possible contemporary framework for education, using the Imagineering concept to enhance students' learning performance and creativity in their thinking.

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## Introduction

The concept of Imagineering is not new. The term 'Imagineering' has been most used significantly by the Walt Disney Company in its Imagineering section.* Staff from different career paths are called dreamers and doers at the company. Their disciplines cover master planning, creative development, concept development, show writing, design, engineering, architecture, interior design, production, project management, research and advanced development, ride systems, special effects, interactive technology, and multimedia design (*The dreamers, the doers, the masterminds of magic*, n.d.). People from these departments use their imaginations to create fantasy themes, cartoons, and movie characters, which were for a long time controlled by Walt Disney, the owner and founder, who oversaw this department from its initial establishment. In the media, especially, in the areas of science fiction, fantasy, and animation, the company uses mechanical tools, IT applications, and engineering and computing knowledge to convey imaginative stories to create fascinating films that seem impossible, to become "reality" or, at least, to look as if they are real.

Imagineering does not particularly focus on engineering of imaginary themes (Betty *et al.*, 2004). It can be widely applied and does not always require a computer device or a high level of technology integration. Disneyland, for instance, attracts worldwide visitors with the tremendous "Sleeping Beauty Castle" built without any computerized special effects or even modern technology (Dehrer, 2011). The castle and its surrounding environment (Menefee, 2011) has become an iconic source of romantic stories.

Without vivid imaginations, people will not be very creative and productive. The Disney experience confirms—in its media and in its theme parks—that the company's successful utilization of powerful tools, mechanical knowledge, and innovative ideas, derived from imagination, has been very profitable.

## Imagination: The Essence of Imagineering

Ribot (1901, cited by Vygotsky, 2004, p. 9) states: "Every invention, whether large or small, before being implemented, embodied in reality, was held together by the imagination alone. It was a structure erected in the mind through the agency of new combinations and relationships…" Albert Einstein also reflects the recurrent conflict in human thought of imagination versus knowledge: "Imagination is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the

* "Imagineering," while used most widely and popularly by the Walt Disney organization, was not coined by Disney. It has been used by others, including Alcoa, as early as the 1940s.

entire world, and all there ever will be to know and understand" (Gershowitz & Porter, 2012; Viereck, 1929). Having imagination is more significant for scientists than pure knowledge. If people have abundant knowledge but lack imagination, they will be unable to utilize and transform abstractions into objective practicality.

Vygotsky (2004, p. 13) also stated that "the first type of association between imagination and reality stems from the fact that everything the imagination creates is always based on elements taken from reality,…" Van De Wind (2003, cited by Hendrix, 2010) stated that "psychological research has found that the imagination is a necessary part of the creative process and that somewhere between the imagination and the reality principle, the mind can play on an infinite measure of continuum between these binary opposites."

## Imagineering Concepts

Imagineering is a combination of 'imagination' and 'engineering.' It brings art and science together to turn fantasy into reality and dreams into "magic." Therefore, 'Imagineering' means transforming imagination into concreteness. In other words, it is a procedure of changing ideas into innovative products. The Disney organization's unique strength comes from the dynamic global team of creative and technical professionals, building on the company's heritage of storytelling to pioneer new forms of entertainment through technical innovations and creativity (*About Imagineering*, n.d.).

Other terminology related to Imagineering includes 'imagineer,' which refers to a person who has engineering knowledge combined with imagination (Chytry, 2012). Other meanings used in Disney's departments cover all who are sufficiently intelligent to design imaginative amusement rides, for visitors to feel very excited and enjoy the fantasy lands in their parks (Teainput, 2012). In psychological terms, imagineers use their left and right brains to work simultaneously on important projects.

An *instructional Imagineer* works in collaboration with faculty to present instructional imagination possibilities and is able to implement innovative systems for teaching, including meetings at a distance. They are also required to evaluate and make appropriate recommendations about the latest communications technologies, to develop technology services, and to advise and design teaching systems with technologies via the Web, video, audio, online streaming, and digital media. More responsibility may be extended to learning management and administering relevant technology projects (Instructional Communications Systems, 2012).

Desirable characteristics of instructional Imagineers, as defined by King Mongkut University of Thailand, Thonburi (*KMUTT Imagineering*, 2012), include:

- *Attitude*—involves being a leader and using opportunities, which others may not understand, to create products from convergent technologies and to design them to be sustainable.
- *Creativity and innovation*—solving pressing problems by those who are trained to be creative thinkers, from the most basic science processes to exciting applications of new ideas.
- *Global citizens*—able to address current environmental challenges and problems and offer sustainable and environmentally friendly solutions.
- *Knowledge*—using facts and theory to design or create better products or services, in particular, to use support technologies to facilitate various learning ideals.
- *Skill*—the ability to apply knowledge in work environments effectively. It is also known as managing learning skills, Imagineering, communication management, and research.
- *Habit*—the ability to self-manage. Although people may have sufficient knowledge, skills, and attitude, if they cannot manage their own affairs, they may fail in other types of management. The important habits that Imagineers should possess include discipline, transparency, and responsibility.
- *Market mentality*—the ability to recognize, acquire, and understand products and the economic values of their design, while being able to envision high-level business opportunities, links and project developments in the enterprise and its social contexts. KMUTT is not alone in including business factors as central to the education of instructional Imagineers. The Breda University of Applied Sciences (2012), in its course advertising, also describes Imagineering as a tool for business transformation. It provides "a new kind of convergence, between consumers' desires, technological capabilities, and organizational innovations, which is a fundamental process of the creative economy."
- *Culturally aware*—the ability to understand the nature of global markets and cultural diversity of rapid global changes and challenges. This ability also involves providing learning experiences to foster culturally sensitive Imagineers and to identify and understand the impact of social and cultural challenges on technologies and society.
- *Lifelong learning*—involves the understanding that it is essential to continue learning, especially about newer technologies, and communicating knowledge to other group members.

## Imagineering Process

In the Walt Disney Company, for example, hundreds of employees from different departments are transferring thousands of human dreams to physical outputs.

With their own research and development teams, they start from what is required, and then they plot their ideas and draw storyboards to delineate how things operate. Once the blueprint has been shaped, they analyze and create models in order to build and develop the mold into the final production. Then they will trial and adjust the model until it is satisfactory.

Many businesses have adapted Imagineering steps in their specific environments, aiming towards best practice. Imagineering, as practiced by the Disney organization, may be analyzed into eight strategic procedures (Wright, 2008) as follows:

- *Setting development boundaries:* Imagineers may be operating in the areas of architectures, props, and display components.
- *Blue sky thinking:* The first imperative is to think that everything is possible. There is no need to consider other conditions that may affect creativity and cause the 'sky' to become overcast.
- *Brainstorming:* This is a process of gathering general objectives from different possibilities within a short time. People often believe that brainstorming always produces the "best" ideas, which is not necessarily the case. However, there should be a rule forbidding pitting of negative thoughts against the flow of ideas.
- *'Dark corner sitting':* This term is used to explain the workings of fascinating tourist attractions for crowds. Sitting in the dark corner will help learners differentiate between the props and the light controls. This step may not have an application in instructional design projects.
- *Creating an elevation:* This is about imagining what we can see when our eyes are leveled, from various angles, towards the object or model that we want to build.
- *Kinetics:* This process is one of learning the relationships between physical movement and the effects of the reaction to that movement. Objects moved and propelled on the screen, for example, may look as if they are real, for example, with energies similar to those of moving vehicles.
- *Accumulating:* Many Imagineers attempt to develop their work further, even though they have already met basic requirements.
- *Acting or presenting:* When we provide an effective presentation of our completed project, most people will perceive what it is all about. This success leads us to believe that these techniques might also be applied to the education field, as a means of translating the imaginative story into reality.

The main obstacle is translating imaginative concepts into realistic approaches. It is not easy to implement concepts that we see in businesses to education. Therefore, a structured procedure should be applied.

## Cultivating Imagineering in Learning Environments

Dickinson (1924, cited by Greene, 2008, p. 19) notes: "Imagination lights the slow fuse of possibility," whereas Ricoeur (1973, cited by Greene, 2008, p. 19) believed that possibility is derived from a passion. Imagination is thus a necessary component of rich learning (Blenkinsop, 2009), or educational context (Stewart, 2009), which may develop human learning performance into reality by "making visible what is just out of sight" (Greene, 2008).

Utilization of imagination has made some companies become very successful, so why are there not similar success stories in education? People don't need to be engineers to call themselves Imagineers. Egan (2005, cited by Stewart, 2009) believes that "engaging students' imaginations in learning is one key to successful teaching (p. xii)…students who are able to think flexibly, creatively, and with energy about the knowledge they gain about the world and experience" (p. 8) are likely to be successful. Egan also encourages the use of a range of cognitive tools, such as story, metaphor, binary opposites, rhyme, rhythm and pattern, jokes and humor, mental imagery, gossip, play, mystery, and embryonic tools of literacy to engage students' imaginations. Bloom *et al.* (1956, cited by Eisner, 2000) descried the cognitive domains, which include the six major steps of knowledge, comprehension, application, analysis, synthesis, and evaluation. Eisner (2000) supported Bloom *et al.'*s idea that creativity derived from evaluation is the highest level of cognition. That means humans have the ability to implement their comprehensive knowledge and extend it to practicalities. Furthermore, Gagné (1977) proposed that learning transformation is the highest level of achievement.

King Mongkut University of Technology, Thonburi posted its view of the importance of Imagineering and the educational curriculum: "Imagineering provides a beginning to a lifelong and dynamic learning journey focusing on creativity and innovations evolving from the understanding of the connections between scientific principles, engineering applications, technologies, and social implications." In addition, Imagineering is a key element to improve students' performance to become expansive, creative thinkers and be ready for technology-based careers, as well as their future academic development (*KMUTT Imagineering,* 2012).

Brain and mental development techniques provide educational benefits, which require similar brain power to Imagineering. For instance, *mental arithmetic* and *contemplative education* have unique concepts and individual learning directions. It is important to describe the differences of each concept implanted in education. These include:

*Mental arithmetic* or mental math abacus is a learning method that stimulates children to develop fundamental skills in calculating, analyzing, and logical thinking. They learn how to use an abacus, single slanted deck for infants and upper deck and bottom deck for primary children (Peechapat, 2012). This technique stimulates left brain function to deal with linear, logical, analytical, or verbal tangible facts and details (Hendrix, 2010). Once the children are skillful with the calculation tool, they are encouraged to use visual brain processes to picture an abacus. At this point, the right brain will perform, while the children are relishing their mental calculation abilities. The right brain works with nonlinear, intuitive, holistic, visual, imagination, feeling, and design concepts (Hendrix, 2010). Both sides of the brain work simultaneously to find the right answer (Peechapat, 2012). Mental arithmetic is therefore a subject of brain development, using the abacus as a tool, and requires children's performance in learning to create an image in their brains in order to practice the balance between the left and the right brain (Airsiri, 2010). This is a good technique for developing fluent thinking but not for implementing work.

*Contemplative education* aims to create personal transformation from inner development. It includes mental activities and rational thinking. Learners will benefit from different performances, until they develop introspectiveness, kindness, and open-mindedness. In addition, they will gain self-consciousness and become public-minded so that they are able to connect with what they have learned and what is real (Sirimark, 2011). Contemplative education may reduce nervousness and distress, and enable students to relieve their anxiety and feelings so that they can learn to self-analyze problems and improve themselves (Eiamnumcow *et al.*, 2012). Contemplative education therefore aims to stimulate rationality.

Would it not be positive if we could merge Imagineering and education as a transformation of education? We could enrich curriculum studies, creativity, and citizenship education by increasing students' creativity in developing and implementing new and existing ideas and advancing innovative practices in schools and society. Imagination and scientific methods would be utilized as tools to increase learners' academic achievement or to represent their disciplinary knowledge. Multiple approaches to advance students' intellectual capacity are important, and Imagineering has much to contribute to engaging students in learning. The authors would like to examine the value of Imagineering in terms of its capacity to release the imagination, rather than from functionalism for outcome-based educational practices (Moon *et al.*, 2013). ***Table 1*** illustrates the close relationships between Imagineering and constructivism in learning.

**Table 1.** The Imagineering continuum.

| Learning Method | Imagineering Process |
|---|---|
| Inquiry-based learning | Learners need to search for knowledge and integrate it in an imaginative way in order to create learning objects or fulfill course requirements. |
| Project-based learning | Although objectives and instruction may be provided, so that the required output is achieved, learners' imaginations should be engaged creatively. |
| Problem-based learning | To undertake problem-based learning, learners need to develop a basic understanding of existing knowledge before they can imagine what further options may be possible. |
| Case-based learning | Learners need to practice by considering individual cases to identify common important issues. Searching for related data will permit informed discussion and lead to imaginative conclusions, which may then be examined to determine whether the knowledge created is valid. |

Imagineering learning has constructivism as its foundation. Students need their imaginations to create images of the learning tasks they need to complete. Their imaginations may be based on the prior knowledge that is embedded in their long-term memories. This abstract knowledge may then be converted to creative processes. In addition, they need to solve problems that may arise. Finally, the students should be able to explain relevant case studies that may have been completed. In this way, students will create their own cognitive learning spontaneously. Whatever the students learn through their own imagination will remain in their long-term memories.

## A Model of Imagineering in Education

The Imagineering learning model has been synthesized from several concepts discussed in the literature. These include:

1. Making an imaginative story real by using the art of storytelling combined with the power of technology (Wright, 2008), using a storytelling method to motivate the students to imagine a community of practice that they value through six processes. These consist of starting an imaginative story, evoking a collective cultural memory perceived from authenticity, focusing on details to enhance the experience (*Imagineers*, 1998, quoted by Guzdial & Tew, 2006), changing imagination to reality when necessary, paying attention to consistent transitions, and pre-

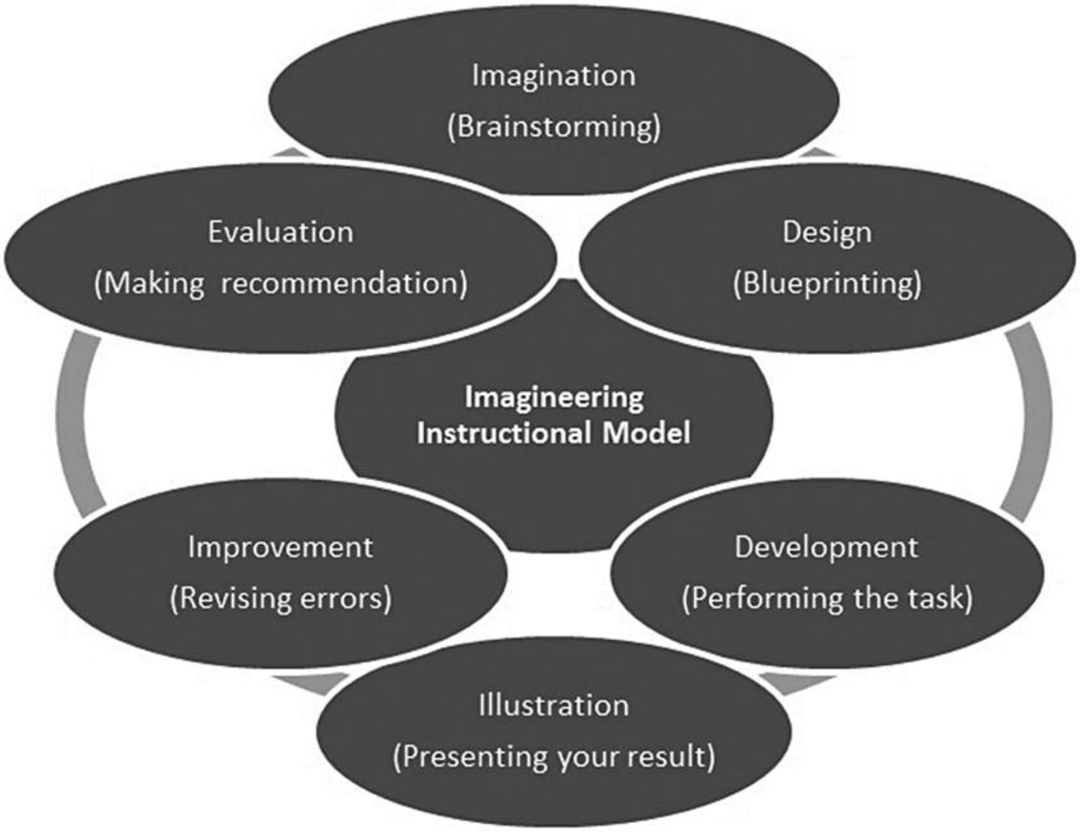


**Figure 1.** Imagineering Instructional Model. (Adapted from Nilsook & Wannapiroon, 2012; McKenna, 2012; Hendrix, 2010; Langford International, n.d.)

senting the work professionally (Guzdial & Tew, 2006).

2. Focusing on the learning experience from the perspective of imagination in the classroom and transforming the traditional logic that inspires stakeholders to co-create (Breda University of Applied Sciences, 2012).
3. Seeing real Imagineering by visiting a studio or workshop is an important part of the Imagineering experience and should be included in the curriculum (Yates, 2012).
4. Engaging young people with activities, often using the latest technologies, to build or create something from their imagination, which is closely related to what they can see and experience in the world around them (Paczuska, 2012).
5. Using brainstorming techniques to identify what an individual or group envisions as the perfect outcome, project, process, or system. The processes consist of clearly stating the aim, jotting down all ideas relating to the stated objective, collecting and compiling the ideas, posting and sharing the ideas, reviewing all ideas clearly and rationally, removing redundant ideas, disseminating and revising the result, and utilizing the output of the Imagineering session as a reference (Langford International, n.d.).
6. Managing the relationship with students "in such a way that they are likely to commit themselves" (Nijs & Peters, 2002, as cited by Bleda & Lindert, n.d.) to further learning.
7. Applying the principles and practices of Imagineering to other creative endeavors is included but not limited to marketing/advertising, product design and development, game design, information development, technical writing, information architecture and design, and instructional design (Prosperi, 2011).

Imagineering processes in education may be formed into a model of Imagineering in learning. There are six significant processes in the model, which are illustrated in ***Figure 1***.

*Imagination* is the first procedure of the Imagineering instructional model, using the brainstorming technique. This technique involves searching for inspiration and envisioning goals. This process requires effective collaboration (Langford International, n.d.), discussing and seeing the feasibility of what has been imagined (Nilsook & Wannapiroon, 2012). Heath (2008, cited by Stewart, 2009, p. 1) suggests that imagination "is not a precise term but rather describes a loose set of connections describing cognitive states or mental activities." This means learners need to use their imaginations to create questions and to demonstrate what makes them interested. What inspires their thinking? Why do students want to follow their dreams (McKenna, 2012)? Once the questions have been determined, the right brain is engaged in the thinking process, which forcefully induces them to find answers (Hendrix, 2010).

*Design* uses the blueprinting technique, which includes drafting, storyboard building, scripting, and prototyping (Nilsook & Wannapiroon, 2012), by laying the foundation for the ways in which learners are going to design their plans (McKenna, 2012). Afterwards, they need to merge their imaginations into a concrete work process.

*Development* is associated with performing the task. This includes creating and testing the model, using many perspectives, to promote creativity and to approach problems, which can occur at any time during the creative process (Hendrix, 2010; Langford International, n.d.).

*Illustration* refers to presenting students' results, and includes illustrating outcomes, contesting other comparative works, and accepting suggestions (Nilsook & Wannapiroon, 2012).

*Improvement* involves the step of revising errors, which means students should be able to revise and summarize their work. This includes refinements to achieve desired end results and creative solutions (Hendrix, 2010).

*Evaluation* is the step of making recommendations. Students should be able to suggest appropriate advice that they have developed in carrying out their project, either from their work process or product quality investigations. Students need to learn from previous case studies which have offered concrete results. Their self-motivation will provide knowledge which will remain with them.

We contend that the storytelling techniques that Imagineering offers help to convey a sense of a community of practice that may help to sustain students' motivation through their courses (Guzdial & Tew, 2006).

## Conclusion

Imagineering in education is a new learning concept applicable to educational curricula. This article has shown how Imagineering works in a sequenced procedure. This means that students will be able to think about their interests, express their dreams in their stories, create models, then present their work, and adjust it for the best outcomes.

Finally, they will be able to make recommendations based on their findings.

It has depicted ways that Imagineering may be applied in educational activities to enhance students' learning performances and creativity in their thinking.

Most importantly, students will be able to continue to extend this concept beyond learning in their classes to real work environments and their further education. □

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# Teaching Problem-Solving and Critical-Thinking Skills Online Using Problem-Based Learning

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**Agnes Orzechowski**
**Ola Rahatka**

The availability of technological tools is promoting a shift toward more student-centered online instruction. This article describes the implementation of a Problem-Based Learning (PBL) model and the technological tools used to meet the expectations of the model as well as the needs of the students. The end product is a hybrid course with eight weekly components. The main component offers information to students about the problem to be solved, including the context of the

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problem. The following components expose the students to content and activities related to the problem they need to solve. Additionally, students form groups, according to their topic of interest, and work in teams to complete a five-step analysis that would help them solve the problem. Lastly, students reflect on the overall experience of the course.

## Introduction

Online education is growing, particularly in higher education. More than ever before, traditional higher education institutions are offering e-learning opportunities to students in the form of fully online and hybrid courses (Allen, Seaman, Lederman, & Jaschik, 2012). To cope with the expansion, many institutions are involving faculty members in the design and development of online courses. However, the skills of faculty, related mainly to face-to-face teaching, do not always translate into effective online instruction (Yoshimura, 2008). Often, online courses developed by faculty members who usually teach face-to-face courses tend to center on the teacher and be based on narratives and evaluation activities that leave little room for active participation and knowledge application (Dunlap, Sobel, & Sands, 2007). Despite this shortcoming, the available technological tools are triggering changes in the way we see teaching and learning and are challenging us to consider innovative approaches to teaching online (Contact North, 2013), such as constructivist approaches.

Constructivism is a learning theory that views knowledge as individually constructed based on the learners' interpretations of experiences in the world (Jonassen, 1999). Therefore, constructivist approaches focus on knowledge construction, critical thinking, and problem solving (White, 2001). One constructivist framework successfully applied in online environments is Problem-Based Learning (PBL). Problem-Based Learning is defined as an instructional method that centers the learning process on solving a central problem or challenge (Jonassen, 2000). In PBL, students become engaged in the direction of their own learning because the work students do, in order to solve the problem, such as exploring, rationalizing, and presenting solutions, drives the learning process (Jonassen, 1999). To solve the problem, students must work collaboratively with their peers and with the support of the instructor (Eggan & Kauchhak, 2012) to make decisions, negotiate meaning, solve conflicts, and organize information (Bayrak & Bayram, 2011). According to Kloppenborg and Baucus (2004), building these skills is significant for students in higher education, as these skills are desired by today's employers. Therefore, the PBL method can be considered an opportunity for teachers to equip students with the skills needed to face real workplace situations.

In order to develop instruction centered on the students, a team of two faculty members and an instructional designer implemented the PBL model proposed by Jonassen (1999) to create a hybrid course based on pre-existing course and program outcomes. The course is an intermediate level English as a Second Language (ESL) course, geared to adult students with diverse characteristics who are learning English for different reasons, such as engaging in higher education studies or getting a job. This article describes the application and implementation of a PBL model and how the team applied instructional strategies and technology tools to promote problem-solving and critical-thinking skills.

## Instructional Design

To design the course the team analyzed the course outcomes under the PBL framework and developed a problem which aligned with the outcomes of the course. The end product is a hybrid course with eight weekly online modules. Each online module complements classroom learning and is linked thematically and in terms of language acquisition with what students study in class. The online portion of the course can be visualized as having two major components. In the first component (Module 1) students are offered information about PBL and the problem to be solved, including the context of the problem. In the second component (Modules 2–8) students are exposed to content and activities related to the problem they need to solve. Additionally, students form groups, according to their topic of interest, and work in teams to complete a five-step analysis that would help them solve the problem. Lastly, students reflect on the overall experience of the course. The details of the two major components are shown in ***Figure 1***.

In order to develop the course, the team followed the steps of the PBL model: presentation of the challenge or problem, related information, additional resources, knowledge construction and collaboration tools, contextual support tools and scaffolding, and metacognitive awareness (Jonassen, 2011a). The implementation of these steps is described in the next sections, and the components of the model are shown in ***Figure 2***.

### PBL STEP 1: Presentation of the Problem

The focus of the PBL model is a challenge or problem that students need to solve. In this course, the challenge is to plan for future sustainability in one of the following areas: travel, fashion, the environment, money, science, or culture. The context for this challenge is the rapid changes happening in these areas in society today. In order to familiarize students with the problem and to set the context, in Module 1 the main learning activities are geared toward providing information about the changing nature of society and the rapid pace of change. To help the students contextualize the concept of change, they are required to reflect on and discuss their own experience with change. This is done

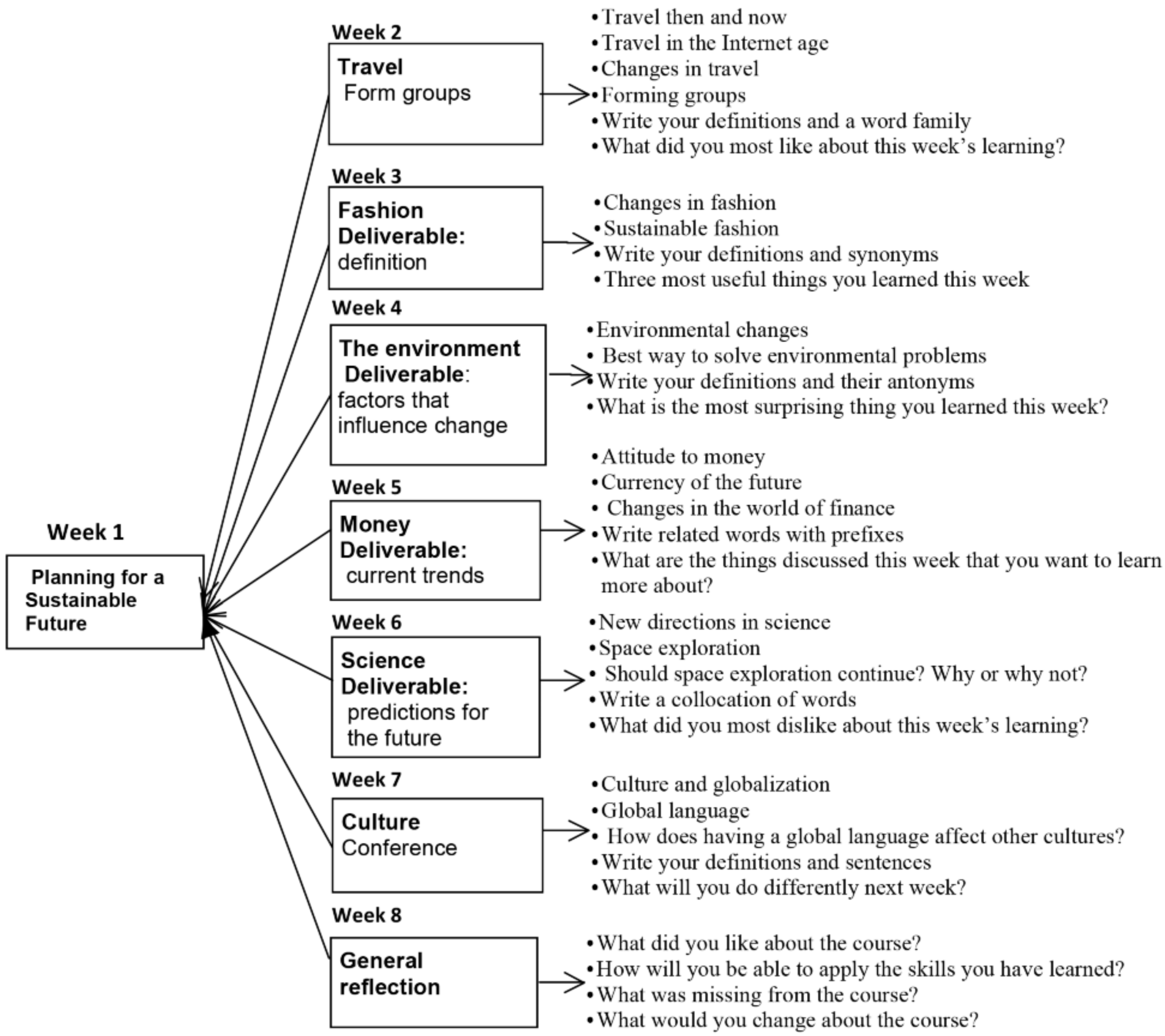


**Figure 1.** Course structure and content.

through a discussion board which asks students to describe their experience with change, positive/negative changes that have happened in their lives, and how they prepare for change. This has the potential to engage students and to activate prior knowledge, as recommended by Jonassen (2011b), since most people with the characteristics of the target audience have experienced change in different areas of their lives. Research has shown that when students are able to connect what they already know with the new information presented, prior knowledge is activated (Driscoll, 2000), which is a condition for learning (Gagné, 1985).

In Module 1, along with the problem, students are also provided with information about the culminating activity. The culminating task is a student conference titled Planning for Change where students, as part of strategic advisory groups, are invited to present solutions for a sustainable future in their chosen area. While the solution of the problem takes place online, the culminating activity will happen in the face-to-face component of the course.

## PBL STEP 2: Related Information

To guide the students through the process of solving the problem, as suggested by Jonassen (2011a), the problem (Planning for Change ) is broken down into five components: definition of the area selected, factors that influence the area, current trends in the area, predictions for the future, and recommendations. These also serve as the deliverables students need to submit throughout the course.

To help the students in their analysis, students are provided with resources. Six of the eight weeks that comprise the course are devoted to providing information about the areas and the content provided in the weekly modules.

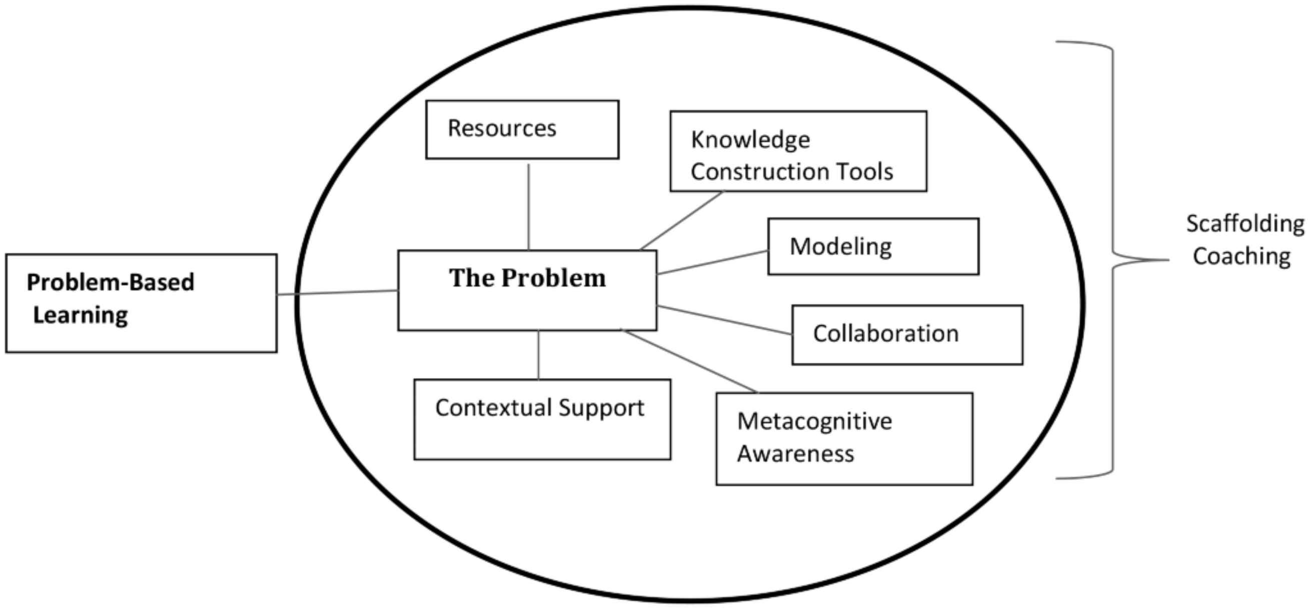


**Figure 2.** The model implemented (based on Jonassen, 1999).

Apart from providing definitions of concepts, descriptions of facts, and focusing on questions and resources, each week starts with an introduction that is narrated by an avatar (see ***Figure 3***). This virtual *persona* acts as a directing guide, which according to Yelon (1996), helps students focus on important concepts or ideas. In this case, the avatar guides students though an introduction to the weekly topic and through the components of the weekly lessons. Additionally, the avatar provides elements to attract the attention of the student and to generate curiosity. One or more questions are inserted in the weekly introductions to guide the learners to examine the resources, to produce mental responses (Andre, 1979), and to promote critical thinking and self-directed learning (Jonassen, 2011b.). The content provides students with opportunities to practice the application of knowledge, which is how they will be evaluated. According to Nitko (1996), the content shapes the evaluation; for example, if the content is based on definitions and explanations, it is expected that students will be tested on verbal knowledge.

## PBL STEP 3: Additional Resources

According to Jonassen and Rohrer-Murphy (1999), in order to solve a problem, students need resources. In this course, students have the opportunity to use two major resources, one generated by the instructor and the other by the students themselves. The first source is a bank of resources created to provide learners with information. This bank of resources is Web-based and organized by topic to facilitate availability and access to all students. An additional resource comes from data gathered by students from conducting interviews with the public. To create this resource, students are required to interview people and ask questions to get their opinions about what changes, positive or negative, they are noticing in the area that they selected and make predictions about what might happen in the future. Students present the data gathered in the interviews in a graphic form and include it in the group blog and final presentation. In the way of scaffolding, some questions are suggested, such as:

- What are the three most important changes happening in the selected area today?
- Which trends are positive? Which ones are negative? Why?
- Why are these changes taking place?
- How will the current trends develop in the future?

## PBL STEP 4: Knowledge Construction and Collaboration Tools

Constructivists suggest that before learners internalize the knowledge, they first construct such knowledge through social interactions (Jonassen, 2000). To facilitate social interaction in this course, students are asked to form groups, according to their topic of interest, and work together in these groups throughout the course. The maximum number of students allowed in each group is five, in accordance with the idea that in mid-size groups learners tend to perform better than in groups with a large number of students (Lohman & Finkelstein, 2000). To facilitate group work, students are provided with virtual spaces with different tools, such as a wiki, a discussion board, a blog, and a glossary of terms and definitions.

In this course, a wiki is used to generate the weekly deliverables: definition of the area selected, factors that


**Figure 3.** The avatar.

influence the area, current trends, and predictions for the future. The wiki tool allows students to make decisions in relation to what changes to plan for. For example, the group that chooses science as their topic will need to decide what direction to take, such as to plan for the future of space exploration, genetics, stem cells, etc. Additionally, in order to plan for the future in any agreed direction, students will need to negotiate what content to include in each deliverable. According to Jonassen (2011b), negotiation requires comparing and contrasting and considering advantages and disadvantages. The wiki allows the students to do this by providing an open space, where they have the freedom to control the content, the structure, and the changes, in order to meet their needs

Another tool used in this course is the discussion board. This tool allows students to interact, learn from each other, and put in writing their understanding of change as it relates to each weekly topic. Weekly discussions are initiated by a set of open-ended questions, which help students to become aware of the multiple approaches that can be taken to plan for change.

In this course, a blog is used to present their understanding of the problem and the articulated solution. A blog is the tool that students will use to submit the deliverables and to organize the content for the end product, the face-to-face group presentation at the "Planning for Change" conference. The development of the blog begins in Week 3 with the description of the selected area, followed by factors that influence changes in that area, most important current trends and predictions for the future. According to Sage (2000), technological tools allow students to organize, distribute, and present information. In this course, students publish the content in the group blog, and in order to do that, they need to analyze, synthesize, summarize, and ultimately negotiate what to publish. The blog that students develop while they work in groups will be the visual representation of the solution of the problem. In the blog, students are encouraged to use graphics and images, as well as graphic representation of the data collected in the survey.

Another knowledge construction tool offered to students is a glossary of terms and definitions where students create their own definitions related to vocabulary found in the weekly topics and also added synonyms, antonyms, collocations, word families, sample sentences, etc. This tool allows students to create meaningful vocabulary lists that reflect their experience, perspective, and particular points of views.

### PBL STEP 5: Contextual Support and Scaffolding

Contextual support and scaffolding refers to the guidance provided to students while they are working on the solution to a problem (Hung, Jonassen, & Liu, 2008). Important contextual support anticipated in this course is the feedback offered by the instructor in relation to the work students do. This is critical since, according to Tobias (1982), when students are faced with learning new and difficult tasks, they are more likely to seek information about whether they are on target with what they are supposed to be doing. This confirmation is known as feedback, which in a constructivist environment refers to information that guides the work of students when they are working in groups, evaluating their work, and applying knowledge (Hung *et al.*, 2008).

Another instructional support provided to students is implemented by developing a peer-to-peer help blog, which prompts students to share in the role of an instructor. In this blog, they can post questions or comments to which other classmates respond. Students are usually more comfortable asking questions of their peers than instructors, and when students participate in teaching activities, they tend to apply the information they have acquired to address a new situation (Bayrak & Bayram, 2011). When students ask questions and make comments about learning materials and activities, they improve their problem-solving skills (Ge & Land, 2003).

### PBL STEP 6: Metacognitive Awareness

Metacognitive awareness makes learners aware of how they learn. This enables students to review what they have done and properly analyze their performance; a checklist and rubric usually prompt this. In this course, students are provided with rubrics to guide the final group presentation. Additionally, at the end of every weekly module, students complete a self-assessment checklist that prompts them to determine if they have accomplished the objectives and tasks proposed for the week. Another tool implemented in this course is a reflection journal in which students have the opportunity to reflect on their own learning process. The reflection is guided by a set of questions, which prompts student to think critically about their own learning (see ***Figure 4***).

## Discussion and Future Research

This article describes the application of a PBL instructional model to create student-centered instruction in a hybrid ESL course. The application of the framework can em-

| Learning Objectives | | |
|---|---|---|
| I can ... | Yes | No |
| • identify trends in fashion | ☑ | ☐ |
| • identify materials used to make clothes | ☐ | ☑ |
| • assess the environmental impact of different materials | ☐ | ☑ |
| • identify sustainable materials | ☑ | ☐ |
| • create definitions and synonyms of new words related to fashion | ☑ | ☐ |
| • develop the description of my topic, in collaboration with my team | ☑ | ☐ |
| **Task Completion** | | |
| I completed the following tasks: | Yes | No |
| • Reading *Big Question: Why Does Fashion change?* | ☑ | ☐ |
| • Listening *Which Outfit Is Greenest? A New Rating Tool* | ☑ | ☐ |

**Figure 4.** Self-assessment checklist.

power faculty to create innovative instruction that goes beyond the traditional teaching methods of presenting information to students. It is expected that if faculty accept the challenges of creating student-centered instruction, the quality of online courses offered in colleges and universities can be positively affected.

We believe that this experience, if used by other faculty members, can support the professional development of traditional faculty members involved in online learning, which is predicted to increase over the years.

It is recommended that this model be applied in the development of other courses in order to test its effectiveness for learning. It is also recommended that data be gathered from instructors as well as from students to measure their level of engagement and satisfaction with the PBL experience. ☐

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# Approaching Hospital-Bound/ Home-Bound Special Education as an Opportunity for Innovation in Teaching

**Guglielmo Trentin**
***Contributing Editor***

Paradoxically some "extreme" didactic needs, such as those of students who are unable to attend normal education regularly (e.g., hospitalized and/or home-bound students), have shown themselves to be ideal for the development of a teaching style aimed at stimulating the active role of the student, at fostering a learning process based more on doing than on listening, hence in line with so-called "2.0 pedagogy." In this sense, that special pedagogy can be considered as a potential crucible for educational innovation. After a few considerations on the current relationship between technology and pedagogy, the author considers how it is possible to capitalize on the numerous individual experiences of hospital and home teachers, in order to foster innovation in teaching and teachers' professional development. Although the considerations in this article particularly refer to the author's direct experience in the context of hospital/home-bound special education, it should be pointed out that numerous research projects in other special education contexts (e.g., cognitive, sensorial disability) reach similar conclusions.

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## Introduction

If we exclude those teachers who already have a marked interest in both didactic innovation and information and communications technologies (ICT), technology at school is in most cases perceived as an encumbrance, an "extra." It is used because someone has brought it into the school or because someone else has asked to use it for projects. And when it is used, what a problem it presents: managing a whole class in the lab, or using machines which are hyper-protected by technical assistants for fear of the students' tampering with them or contaminating them with computer viruses. And the list of complications goes on and on.

So, we have an almost forced use of technology and thus almost never a creative one, based on "conventional" teaching methods and practices rooted in old teaching/learning schemes. But the introduction of new technologies calls for the conception and introduction of new methodological proposals inspired by so-called "e-pedagogy" (Elliot, 2008), proposals which are able fully to exploit ICT's potential both for collaborative study and for individual access to knowledge.

In this context, Thorpe (2012) argues that one of the main reasons for the lack of success in trying to innovate educational processes through the use of new technologies is the obstinacy in continuing to use pedagogical approaches which are now obsolete and which are limited to simply re-proposing old practices with modern tools.

Likewise, Norris and Soloway (2012) add that the didactic use of technology practiced exclusively at school, moreover with inadequate pedagogical approaches, has caused the school world to miss out on the "desktop revolution," the "Internet revolution," and finally the "laptop revolution."

Today the most up-to-date and used ICTs are not those made available by schools, but rather those that students and many teachers use daily, devices they carry in their pockets, bags, or rucksacks. In this radical change of scenario, with technology pervading daily life, it would be unjustifiable for school to miss out on the "mobile revolution" too (Norris & Soloway, 2012).

Alas, many alarm bells can already be heard ringing. For example, the gap between the personal/daily/informal use that students and many teachers make of the new network and mobile technologies (NMTs) and the way in which, instead, these same means are used/proposed in so-called "formal" teaching (Trentin & Repetto, in Trentin, 2013b) is constantly widening. What can clearly be perceived is a kind of "backstage use" (the stage being the classroom) of technology, a parallel use to that in the school-space context, and a much faster one:

- on the one hand, the students, assiduous users of social networks also for interacting with class-

mates (mostly activating somewhat unorthodox mechanisms of sharing/passing assignments), or for accessing informational resources for research projects, often consisting of haphazard copy-and-paste operations;
- on the other hand, the teachers, who are also increasingly often technology and online resource consumers, but who however limit themselves to using them in the preparation stage of classroom activity, rather than in fostering learning processes which promote the indistinguishability and interchangeability of study inside and outside the school area.

Thus, for those operating in the school context, the need arises to understand more and more fully the existing and increasing interconnection between these two apparently (or perhaps really) parallel contexts: school and extra-school.

We must, however, tread very carefully here, since NMTs are based on general-purpose functional models, not necessarily oriented to educational uses; hence, all those initiatives which tend to impose them without any specific pedagogical choices or any precise analyses of the real underlying didactic needs are bound to fail. Two scenarios seem currently to favor our purpose (Trentin, 2013a):

- the need for a didactic-pedagogical innovation which is centered more on doing than listening, and is more in line with the habits, pace of life, and communicative styles of the new generations and with the informational resources which these generations have literally within hand's reach throughout the day;
- the need to exploit the potential of technology in the management of teaching/learning processes in difficult, sometimes extreme, situations (e.g., social/educational inclusion of those who have difficulty in regularly attending normal study courses).

## The Teacher's Crucial Role

In the scenario hypothesized in this article, the teacher must logically play a crucial role, not only in his/her guise of subject area expert, but also in that of researcher (teaching implies a process of constant research) and educator. This is possible only if the teachers are willing to (Trentin, 2010, 2013b):

- enter the communicative dimension of the new generations, using the students' own virtual spaces (i.e., "going to visit" the students where they normally interact among themselves);
- indicate study methods which exploit the above dimension;
- educate students to use the potential of the network and mobile technologies which are at their daily disposal in a discerning, intelligent way; and
- educate students to digital citizenship.

In all this, we cannot ignore the urgent need for a systematic initial training program for educators, and for their continuous updating. They must be made aware of the need for change, and this can only begin from within and from the conviction that this is the only way to achieve an alignment between the ways of communicating at school and in everyday environments (Zimmerman & Trekles Milligan, 2007).

But what incentive can produce a strong enough impulse in teachers to make them change their usual way of teaching, when school organization itself is so alien to the demands of a 2.0 teaching method? In other words, if the teacher is mainly asked to respect the curricula indicated by a Ministry of Education, or a State Education Department in the USA, why bother to make extra work (which in any case is usually not even acknowledged). Why run the additional risk of being seen as someone who wants to destroy the well-established (or rather "crystallized") schemes which suit more or less everyone?

Two possible favorable situations can be hypothesized here (Trentin, 2013a):

- Teachers really desire to renew their teaching and bring it up-to-date, guiding their students towards the discovery of discipline-specific knowledge by exploiting their technological aptitudes and habits (what Norris and Soloway call the "artisan teacher"). Thus, teachers do not limit themselves to acting as didactic mediators, passing on discipline-specific knowledge to their students, but also (above all) help them to become citizens of the future: citizens who are able not only to read, write, and do arithmetic, but also to master methods and strategies for the effective and efficient use of communications technologies in accessing knowledge and in continuous learning (Trentin, 2013b).
- Teachers are up against a didactic problem whose complexity cannot be tackled using conventional methods and tools (hence even more "artisan" than the previous one). For example, teachers are operating in contact with students affected by cognitive disease, or those students with difficulty in attending lessons and/or normal educational courses regularly (e.g., hospital-bound/homebound).

Experience has taught us that (Trentin, 2013a):

- in the first case, innovation rarely catches on, since it has to appeal mainly to the teacher's "intrinsic" motivation to innovate and create *ad hoc* spaces in "canonical" school life;
- conversely, in the second case, there is a clear, prevailing "extrinsic" motivation; this derives from the particular operational situation, which paradoxically often presents an ideal context for

the application of tools and methods (especially online ones) aimed at technology-centered didactic innovation.

## Extrinsic Motivation Due to a Problematic Situation

In order to explain more clearly the extrinsic type of motivation which may induce a teacher to radically rethink his/her way of teaching, it could be useful to compare the features of the two different situations presented above (see ***Table 1***).

The last point in the table is particularly interesting, since the author has had the opportunity to witness how problematic situations (Trentin & Benigno, 2013) turn out to be a kind of Trojan horse for wider reflection on the introduction of NMTs into teaching (Mitchell, 2010).

Undoubtedly, the proposal even to partially re-program teaching activities in order to facilitate a remote student's normal school attendance always provokes much perplexity within a group of teachers, even more so if this implies the introduction/"intrusion" of technologies. This perplexity is even more marked when the disproportionate overall effort required for managing what actually amounts to a single case is taken into account.

These resistances can often be broken down if teachers can be made to take a positive view of what is certainly not a positive situation (especially for the disadvantaged student): that is to say, if it can be demonstrated to them that the management of that problematic situation may become an opportunity for acquiring knowledge and skills on the NMT's educational use, which can then be extended to the whole class (and more generally to the whole school) also for other purposes at a future time. So, it is not only for solving a (hopefully occasional) emergency situation, but also for innovating and potentiating the learning/teaching process throughout the class/school.

These situations, in which teachers, head teachers, parents, and classmates have an interest in finding solutions to include disadvantaged learners are evident, have often turned out to be true incubators of educational innovation for that class/school, fostering exemplary experimentations in the didactic use of NMTs, which can be used as models also for "normal" teaching.

So, we are looking at a teaching style which is forced to develop in unrestricted spaces, and which may act as an example and a guide to the opening up of the day-to-day spaces of the school system, a system that is still much too strongly anchored to schemes which do little to meet its users' expectations and demands for renewal.

As we have said above, the fact of operating in a dimension which is more "open" than that of classroom

**Table 1.** Technological integration, "normal" teaching, and teaching in the presence of problematic situations (Trentin, 2013a).

| "Normal" teaching | Teaching in the presence of problematic situations |
|---|---|
| School space and didactic organization inadequate for the development of pedagogical approaches exploiting the potential of the new technologies. | The school space is anywhere study is possible (home, hospital), preferably offering the chance to do it in collaboration with other, even remote, students, and with teachers' support, even if they are not always present. |
| Teachers hesitant in considering teaching activity which extends outside school time. | Most (sometimes all) teaching activity is developed outside the school spaces. |
| Teachers generally unmotivated to change their teaching style when they perceive no real need for them to do so. | Teachers' strong motivation to seek solutions which allow the disadvantaged student to take part in class lessons, helping their study through personalized paths potentiated by technologies and causing them to actively participate in collaborative study activities in class as well as in extramural ones. |
| On one hand, strong perception of students' need to acquire soft skills in using technologies to enhance their scholastic and lifetime learning process. On the other hand, since these skills are not "assessable" for school credits, technologies at school are seen as cumbersome, and their use is often a forced one, sometimes not understood by students' families (a teacher who uses Facebook? Heresy!). | Awareness that only through a systematic and programmed didactical use of NMTs can disadvantaged students enjoy both equal opportunities in following educational courses and total autonomy in the future in tackling lifetime knowledge needs. It does not matter that these skills are not recognized in scholastic assessment. It is a non-problem, since those skills are not an extra but fundamental. And their fundamental nature is recognized and requested by students' families themselves. |
| The above circumstances lead to great difficulty in involving the whole of a teaching faculty in re-planning teaching processes in order to integrate NMTs. | It is often precisely these problematic situations which convince even the most skeptical teachers to give it a go and which thus unite the various members of a faculty. |

teaching alone places the "special" (e.g., hospital or home) teacher in a situation which is, from some points of view, ideal for experimenting with a new interpretation of their role of mediator in the students' learning process, even though they have to do without the normal, day-to-day, face-to-face interaction which the classroom situation would guarantee. Interest is generated in experimenting with the use of technologies in order to create the necessary continuity in the relationship with the student confined to hospital or home, an element which is in any case fundamental for any teaching/learning process.

This is why the study and observation of the solutions which hospital and home teachers have worked out to meet their teaching needs is particularly useful for realizing how even in a "normal" situation, the teacher's role can/should change to create a teaching/learning process which exploits the potential of the new communication channels and students' new ways of interacting (Roth & Erstad, 2013).

This study and observation could generate both the most suitable teacher-training courses (preferably at an early stage of their training), as well as indications as to what norms should be instituted to create a type of school organization which can promote a true didactic innovation based on the considerations expressed above.

This is why for some time now the context of hospital and home teaching has been considered as an incubator for teaching innovation, centering on the use of new technologies, and consequently as a potential crucible for 2.0 teachers.

In this regard, it should be specified that the term "2.0 teacher" (Trentin, 2010) is used here to indicate the function that teachers perform not only in the context strictly connected to the use of technologies, but also in a more general sense, when they organize and manage learning paths where 2.0 resources can take on differing roles according to the different didactic methodologies which are being adopted, i.e., ranging from being essential to being more modestly a simple support which is useful but not necessarily indispensable.

At the present moment, however, the knowledge and skills for performing this function efficiently are not widespread among teachers. One element of sustainability for 2.0 teaching is thus closely related to teacher training, both in the instrumental use of 2.0 resources and in the various teaching/educational approaches connected to their use.

But what kind of training? Given the affinity between 2.0 teacher and online training tutor/teacher, and drawing on the experience acquired in the training of the latter figure, it may be concluded that if we wish to spread knowledge, skills, and culture related to the didactic/educational use of 2.0 resources, we must use teacher training tools and approaches based on the same resources and methods by which they can then be proposed to students (Trentin & Repetto, in Trentin, 2013b).

Hence, we would have no longer (or at least not only) formal training (i.e., participation in classroom or distance-learning courses), but interventions focused above all on informal (or non-formal) learning processes (Cross, 2005), which exploit the potential of the NMTs for accessing and sharing information, knowledge, and good practices, by means of direct consultation of online sources and social interaction in networked communities of practice (Trentin, 2005; Wenger, 1998).

## Conclusions

The body of individual experiences deriving from sometimes "extreme" didactic needs, such as those of students affected by physical/cognitive disease or who are unable to attend normal education regularly (if at all), has provided and continues to provide school and research worlds with useful material for reflecting on and experimenting with new forms of teaching.

We are talking about an "open" type of teaching which ignores the physical perimeter in which the class usually operates, while guaranteeing the same social and communicative dimension that must be allowed to develop within a class.

Studying these "extreme" experiences may undoubtedly help us to correctly dose moments of face-to-face interaction with moments of individual and/or collaborative study potentiated by technology-mediated interaction, also in a so-called "normal" teaching situation. And also to understand what role and functions a teacher must perform in order to successfully oil the new learning mechanisms which are increasingly centered on students' active role (learning by doing) and the individual, knowledgeable, and informed use of the information and knowledge sources which can be accessed with the technologies they have daily within hand's reach.

The ideas developed in this article frequently refer to the context of hospital-/home-bound special education, this being the research field in which the author has developed most of his experience regarding special education problems.

It is worth pointing out, however, that many of the conclusions reached here are shared by other authors, working in other special education areas (Haddad, 2009; Roper, 2006), e.g., those pertaining to cognitive and sensorial disabilities.

It is in this sense that experts are becoming more and more convinced that special teaching in general is a potential crucible for what we have called "2.0 teaching." □

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# Thinking Tools in Computer-Based Assessment: Technology Enhancements in Assessments for Learning


**Yigal Rosen**



One of the greatest concerns in schools today is how teachers can bring together assessment and learning in a way that is meaningful for students' thinking skills, while focusing on content standards. Better understanding of how different types of technology-based thinking tools can be used for improving classroom teaching and learning, especially across the most challenging areas of performance, is crucial. Using thinking tools, as forms of graphically and verbally displayed thinking processes, engages students in a variety of higher-level cognitive activities. What does not show up in students' responses is their thinking patterns and processes of understanding. This article describes how concept mapping methodology that is widely used for learning purposes can be adapted to Evidence-Centered Concept Maps (ECCM) in assessing higher-order thinking. ECCM facilitates the analysis that students conduct and requires them to think more deeply about the multifaceted topic being analyzed than they would have without the thinking tool. The author discusses the educational opportunities for using thinking tools in computer-based formative assessment and instruction.



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## Introduction

Computer technologies such as interactive thinking tools can support intellectual performance and enrich individuals' assessment and learning experiences. Thinking tools (or "mindtools") are computer applications that enable students to represent what they have learned and know by using different representational formalisms. These graphic-verbal representations are constructed by individual or collaborative learners across different situations and environments. There are several classes of thinking tools, including semantic organization tools, dynamic modeling tools, information interpretation tools, knowledge construction tools, and conversation and collaboration tools (Hyerle, 2009; Jonassen, 2006). These tools are now commonplace in school, college, and work settings. In educational assessment, thinking tools represent processes in which the student is engaged in activities such as evaluating, analyzing, connecting, elaborating, synthesizing, designing, problem solving, and decision making. Using Perkins's (1993) terminology, the unit of analysis in these assessments is not the student without the technology in his or her environment—the *person-solo*—but *person-plus*, in this case, the student plus the thinking tool.

Concept mapping as a thinking tool supports, guides, and extends the thinking processes of the student. The thinking tool does not necessarily reduce information processing; rather, its goal is to make effective use of mental efforts of the student to create a *person-plus* technology setting in computer-based assessment. To successfully make a decision or solve a multifaceted problem, the student must mentally construct a problem space by analyzing various pieces of information, and mapping specific relationships of the problem. Concept maps facilitate the analyses that students conduct and requires them to think more deeply about the multifaceted topic being analyzed than they would have without the thinking tool (e.g., the extent each of the claims presented in the source materials is supported by valid and reliable evidence; how different claims are connected to each other). These mental maps depict complex relationships and can become "blueprints" that make abstract thoughts more visible and concrete. Without the scaffolding provided by a thinking tool, many students simply copy down ideas in a static, linear form, even though the information is hierarchical, causal, or comparative. What does not show up in students' responses is their thinking patterns and processes of understanding. This ability to capture both the thinking processes and the outcomes is at the heart of assessment that truly informs learning.

Learning to construct this visual representation of information appropriately may take considerable time, and this might not be available in many assessment settings. Thinking tools should be in limited use when the formation of verbal generalizations is what is expected from the learner, and not necessarily in-depth concept understanding. Therefore, the benefits of using thinking tools in assessment must be weighed against the time invested in creating them and the measurement appropriateness.

In working with teachers, a central question should emerge: Do you already use thinking tools or graphic organizers in your classroom? How? Additional important questions that are essential for better understanding of possible ways to introduce thinking tools in formative assessments: What types of thinking tools are suggested in student learning materials? Can students use these tools without your guidance? Do students enjoy using thinking tools? Identifying the appropriate set of thinking tools and integrating them with teaching and learning are key factors for successful use of these tools in formative assessments.

## Adapting Concept Mapping to Formative Assessment

Concept maps have been widely used as thinking tools for teaching, learning, and assessment as a way to help students think and represent their thinking processes more often in problem-solving contexts. A concept map is a semi-formal knowledge representation tool visualized by a graph consisting of a finite set of nodes, which depicts concepts, and a finite set of arcs, which expresses relationships between pairs of concepts (Novak, 1998; Novak & Cañas, 2008). A linking phrase can specify the kind of relationship between concepts. As a rule, natural language is used to represent concepts and linking phrases. Several studies have shown that concept maps are a valid and reliable medium to represent students' understanding, making them a valuable pedagogical and assessment tool (Hoeft *et al.*, 2003; McClure, Sonak, & Suen, 1999; Rosen & Tager, 2013).

Concept mapping is a cognitively challenging task that requires various higher-order thinking processes, such as assessing and classifying information, recognizing patterns, identifying and prioritizing main ideas, comparing and contrasting, identifying relationships, and logical thinking (Jonassen, 1996). These processes require the student to elaborate and organize information in meaningful ways, which cannot be realized through simply memorizing facts without understanding their meaning and underlying associations. The thinking processes involved in concept mapping are highly related to critical thinking competency, as defined by various assessment frameworks (Binkley *et al.*, 2012; OECD. 2010).

One of the major considerations in adapting concept mapping tools to the assessment context is the ability to draw valid and reliable inferences about students' knowledge, skills, and abilities, based on independent measures, without introducing construct-irrelevant bias (e.g., student technological skills).

In order to enable a certain level of interdependency between conceptually different measures in a student's critical thinking performance, a three-phase concept map is proposed. The Evidence-Centered Concept Map (ECCM) is designed specifically for formative assessment use to empower the student to analyze various claims and evidence on a topic and to draw a conclusion. The stages of student work with ECCM on an assessment task include: (a) gathering various claims and evidence from the resources provided (some claims and evidence contradict one another); (b) organizing the claims with supporting evidence gathered in the previous phase on ECCM without hierarchical relationships; and (c) linking claims and specifying the kind of relationships among claims.

The three-phase working structure of the ECCM is designed to increase the cognitive and measurement interdependency between the three distinctive competencies in critical thinking, as they are identified in our research: (a) analyzing and evaluating evidence, arguments, claims, beliefs, and alternative points of view; (b) synthesizing evidence, arguments, claims, beliefs, and alternative points of view; and (c) making connections between information and arguments. By using the ECCM in a critical-thinking assessment, students are able to construct a well-integrated structural representation of the topic, as opposed to the memorization of fragmentary information, and we externalize the student's conceptual understanding of the topic.

## Sample Assessment Task

In this critical-thinking computer-based assessment task, the student is asked to analyze various pros and cons of whether or not to buy organic milk for the school cafeteria and to write a recommendation to a school principal. Students are required to use ECCM during analysis of Web-based pre-determined resources. Among the Websites accessible to the students are: an organic milk company Website, along with an interview script/video with the CEO of the organic milk company; an independent organic milk association, Dairy Farmers of North America; an anti-organic milk blog along with an interview script/video with the blogger (a past worker at an organic milk company); a Disease Control Center; and a news Website. The resources include various content orientations (pros and cons related to the organic milk issue) relevancy, and level of reliability. ***Figure 1*** shows an example of the task screen. The major area of the screen allows the students to view the available Web-based resources. On the right side of the screen, the students are able to take notes by using drag-and-drop functionality or typing the text. The students are able to classify the notes into claims and evidence in preparation for constructing the concept map.

Then, the students are asked to create relationships among claims. Those are created by dragging from the link icon on a claim to a second, related, claim and typing a short description of how they are related. ***Figure 2*** shows an example of a screen for relationships created in a task.

In this sample assessment, the thinking tool is introduced before the actual measurement of student performance begins. However, no examples of a constructed ECCM or teacher-led instructions are provided to the students. One may consider adding these introduction components to such an assessment to promote student familiarity with the tool, as well as support student meta-cognitive awareness of the potential benefits of using this tool in an assessment context.

Results using these resources, conducted with sample 14-year-old students in four countries, indicate that students assessed with ECCM outperformed their peers that were allowed to use a basic notepad in their critical thinking computer-based assessment (Rosen & Tager, 2013). Moreover, the study demonstrated that ECCM introduced no motivational obstacles for students in terms of being required to work with a thinking tool. This evidence of student performance and equivalent motivational level during both modes of critical thinking assessment is a preliminary positive indicator for the use of thinking tools in general and ECCM in particular in computer-based assessments.

## Conclusion

The "big idea" behind this article is that if we could embed thinking tools in assessments used to help guide teaching and learning of higher-order thinking, and if these assessments had a salutary effect on learning and achievement, then for a relatively small investment (embedding thinking tools) we might experience a substantial impact on learning and achievement for large numbers of students. Thinking tools enable all students to visually and verbally organize complex information, and to transform information into active forms of understanding beyond the traditional linear structures most often used in educational assessments. However, assessments delivered with or without thinking tools may differ in score meaning and their instructional implications. Each mode of assessment can be uniquely effective for different educational purposes. For example, an assessment program that has adopted a vision of a conceptual change in assessment may

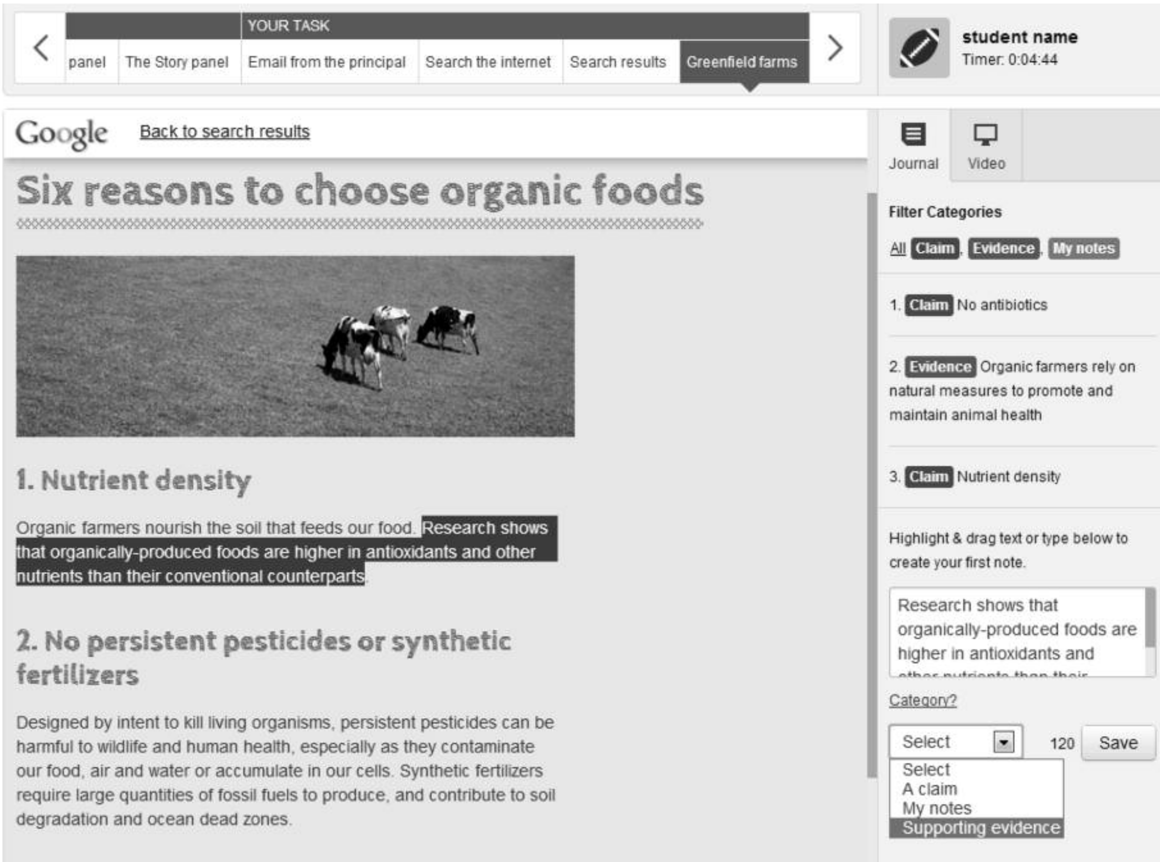


**Figure 1.** Classifying notes into claims and evidence in preparation for ECCM construction.

consider the *person-plus* thinking tools approach as a more powerful avenue for next generation formative assessment, while the *person-solo* approach may be implemented as more conventional summative settings.

While technology tools can promote fundamental improvements in assessment of higher-order thinking skills (Bennett *et al.*, 2007; Pellegrino, Chudowsky, & Glaser, 2001; Rosen, 2009), assessment of foundational knowledge, skills, and abilities can rely on more traditional *person-solo*-oriented assessment approaches. Thinking tools can enable scaffolding and visibility in the student thinking process while working on complex problem-solving or decision-making situations that require mindfulness and thinking beyond What You See Is All There Is—WYSIATI (Kahneman, 2011). Similar to more conventional *person-solo*-oriented assessment, students may benefit differently from qualitatively different types of assessment item types or environment.

Thinking tools are a pattern language that is grounded in cognitive processes we use as human beings to make sense of our world (Hyerle, 2009; Jonassen, 2006). Teachers use the tools to convey, facilitate, and mediate thinking and learning in their classrooms. Thinking tools are also used as a set of graphically and verbally displayed thinking processes for interdisciplinary problem solving and decision making. Embedding computer-based thinking tools in formative assessments and educational technologies is one of the promising approaches that could foster higher-order thinking in today's school systems. □

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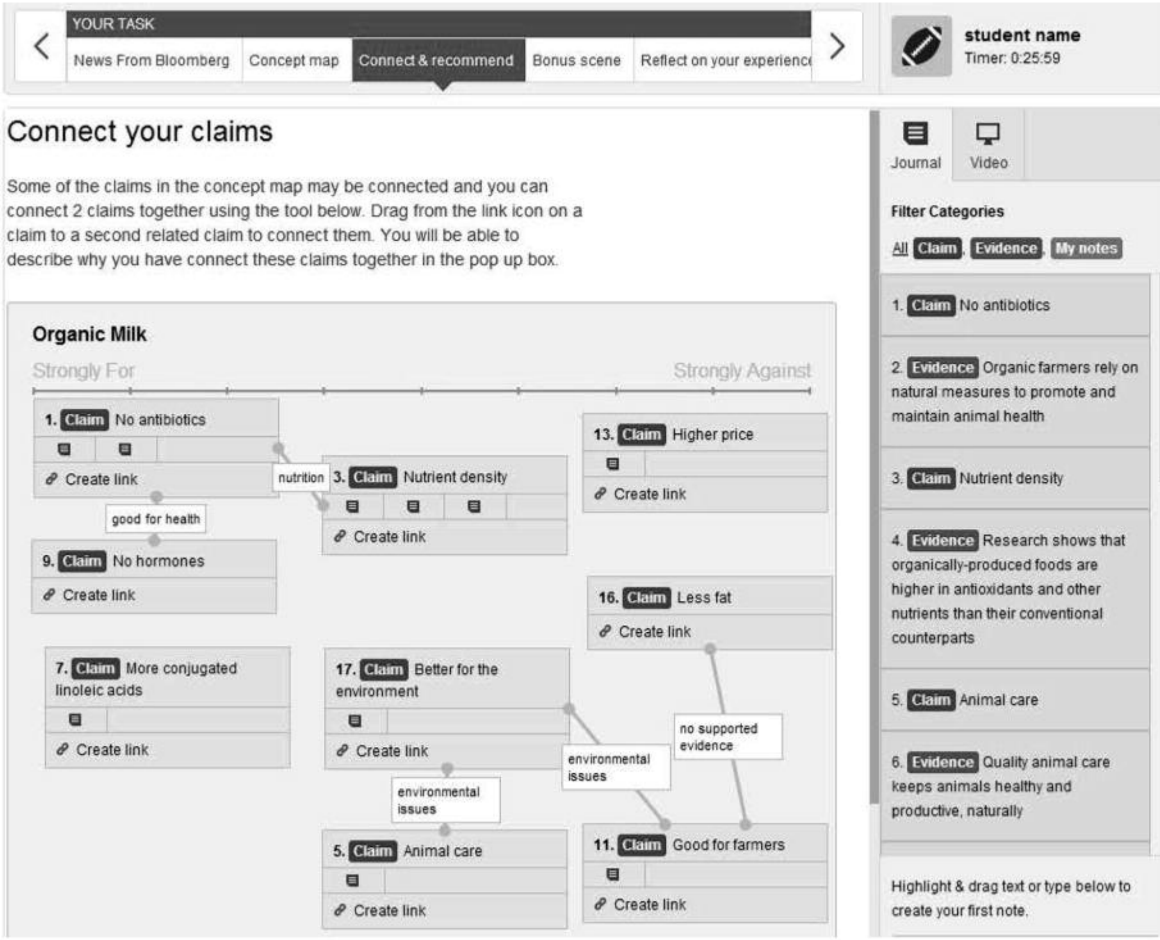


**Figure 2.** The student-created relationships within the concept map.


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# E-Learning and the Use of New Technologies in the 'Kolumbus-Kids' Project in Germany

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**Wiebke Homann**
**Friederike Strehlke**
**Annika Borgmann**

This article presents the science project 'Kolumbus-Kids' as an example of the innovative use of *E-Learning* and other *new technologies* to advance student learning and new-media education. The project benefits from various technology-based education strategies and E-Learning scenarios which are employed during the sessions, their preparation, and follow-up. Media and technology are used as instruments to improve learning and also as objects to learn about.

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## Background and Introduction

Natural sciences and technology have a huge impact on all areas of today's society and have become important elements of our current cultural identity. Due to innovations in the field of media and the Internet, the use of new media and the urge to teach them in schools have developed considerably. This allows for new didactic potentials and innovative aspects of teaching and learning. If appropriate technological resources are offered and managed, the use of learning software, Internet applications like blogs or wikis, or other E-Learning scenarios can support learning as well as teaching processes and improve performance to a high degree. Consequently, transmitting competent knowledge and skills regarding a responsible use of new media is now being integrated into every school's programs.

Innovations in the media and technology sector, however, can turn working with those into a challenge for teachers. They are to develop their science and technological education in ways that are both satisfying for themselves and stimulating for their students. This article presents the science project 'Kolumbus-Kids' as an example of the innovative use of *E-Learning* and other *new technologies* in order to advance student learning as well as supporting new-media education. This method has proven to be beneficial for both university students functioning as teachers and their pupils.

## The Project 'Kolumbus-Kids'

Since 2006, the Bielefeld University's 'Kolumbus-Kids' project has been working with gifted learners between the ages nine and 12. Selected students at regional schools are invited to participate in interesting sessions dealing with biological problems and phenomena at the university. These classes are designed and held by university students planning to become teachers. So far, this project is a unique concept in Germany in terms of Biology Didactics, aiming at an adequate support of students gifted in natural sciences. The project is also beneficial for the university students, as they learn about teaching methodology and diagnostics for giftedness in a theoretical seminar, followed by a practical course where they plan and give classes in the context of the project.

The combination of theoretical input and practical experience supports the university students' skills to identify student personalities and their individual needs when designing lessons and teaching units, which is a crucial competence for their future career as teachers (Borgmann & Wegner, 2011; Wegner & Minnaert, 2012; Wegner & Grotjohann, 2010). For further information, visit the project's homepage: ***www.Kolumbus-Kids.de*** .

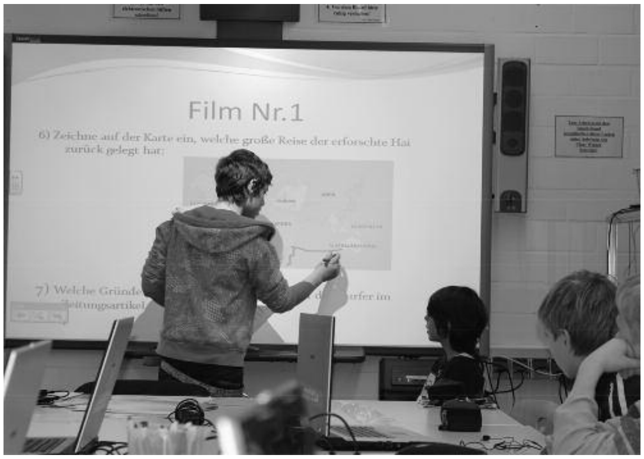


**Figure 1.** Course participants using laptops and the smartboard in the Project classroom

The project was named after Christopher Columbus, who discovered America in the 15th century. The rationale behind the project is that the course participants become explorers, just as Columbus was, and they have to be courageous and to see beyond their own horizons in order to answer challenging questions. Throughout the project, they discover a new world of natural sciences. When working on biological phenomena, they also have to show tenacity and inventiveness, like adventurers.

What also makes the project special is its use of a variety of technology-based education strategies, new media, and E-Learning scenarios during the sessions as well as for their preparation and follow-up. On the one hand, this supports the students' and pupils' media competence. On the other hand, the use of new technologies helps the pupils achieve new scientific knowledge and functions as a tool to advance learning. Hence, media and technology are used in a responsible way in two approaches, namely as an instrument to improve learning, and also as an object on its own to learn about.

## New Technologies Used in the Project

An example for technology-based education during the sessions is the use of laptops and an interactive smartboard (see ***Figure 1***). Diagrams, audio files, videos, and computer animations can be shown easily on the smartboard. With the help of the smartboard, important hand-written notes or mind-maps can be saved, uploaded to electronic platforms, or archived. The videos shown are directed, recorded, and cut by the university students themselves so that they fit the purpose of each session ideally. Besides, the whiteboard enables the pupils to work on E-Learning tasks interactively and to document and visualize their results for the rest of the course. Using this digital board is an innovative and effective way of working and learning, which is already used in some German schools. It is going to play a more important role in future school education, which is why future teachers should learn how to deal with this type of technology. The smartboard comes with voting-system software, enabling the pupils to interactively answer topic-related multiple-choice questions via remote control devices, so-called 'klickers.' This method has proven to be very motivating and effective for pupils as well as university students.

## The Project's Website

The project's Website, ***www.Kolumbus-Kids.de***, contains a variety of different informative and educational elements addressing the needs and interests of participating pupils, their parents, and university students. Apart from the course schedules, news, contact information, or reports of already finished classes, Website visitors find an innovative concept in terms of E-Learning platforms and numerous possibilities to learn interactively. The course members have the chance to watch the videos shown in the session multiple times, and their learning process is supported, as they are provided with additional material, open-source software, and a learning blog system. Besides, the blog offers pupils the opportunity to take electronic mock exams related to the course contents.

Due to the barrier-free platform on the Internet, the course members may set individual focal points and have the chance to improve their learning behavior, regardless of time and space. This computer-based learning environment is similar to that in the vocational world of natural scientists. Being exposed to these learning techniques, the pupils become accustomed to them and have the chance to learn about scientific ways of thinking and working in an authentic context. So far, this has proven to be very motivating and stimulating for the course participants.

Generally, the project's Website helps the university students to acquire scientific knowledge and to simplify and organize the preparation, realization, and follow-up of their sessions. The blog system, for instance, allows university students to exchange data, links, literature, and further information related to the project in a password-protected section of the system. Giving them a chance to share their experiences and to collect further informative material is especially important for less-experienced students. It also helps new students to get prepared for the sessions by watching the short learning videos directed by the university students. They are available for the Website for free and explain how to handle certain equipment in the laboratory, new technologies like the whiteboard in the course room, or a diversity of open-source-software programs. So far, the concept of this

Website is unique in Germany and it is constantly revised and improved.

## Conclusion

Generally, the project's E-Learning concept is transferable to other projects or seminars in the field of natural science, such as chemistry or physics. It has been shown to be very motivational and effective for course participants to work with new technologies and different media during the sessions and also to have the opportunity to use the E-Learning platform whenever they prefer to use the Internet. This means of self-directed learning decreases the threats of over- or underchallenging situations for pupils, which often lead to a loss of motivation.

It is especially important to support gifted pupils in order to keep their interest alive and to nurture their talent, since future scientists will be recruited from within their ranks. Besides serving as a tool to improve the pupils' learning processes, the platform helps university students to learn about dealing with a new set of media and technology. They improve their media skills and become competent using these in their future professional lives.

Another beneficial element of E-Learning platforms like this is that they can be used at any time. The huge repertoire of material and video clips is improved and extended constantly.

The project itself offers its students and pupils an innovative technology-based program and an effective way of improving teaching and learning techniques with the help of new media.

This kind of learning environment has practical value for all sorts of education and is recommended to be used more often in universities and schools. □

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# Characteristics of Useful and Practical Organizational Strategic Plans


**Roger Kaufman**
***Contributing Editor***



Most organizational strategic plans are not strategic but rather tactical or operational plans masquerading as 'strategic.' This article identifies the basic elements required in a useful and practical strategic plan and explains why they are important.


***A useful organizational strategic plan** will identify, define, and justify (1) where the institution is going, (2) why it is going there, (3) how it will add value for all stakeholders, and (4) provide the criteria for effective and efficient decision-making. It will also provide the criteria for planning how to achieve the mission so that financial, human, and physical resources may be properly allocated. Finally, it should provide valid data to justify what it uses, does, produces, and delivers. All must be based on solid data and information.*

There are several strategic planning imperatives, many of which are not included in current and popular approaches. These imperatives include the following:

1. *Provides measurable performance evidence-based criteria.*
2. *Primary focus is on ends and results and their consequences, not on means, programs, activities, courses, or delivery.*

Often so-called strategic plans don't deal with ends, results, and consequences but focus on means, programs, projects, activities, and resources. While it is


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tempting to "follow the leader" and copy what other like organizations are using, this is not useful (Schumpeter, 1975). The definition of 'strategic planning' used here is the identification, justification, and measurable definition of where an organization is headed and why. After strategic planning is accomplished, then sensible tactical and operational planning may be sensibly rooted.

3. *Does not benchmark other institutions.*

Even if you are not a "Deadhead," the Grateful Dead leader, Jerry Garcia, gave some sage advice: "don't be the best of the best, be the only one who does what you do." Benchmarking has some potential traps, including that the organization being benchmarked has the same objectives as your own, and it also assumes that they are not doing continual improvement, so you will be benchmarking old objectives and processes.

4 *Organizational criteria link all criteria to adding value to societal ends, including the entire ecosystem for the institution.*
5. *Enables justifiable evidence for how the results of using the strategic plan will demonstrate value to all of its stakeholders.*
6. *Identifies evidence-based results at all three levels of results:* ***external contributions, organizational contributions, and individual contributions.***
7. *Provides performance data from each of these three levels, derived by documenting the gaps between current results and contributions and desired results and contributions.*

All organizations are means to societal ends. They all compete for scarce resources in order to provide services that add measurable value to all stakeholders, including external communities and society, the organization itself, and those in the organization. What any surviving and thriving organization uses, does, produces, and delivers must add value outside of itself and thus must provide evidence of value.

8. *Performance data from each of the three levels are derived by documenting the gaps between current results and contributions and desired results and contributions.*

For a strategic plan to be useful, it must be built on hard evidence—not on judgments, feelings, or politics. Evidence of where an organization should head, and why it should go there, is best obtained from a "needs assessment" that only collects data on gaps between current results and consequences and desired results and consequences. Gaps in means, programs, projects, and activities should only be addressed after needs are collected and prioritized on the basis of the costs to meet the needs as compared to the costs to ignore the needs.

9. *Is built on the institution's current and future realities and not upon the approaches used by other institutions.*
10. *Criteria provide the measurable evidence for identifying and selecting financial resources.*
11. *Criteria provide the measurable evidence for identifying and selecting physical and human resources.*
12. *Criteria provide the measurable evidence for identifying and selecting and/or modifying programs, projects, and activities.*
13. *Criteria provide measurable evidence for identifying and selecting programs, projects, and activities that should be deleted.*

Valid data will allow for fiscal planning, budgeting, and sensible resource allocations. Too often, what gets called 'strategic planning' becomes protection of turf and resources and is not based on hard evidence of needs (not wants). For effective tactical and operational planning, the integrity of the data collected is central and vital.

14. *All stakeholders—internal and external representatives—are actually committed to the plan.*

It is key that all partners not only contribute to the plan but also commit to follow the results and use the plan each time a decision is to be made. A key indicator of the usefulness of a strategic plan is the extent to which it is used when decisions are to be made. Peter Drucker called getting the buy-in "transfer of ownership" from "your plan" to "my plan."

15. *Uses a plan for collecting performance data on closing the gaps in results (needs) identified and selected.*
16. *Uses a model or technique for determining measurable and valid value-added for all three levels of results.*

A viable plan for collecting needs data is vital, and it should be formalized and include or be acceptable to all planning partners. Based on this data, a viable model for determining the costs-consequences for meeting the needs should be in place.

17. *Integrates with other strategic plans for other institutions in the overall system.*

No organization operates in a vacuum. It is useful to make sure that your strategic plan synchronizes well with other institutions with which it must operate. Your approach, also, might serve as a model and inspiration to others.

18. *Strategic planners will constantly collect data on effectiveness and efficiency and be updated as required.*
19. *The strategic plan and criteria will be used when decisions are to be made.*

Periodically, the planners should track the results of the strategic plan and revise as required, and no plan is useful if it is not used, so the strategic plan should be valued enough that when decisions are to be made, the plan is taken out and used.

***Research and applications roots of this approach.*** Much of this is based on *The Assessment Book* section on strategic planning (Kaufman & Guerra-Lopez, 2008) and extensive work on strategic thinking and planning in pubic and private sectors (Bernardez, 2009; Bernardez, Kaufman, Krivatsy, & Arias, 2012; Bernardez & Kaufman, 2013; Kaufman, 1998, 2000, 2006, 2011; Kaufman & Guerra-Lopez, 2013). It also responds to many legitimate criticisms of conventional strategic planning in order to rectify the many flaws in what is often done (Lloyd, 1992; Mintzberg, 1994, 1995).

Following is the rationale for the essential characteristics of a practical and useful strategic plan:

***Problems with most strategic planning approaches.*** Defining and justifying where you are going is a good thing. But, sometimes, on the way, things get distorted. Troublesome issues include:

1. Focusing on means, finances, budgets, or human resources first before defining and justifying one's mission.
2. Selecting a strategic planning approach based on what others have done instead of tailoring the plan to institutional internal and external realities.
3. Not collecting performance data on needs—gaps in results—but seeing needs as wants and doing planning on the basis of programs, projects, activities, and funding.
4. Not relating the strategic planning to the entire value chain that runs from individual contributions, to organizational contributions, to community and societal contributions.
5. Changing the strategic plan each time there is a change in leadership. If a plan is based first on societal value-added factors, leadership should put their 'stamp' on an institution in terms of how to meet the needs.
6. Selecting programs, projects, activities, and human resources without doing costs-consequences assessments.
7. Substituting political initiatives for actual strategic planning.
8. Not using these essential characteristics to assure that the strategic plan will be practical, valid, and deliver measurable useful results.

***Agile and alert organizations are in a unique position in our societal new realities.*** Those organizations that intend to survive and thrive in today's realities will realize that their future lies in creating a future with rewards different from the past. Drucker (1993) suggests that the "new capitalism" is not one of money and things but of knowledge and ideas. Our new-age organizations have a unique niche to contribute to this new future. □

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# Educational Technology Research Journals

## *Journal of Computer Assisted Learning, 2002–2011*

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**Grant D. Zabriskie**
**Scott M. Ashton**
**Jered Borup**
**Richard E. West**
***Brigham Young University***

In this study, the authors analyzed all research articles published between 2002 and 2011 in the *Journal of Computer Assisted Learning*, in order to understand the research topics methods, major contributing authors, and most-cited publications. Over the 10-year period, they found the journal has explored educational uses of computer technologies in a wide variety of contexts, but most recently the journal has emphasized studies on online learning. The three most common topics over the decade have been collaboration, communication technology, and distance learning. Another prevalent theme has been mobile learning, with three special issues and two of the top three most frequently cited *JCAL* articles focusing on this topic. Most recently, the topic of social media in learning has emerged as a common one. The research published in *JCAL* is internationally diverse, with its 15 most frequently published authors representing nine different countries. Its three most frequently published authors were Tak-Wai Chan of the National Central University of Taiwan, Chee-Kit Looi of the National Institute of Education in Singapore, and Eileen Scanlon of the UK Open University. About a third of the published research was inferential and most of the remaining research was interpretive or combined.

### Introduction

Founded in 1985, the *Journal of Computer Assisted Learning* is a bi-monthly journal covering a broad range of topics in educational technology, including "collaborative learning, knowledge engineering, open, distance, and networked learning, developmental psychology, and evaluation" (Wiley, 2012). The current editorial board is headed by Paul A. Kirschner and Liesbeth Kester from the Open University of the Netherlands. All submissions are subjected to a double blind review and typically range between 4,000 and 7,000 words.

The purpose of this research study was to analyze the various components of the *Journal of Computer Assisted Learning*, including the main topics of study, the journal's most common research methodologies, and influential authors and articles within the journal.

### Methods

The researchers analyzed all 418 articles published between the years of 2002 and 2011. Because this study's purpose was to provide insight into the type of academic research accepted by *JCAL* during these years, the analysis did not include book reviews nor editorials. Overall, four separate analyses examined the author-provided keywords, research methods, published authors, and citation frequencies. Detailed descriptions of each analysis method are given below.

#### Topical Analysis

A topical analysis was conducted using author-provided keywords. All of the articles' keywords were compiled, sorted, and totaled. Similar keywords were combined to better identify topical themes. For instance, the terms *e-learning, online learning,* and *Web-based learning* were combined under the keyword category *distance learning.* Similarly, *discourse, dialogue,* and *interaction* were combined under the keyword category *communication.*

A list of all of the special issues and special sections dedicated to specific topics was also compiled as part of the topical analysis.

#### Article Type and Methodology Analysis

Employing a content analysis methodology, researchers categorized all articles according to the following taxonomy:

- *Theoretical*—articles consisting of non-data based discussions, such as literature reviews and explanations of theoretical frameworks or models.
- *Interpretative*—qualitative studies employing methods such as observations or interviews to inductively interpret findings.
- *Inferential*—quantitative studies employing predictive statistical analysis methods, such as experimental, quasi-experimental, and correlational designs.
- *Descriptive*—quantitative studies mainly employing non-inferential descriptive statistics.
- *Combined*—mixed-method studies.
- *Content Analysis*—analysis and categorization of content using predefined definitions.
- *Other*—any study or article not fitting the above definitions.

In order to develop a common understanding and agreement on these definitions, the research team members independently examined a 10% sample of the journal articles and met to resolve discrepancies. After reaching a consen-

**Table 1.** Highest-ranked keywords for the years 2002–2011.

| Keyword Category | Total Count |
|---|---|
| Communication & Communication Technology | 103 |
| Case Study & Qualitative Methodology | 71 |
| Collaboration | 66 |
| Distance Learning | 60 |
| Secondary Schools | 59 |
| Mobile & Wireless Learning | 50 |
| Technology Use & Integration | 49 |
| Elementary Schools | 47 |
| Assessment & Evaluation | 43 |
| Post-secondary Education | 41 |
| Internet | 38 |
| Affective Outcomes | 28 |
| Teaching & Pedagogy | 23 |
| Multimedia | 21 |
| Survey Research | 19 |

sus, teams of two researchers each double coded a sample of 10% of the remaining articles and worked together further to resolve any discrepancies. Once an acceptable rater agreement of 85% was reached for both teams, the remaining articles were divided up and coded by individual researchers. Unique articles were double coded to ensure coding consistency.

### Authorship Analysis

The name of each author in the 418 articles was compiled. Each author was analyzed according to two factors: the number of articles published and the author's rank for each article. A medal system was used to better determine each author's ranking by awarding an author three points for being the first author of an article, two points for being the second author, and one point for being a third or further author.

### Citation Analysis

The most frequently cited articles were identified using *Publish or Perish* software (Harzing, 2011) in analyzing Google Scholar citation counts for *JCAL* issues between 2002–2011. In contrast to the analysis done in other sections, editorials were included in this stage of the analysis.

## Findings

### Topic Analysis

***Table 1*** shows a list of the most common keywords for the years 2002–2011. An examination of the table reveals several trends. First, *communication and communication technology* had the highest overall keyword count.

**Table 2.** Special issues and sections for the years 2002–2011.

| Year | Volume (Issue) | Topic |
|---|---|---|
| 2002 | 18 (4) | International uses of ICT |
| 2003 | 19 (2) | Children and new technology |
| 2003 | 19 (3) | Wireless and mobile technologies in education |
| 2004 | 20 (3) | Developing discussion for learning |
| 2005 | 21 (3) | Wireless and mobile technologies in education |
| 2006 | 22 (5) | Gender and ICT |
| 2007 | 23 (2) | Computer supported inquiry learning in science *special section (4 articles) |
| 2007 | 23 (4) | Mobile learning |
| 2008 | 24 (2) | Networked learning |
| 2009 | 25 (1) | Social software, Web 2.0 and learning |
| 2010 | 26 (1) | 'CAL': Past, present, and beyond |
| 2010 | 26 (2) | Adaptive testing *special section (4 articles) |
| 2010 | 26 (5) | Net generation *special section (4 articles) |
| 2010 | 26 (6) | Pedagogical uses of ICT worldwide |
| 2011 | 27 (1) | Mobiles and literacy *special section (7 articles) |
| 2011 | 27 (4) | Parental engagement |

*Collaboration* and *distance education* also had relatively high keyword counts. Distance education courses traditionally were correspondence and independent study programs (Garrison, 2009). However, the advent of the Internet has allowed a greater level of learner–instructor and learner–learner communication than was possible before. The high count of collaboration, communication technology, distance education, and Internet-related keywords possibly indicates that a common focus of research in the last decade has focused on collaboration and interaction in online learning settings. Second, *case study and qualitative methodology* ranked second on the list of most frequent keywords. Although the contextualized nature of case studies typically prevents generalizations to be made to other contexts, Merriam (1998) and Stake (2010) explained that case studies and qualitative research are required to understand the particular. Although not generalizable, this type of research can provide practical insights to researchers and practitioners. Third, the keywords *secondary schools, elementary schools,* and *post-secondary education* indicate that a

**Table 3.** Methodology type counts by year, 2002–2011.

| Method | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | Total (%) | Standard Deviation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inferential | 14 | 12 | 15 | 13 | 15 | 18 | 19 | 11 | 16 | 15 | 148 (36.1%) | 2.5 |
| Combined | 9 | 16 | 9 | 5 | 4 | 6 | 7 | 12 | 6 | 14 | 88 (21.5%) | 4.0 |
| Interpretive | 15 | 9 | 6 | 8 | 9 | 4 | 11 | 7 | 7 | 11 | 87 (21.2%) | 3.1 |
| Theoretical | 3 | 10 | 1 | 4 | 5 | 7 | 4 | 6 | 12 | 4 | 56 (13.7%) | 3.4 |
| Descriptive | 2 | 0 | 3 | 4 | 0 | 3 | 2 | 1 | 1 | 0 | 16 (3.9%) | 1.4 |
| Content Analysis | 1 | 0 | 2 | 4 | 3 | 1 | 0 | 0 | 0 | 1 | 12 (2.9%) | 1.4 |
| Other | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 (0.7%) | 0.9 |

large proportion of research published in the last decade has been conducted in traditional educational environments. The keywords *secondary schools* and *elementary schools* combined for 106, while *post-secondary education* accounted for only 41 keywords, possibly indicating a larger focus on K–12 environments as compared to higher education. However, it is important to note that not all authors used a keyword to describe the setting of their research. It is possible that authors researching in less typical environments would be more likely to describe the article using a keyword that described their setting, and authors researching in a more typical environment would be more likely to describe their article with a keyword describing their method or pedagogical framework. Fourth, *mobile and wireless learning* was also a common keyword category. Mobile technology and tablets are rapidly growing in popularity, and this growth seems to have spurred expanding research interest. *Teaching and pedagogy* was also a common keyword category. However, it had less than half the total count of *mobile and wireless learning*. This may indicate a larger focus on media than on method.

In addition to the keywords, the 16 special issues and sections between 2002 and 2011 function as a guidepost for understanding the journal's topical emphases and emerging themes. ***Table 2*** shows a full list of the special issues and sections for the years 2002–2011. A total of 12 special issues of the journal and four special sections of regular issues, each containing 4–7 articles, were published. A number of themes are particularly visible from the table. First, nearly half of the topics directly involve the Internet and learning. This harmonizes with the findings in ***Table 1***, which further confirms the journal's commitment to research on online and networked learning. Second, three special issues and one special section are dedicated to mobile and wireless learning. These issues are spread throughout the decade, which suggests that mobile learning will likely be a consistently recurring theme for years to come. Third, two special issues focus on worldwide uses of ICT. It became salient after scanning each article's abstract that, in addition to these special issues, most issues between 2002–2011 include studies conducted in a wide variety of countries and cultures. This is not visible in the keyword analysis because the keywords listed for each article rarely include the location of each study.

## Methodology Analysis Findings

***Table 3*** shows the results of the methodology analysis. Inferential methods were most common (36.1%), followed by combined (21.5%), interpretive (21.2%), and theoretical (13.7%). All other categories comprised a small percentage of the articles. The table is organized by year in order to demonstrate trends in frequency. Each category remains fairly consistent across the years. The occasional spikes are largely attributable to special issues. For example, the unusually high concentrations of theoretical articles in 2003 and 2010 stem primarily from the 2003 special issue on mobile learning and the 2010 special issue on computer-assisted learning.

The editors' openness to a variety of research methodologies is evident. While inferential studies comprise a plurality of the total articles, there is a relatively balanced split between inferential, combined, interpretive, and theoretical methodologies. This seems to indicate that the journal does not focus exclusively on a single methodological approach to research.

## Authorship Analysis Findings

A total of 886 authors contributed to the 418 articles. One author published eight times, two authors published six times, four authors published five times, and six authors published four times. ***Table 4*** shows the 15 authors who scored highest on the medal count, listed according to each author's total medal count score. Authors with the same total medal count are listed alphabetically. The table demonstrates the international diversity of the authors in the journal. Of the 15 authors, nine countries are represented. More than half of the 15 authors represent universities in either Taiwan or the United Kingdom.

The top three authors have contributed significantly to a number of fields. Tak-Wai Chan is the Chair Professor of the Graduate Institute of Network Learning Technology at the National Central University of Taiwan. He has been on the

**Table 4.** Highest scoring authors according to medal count.

| Author | Institution | Total Publications | Author Rankings | Medal Count |
|---|---|---|---|---|
| Tak-Wai Chan | National Central University of Taiwan | 9 | 1st, 2nd (x2), 3rd, 4th (x2), 5th (x2), 10th | 13 |
| Chee-Kit Looi | National Institute of Education, Singapore | 5 | 1st (x3), 2nd (x2) | 13 |
| Eileen Scanlon | The Open University (UK) | 7 | 1st (x2), 2nd (x2), 3rd (x2), 4th | 13 |
| Ton De Jong | University of Twente (Netherlands) | 6 | 1st, 2nd (x3), 3rd, 4th | 11 |
| Jo Tondeur | Ghent University (Belgium) | 5 | 1st (x3), 3rd, 4th | 11 |
| Tzu-Chien Liu | National Central University of Taiwan | 4 | 1st (x2), 2nd (x2) | 10 |
| Miguel Nussbaum | Pontifical Catholic University of Chile | 5 | 2nd (x5) | 10 |
| Lydia Plowman | University of Edinburgh (UK) | 4 | 1st (x2), 3rd | 10 |
| C.-H. Chiu | National Taiwan Teachers College (Taiwan) | 3 | 1st (x3) | 9 |
| Robert Ellis | University of Sydney (Australia) | 3 | 1st (x3) | 9 |
| Bracha Kramarski | Bar Ilan University (Israel) | 3 | 1st (x3) | 9 |
| Martin Oliver | University College (UK) | 4 | 1st (x2), 2nd, 5th | 9 |
| George Palaigeorgiou | University of Thessaly (Greece) | 3 | 1st (x3) | 9 |
| Neil Selwyn | Cardiff University (UK) | 3 | 1st (x3) | 9 |
| Shelley Young | National Tsing Hua University (Taiwan) | 3 | 1st (x3) | 9 |
| (7 authors) | | 3–4 | | 8 |
| (5 authors) | | 3–5 | | 7 |
| (26 authors) | | 2–4 | | 6 |

editorial boards of over 10 international journals and has co-founded a number of conference series and international academic societies. A native of Hong Kong, he received his undergraduate degree in Mathematics at Nottingham University and his Master's and Ph.D. at the University of Illinois in Computer Science. His research expertise includes a wide variety of branches of technology-enhanced learning, including artificial intelligence, online learning communities, mobile and ubiquitous learning, and digital game based learning (Chan, 2012).

Chee-Kit Looi is the Head of the Centre of Excellence for Learning Innovation at the National Institute of Education at the Nanyang Technological University in Singapore. He is an editorial member of *JCAL* and the *IEEE Transactions in Learning Technologies*. He received a Master's at the University of British Columbia and a Ph.D. at the University of Edinburgh. His research expertise covers a number of topics within technology-enabled learning, especially mobile learning (Looi, 2012).

Eileen Scanlon is the Associate Director of Research and Scholarship at the Institute of Educational Technology at the UK Open University. She has received a Bachelor's in Natural Philosophy, and a Dip.Ed (Diploma of Education), PGCE (Postgraduate Certificate in Education), M.Ed., and a Ph.D. Her research expertise includes science education, particularly technology-supported formal and informal science learning, mobile learning, and science communication in the information age (Scanlon, 2012).

## Citation Analysis Findings

***Table 5*** lists the most frequently cited articles for each year between 2002–2011. All information was accessed via the *Publish or Perish* citation software, which uses Google Scholar citation data (Harzing 2008). The journal as a whole has an impact factor of 1.46 (Wiley, 2012) and an h-index of 68 according to a *Publish or Perish* query of the past 10

**Table 5.** Most cited articles between 2002–2011.

| Year | Title | Authors | Citation Count | Cites/Year | Methodology |
|---|---|---|---|---|---|
| 2002 | Learning within incoherent structures: The space of online discussion forums | M. J. W. Thomas | 236 | 21.45 | Content Analysis |
| 2003 | Keynote paper: Unlocking the learning value of wireless mobile devices | J. Roschelle | 396 | 39.7 | Theoretical |
| 2004 | Savannah: Mobile gaming and learning? | K. Facer, R. Joiner, D. Stanton *et al.* | 251 | 27.9 | Interpretative |
| 2005 | Interactive whiteboards: Boon or bandwagon? A critical review of the literature | H. J. Smith, S. Higgins, K. Wall, J. Miller | 285 | 35.6 | Content Analysis |
| 2006 | The digital divide: The special case of gender | J. Cooper | 131 | 18.7 | Combined |
| 2007 | The use of computer technology in university teaching and learning: A critical perspective | N. Selwyn | 169 | 28.3 | Theoretical |
| 2008 | Understanding pre-service teachers' computer attitudes: Applying and extending the technology acceptance model | T. Teo, C. B. Lee, C. S. Chai | 107 | 21.4 | Inferential |
| 2009 | The appropriation and repurposing of social technologies in higher education | A. Hemmi, S. Bayne, R. Land | 112 | 28 | Interpretative |
| 2010 | Beyond the "digital natives" debate: Towards a more nuanced understanding of students' technology experiences | S. Bennett, K. Maton | 51 | 17 | Theoretical |
| 2011 | The effect of Twitter on college student engagement and grades | R. Junco, G. Heiberger, E. Loken | 101 | 50.5 | Combined |

years. On average, articles in the journal have received 27.39 citations per year.

Two trends arise in the table. First, the percentages of theoretical and content analysis articles in ***Table 5*** are much higher than the total percentages for the entire journal. For example, 40% of the most frequently cited articles are theoretical, even though theoretical articles comprise only 13.7% of the total articles. Some 20% of the most frequently cited articles are content analyses, whereas content analyses only comprised 2.9% of the total. The disproportions for the theoretical articles may be attributed to the popularity of special issues. All of the theoretical articles in ***Table 5*** were published in special issues.

Second, the topics addressed in the top-cited papers were similar to the trends of the journal as a whole during the time period. For example, three of the articles discuss "mobile and wireless learning," which is the sixth most frequent keyword category, while four of the articles discuss "technology use and integration," the seventh most frequent keyword. Somewhat surprisingly, three of the articles in ***Table 5*** explore "affective outcomes," whereas the keyword only shows up a total of 28 times in the 10-year time span.

## Discussion

This article presents a multifaceted analysis of *JCAL* for the years 2002–2011. The topical, methodological, authorship, and citation analyses highlight the journal's distinct contributions to the field of educational technology. Four features of the journal are particularly salient in the analyses.

First, the journal's most common motif is the examination of ICT through a wide variety of lenses, including most recently an emphasis on online learning. As mentioned earlier, the three most common topical keyword categories (excluding methodological keywords) are *communication* *and communication technology, collaboration,* and *distance learning.* These categories, as well as a number of other network and Internet-related categories, seem to indicate that the advent of the Internet has triggered an increased research focus on collaboration and interaction in online settings. Additionally, six special issues are dedicated to understanding ICT in different settings, including international uses of ICT (Vol. 18, issue 4), gender and ICT (Vol. 22, issue 5), networked learning (Vol. 24, issue 2), Web 2.0 and learning (Vol. 25, issue 1), the net generation (Vol. 26, issue 5), and pedagogical uses of ICT worldwide (Vol. 26, issue 6).

The journal editors claim "there is currently much emphasis on the use of network functionality and the challenges its appropriate uses pose to teachers/tutors working with students locally and at a distance" (Wiley, 2012). The analysis in this article confirms that claim.

Second, the analyses demonstrate the journal's strong international emphasis. This is especially evident in the results of the authorship analysis, where the top 15 authors represent nine different countries. Additionally, two special issues (Vol. 18, issue 4 and Vol. 26, issue 6) are devoted to exploring worldwide usage of ICT.

The special issue in Volume 18 provides especially notable contributions to research in worldwide educational technology use. It includes, for example, Kozma's and Anderson's (2002) study of worldwide innovative pedagogies, which is exceptional among international comparison studies because "it combines the best of 'area studies,' which tend to be culturally in-depth but limited to one or two countries, and international assessments, that tend to be very cursory but involve 20–40 countries" (Anderson, 2002, p. 381). Hence, both the international authorship and content demonstrate the journal's international focus.

A third prevalent theme is the journal's emphasis on mobile learning research. Three special issues are dedicated to wireless and mobile technologies (Vol. 19, issue 3; Vol. 21, issue 3; Vol. 27, issue 1), one of which highlights the relationship between mobile technology and literacy (Vol. 27, issue 1). Additionally, two of the top three most frequently cited *JCAL* articles between 2002 and 2011 focus on mobile learning, including Roschelle's (2003) keynote paper, which was by far the journal's most cited article of the decade. *Mobile and wireless learning* was also the fifth most common topical keyword category.

As Peters (2007) observed, mobile learning is "highly suited to the 'just enough, just in time, and just for me' demands of 21st Century learners." Hence, the recent proliferation of mobile technologies, as well as the unique benefits that mobile learning offers today's learners, have sparked clear interest in mobile learning research, which is further confirmed by this article's analysis.

A fourth trend, which seems to be rapidly emerging, is the journal's examination of the role of social media in learning. Special issues dedicated to social media have begun to appear, including one in 2009 (Vol. 25, issue 1) as well as a special section that was published after the timeframe of this study in 2012 (Vol. 28, issue 3), which focuses on designing and evaluating social media for learning. The top-cited articles of 2009 and 2011 both examine social media in higher education. In fact, Junco *et al.*'s (2011) Twitter article has been cited more than 50 times per year, which is the highest citation rate among all articles on the list. Ravenscroft *et al.* (2012) argued that educational benefits of social media have broad potential, especially due to their propensity to transcend the boundaries of formal education by reaching into the expanding fields of informal and workplace learning. The sudden, recent propagation of research on social media and learning indicates that much more research in this area is likely forthcoming. □

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# Q & A with Ed Tech Leaders

# Interview with Michael W. Allen

**Michael F. Shaughnessy**
***Contributing Editor***

***1. For our readers, could you summarize some of your work in the field of educational technology?***

I've been working in educational technology since the beginning of my graduate work at Ohio State in 1968. IBM provided a major e-learning demonstration system at OSU (though it wasn't called e-learning back then), and I worked with them to create an analytic and prescriptive system that not only measured levels of content readiness, but also determined learning styles and recommended matching learning activities for each learner. My doctoral research work on these topics carried across with me in my initial work at Control Data on the PLATO system,

***Michael W. Allen,*** *the Chairman and CEO of Allen Interactions, is an architect of interactive multimedia learning and is recognized for his many insights, inventions, and presentations. With over 50 years of experience in e-learning, both in academic and corporate settings, he is known for his role in creating* ***Authorware*** *and overseeing the work of his studios at Allen Interactions. Dr. Allen has published eight books, including a best-seller on creating effective e-learning; a series on designing meaningful, memorable, motivational learning experiences; and three annuals on the state of the art in e-learning. In May 2011, he received ASTD's Distinguished Contribution to Workplace Learning and Performance Award. In 2012, he was selected by the National Ethnic Coalition of Organizations (NECO) Advisory Committee as a recipient of the 2012 Ellis Island Medal of Honor for his accomplishments, representing spirit, hard work, and values of those who took the "American dream" from just a hope, and made it a reality. He holds a Ph.D. in educational psychology from the Ohio State University and is an adjunct associate professor at the University of Minnesota Medical School (e-mail:* ***michael.w.allen@alleni.com****)*

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where I led the development of PLATO Learning Management, an LMS system that was used very widely and internationally beginning in the 1970s.

My next project with PLATO was to improve the ease and speed with which courseware could be developed. The charge was to accomplish in one hour of work what was taking 40 hours to do with PLATO's development language. The work yielded PCD3, the PLATO Courseware Design, Development, and Delivery system, which was the precursor to *Authorware*—an authoring system that was released in 1987 and garnered about 84% of the world market for authoring tools in about three years.

At the same time, Control Data provided research funds that I could grant to universities for specific research projects related to learning. We funded many basic studies and published about 20 research papers a year, giving the results to the community at no charge, simply in the interest of improving our collective knowledge and ability to produce effective learning experiences.

I was the founding editor of *The Journal of Computer-Based Instruction,* editing that refereed journal for many years, and have subsequently published several books on e-learning. Over this period of time, I have designed countless courses and consulted in the design of many more.

Through nearly my entire career, I've been searching for ways to help people create practical, high-impact learning experiences within available time and budget. Too many organizations fall into a cookbook approach that misses the major opportunities. I've tried to simplify concepts, define procedures that guide design creativity, and focus on key aspects of *learning experiences* rather than just presentation of content.

***2. What is the* ZebraZapps Pro *Content Authoring Platform?***

It's an authoring and publishing system that takes many of the concepts introduced in *Authorware* to a new level. Speed, power, ease of use, and visualization of logic are all still there, but enhanced multiple orders of magnitude.

***3. How does it enable better education and training of e-learners?***

Two points here: (1) Design work, whether in architecture, painting, music, or any other area, requires experimentation—iterations to turn an interesting idea into a successful learning experience. (2) Learning to do things requires doing things while learning and seeing the consequences.

*ZebraZapps Pro* not only makes it much easier to create iterative learning events that demonstrate consequences of alternative actions, but also makes it easy to modify functional interactions repeatedly and in any way desired until a really great learning experience emerges.

***4. What elements are involved in "fully interactive content"?***

This is a favorite, big topic. But here's a short answer: Instructional interactivity is basically the concept of *Given context and challenge and the learner's response action, consequence feedback will occur.* For each combination of context, challenge, and activity (response), learners see something happen that instructs them as to whether the action was appropriate or not. Much of what we need to learn can be represented in an "if–then" statement, and so can an appropriate instructional treatment.

Of course, there's more to it, such as scoping and sequencing; but even those design factors can be represented well as if–then statements.

***5. What is the simple code-free visual interface?***

If I'm a graphic of a hazardous object in the workplace, and a learner clicks or drags me, you probably want something to happen. Some form of feedback might appear, such as confirming text, a change in an accidents chart, a sound, etc.

I want the designer to be able to make anything happen in response to both each learner action and to patterns and timing of responses. I want the designer to accomplish this so quickly and easily that if a better idea occurs, there would be no hesitancy about making a change. Designers shouldn't have to ask a programmer or anyone else to do it for them. That's too slow and often hard to communicate.

*ZebraZapps Pro's* code-free visual interface works as easily as this: Each multimedia object, such as a graphic, a button, text, video, or sound, has (a) a menu of things it can do, (b) properties that can be changed, and (c) user gestures and events it recognizes. Authors just scan to find a recognized gesture, such as a learner's click on the object. They click on that item in the menu and drag. A flexible "wire" appears connected at one end to the gesture and the other end to the mouse pointer. The author drags the free end to any object on the screen, and the menu appears of things that the object can do and properties that can be changed. The author releases the wire on whatever item in the menu the author wants the object to do or whatever property should change. Program written; function created. It's incredibly fast.

Because *ZebraZapps Pro* runs projects while they're being created and allows editing while a project is running, authors can instantly view the effects of what they've just done without having to jump back and forth between run and edit modes. They can modify it immediately or later using the same, simple "wiring" technique.

***6. What does* ZebraZapps Pro *enable the typical user to do?***

While authors can use *ZebraZapps Pro* to build interactions of their own designs, pretty much exactly what they want as if they had advanced programming skills, what's critical is maximizing the benefits of the learner's time. I think we forget that too often as we reduce authoring time and effort at the sacrifice of adaptive learner experiences.

Some examples of what authors can provide easily include having multiple interactions and media resources active at the same time. Learners can zoom into one, causing others to shrink to make room while remaining visible and active. Learners aren't confined to one artificially isolated activity at a time.

Simulations are remarkably easy to build. Whether it's a physical simulation such as an airplane flight deck, or a sales conversation with shifting topics, the system provides powerful building blocks. A couple of quick instances: If you want to animate an object along a path, perhaps a volume or speed control, you just hold down a key while you drag the object. A path is created and the object is attached to it. You can then wire the object's path position to any object that should change in response.

Or suppose you want to simulate a sales conversation. A spreadsheet-like table feature can identify the possible statements made by the learner, the sequence in which the statements were made, and the simulated responses the prospective buyer might make. Creating a simulated discussion with complex branching becomes a realistic thing to do even within typical time and cost constraints.

***7. What do you mean by the "flipped classroom"?***

Typically, presentation of information consumes the lion's share of classroom time. The real learning, which usually comes from application and practice, happens when learners do their homework.

The flipped classroom is just the opposite. Information is delivered through media, hopefully adaptive, interactive media, prior to classroom time, like a course from the Khan Academy. Then, under teacher supervision and mentoring in the classroom, learners apply what they've learned to demonstrate their understanding.

But perhaps a more interesting flip is called, "Show what you know." When you prepare to teach a topic you often learn far more about the topic than when it's taught to you. Why not give learners the benefit of this process? In "Show what you know" learners use interactive media to help them teach their peers and in the process learn topics to greater depths themselves.

Because *ZebraZapps Pro* is so easy to learn and use, we're finding that nine- and ten-year-olds are creating not just dynamic presentations, but also interactive e-learning experiences their peers can really benefit from. This is a whole new technology-assisted learning paradigm that I find very exciting.

***8. What are some of the parameters of "engaging and meaningful content without limitations"?***

Successful learning experiences have three critical characteristics. They are meaningful, memorable, and motivational. If any of these characteristics is missing, the time spent was pretty much wasted. If you didn't understand or you can't remember it, you might as well have spent your time elsewhere. And if your learning doesn't motivate you to do something differently (and better) than you would have done otherwise, again, why be there?

***9. What are some of the building blocks for better e-learning content?***

Turning factual content into a learning experience takes a little doing. That's probably why we have so much content presentation as opposed to engaging learning experiences. As I mentioned previously, I've been on an extended mission to find ways to help instructional designers make this conversion more easily, and I think we found the answer in defining the building blocks: content, challenge, activity, and feedback—CCAF. To create learning experiences, you need to translate content into these four components and orchestrate the experience from them.

Briefly, you begin with context. I have to mention immediately that lack of context characterizes poor instructional designs. Trying to teach a principle or concept out-of-context makes learning unnecessarily difficult. Teaching a procedure without teaching when to perform this procedure unnecessarily handicaps performance. These are two very unfortunate and common design errors.

So, again, we begin with *context.* Under what circumstances is the learner to consider his or her options? What constraints must be considered? What's the situation?

Next up is *challenge.* What is the learner to do? Challenges are vital because learners are most alert and most carefully considering their options when there is a risk of not meeting the challenge. Of course, it's important to level challenges to individual learners so that they are neither too hard nor too easy. Because good e-learning is continuously tracking learner abilities, it can do a good job of selecting appropriate challenge levels.

To demonstrate their abilities, learners take action. Provisions must be made for actions to be taken, of course. And depending on the learner's abilities, we want decreasing restrictions and prompting. We want actions to be as authentic as possible, simulating or at least paralleling what and how actions would be taken in real-world performance.

Next, but not really finally, is the *feedback.* There are two types of feedback, intrinsic and extrinsic. *Intrinsic feedback,* perhaps better known as consequences, demonstrates to the learners what would happen if they really took the action they took in the e-learning experience. Intrinsic feedback is powerful and in most instances to be preferred, regardless of whether other feedback is also provided, because it demonstrates why an action was a good or bad one.

*Extrinsic feedback,* perhaps better known as judgment, tells the learner that the action taken was a good one or bad one. It may also explain why, but explanations rarely have the impact that witnessing the consequences has.

We haven't had a good conceptual vocabulary for describing and discussing instructional designs. But now, with these four components in mind (context, challenge, activity, and feedback), CCAF has become a functional framework for me. When I'm reviewing designs, I immediately look for these four components, that is, when they haven't been omitted; I study how they have been interrelated. I then have the means for talking about the design in a specific and constructive way.

***10. How would you compare* ZebraZapps Pro *to say, Prezi?***

*ZebraZapps Pro* has been compared to a lot of other tools because it incorporates many great concepts that are the sole focus of other tools. *Prezi* has impressive animated zooming. It helps focus viewer attention and if used carefully can help learners visualize overall concept relationships. As a presentation tool, it has fascinating (although sometimes stomach-churning) transitions. *Prezi* falls into the presentation tool camp along with *Keynote* and *PowerPoint*. You can create some interactivity with these tools to the limits, but the limits are there; and I find these tools inappropriate (or at least painfully limiting) to the serious instructional designer creating meaningful, memorable, and motivational learning experiences.

*ZebraZapps Pro* can be used to create and show presentations, of course. It does this with panache, in my view. But a huge regret in my career has been that *Authorware,* which was a tool very capable of creating great learning experiences, was too often used for fancy page-turning. It was important to me that *ZebraZapps Pro* would strongly encourage people to create true learning interactivity by making it the natural thing to do, even as a novice user. We'll have to see if this happens.

***11. You discuss "events." What exactly is your operational definition of an "event"?***

People suspect I chose this term instead of a more common, generic term such as page, because I was trying to imply something weighty. And they're right. Apple's dictionary defines an event as: *a thing that happens, especially one of importance.* How could there be a better word? Instruction, in my view, should always be constructed of a series of events—important happenings, not just pages of information.

***12. Having people view simulated consequences of their actions seems to me to be a type of executive functioning training—planning, thinking ahead, organizing, hypothesizing outcomes—am I off on this?***

In the most recent book of *Michael Allen's e-Learning Library, Learner Interface Design,* I added to the CCAF components notion mentioned earlier that connecting with learners individually leads to the greatest outcomes. This set out three basic tasks to guide designers. To help remember them, I refer to them as CEO:

***Connect*** with learners. Although context is a critical (and a too frequently omitted component), not just any context suffices. Since we must engage learners so they will attend and think, the context needs to relate to each learner. Unless you know your learner group is quite homogeneous, assume the context will need to be dynamically adjusted on a learner-by-learner basis. It's what you'd do if you were mentoring individuals. Think, in what performance-challenging situations might learners imagine themselves involved? Then, what unexpected performance-challenging situations might they need to handle? Start from familiar and graduate to the unexpected (if there are any).

***Empower*** learners. If you're learning to do something, you'd better be *doing things* while you're learning. The empowerment I refer to here is giving learners the means of taking actions, to experiment, and to witness consequences. Of course, these empowering requirements of performance-based learning were a major driver in the design of *ZebraZapps Pro*—to make providing a lot of activity in courseware practical.

***Orchestrate.*** Perhaps most directly to your question, authors need to pull everything together into a coherent piece. You have to consider what learners might do that an expert would never consider. Getting a list of frequent performance errors is one place to start. You need to find out what backgrounds your learners have and decide where to start individuals based on a means of identifying their experience and readiness. While the action/consequence paradigm seems to have a fair amount of automatic adaptivity and individualization in it, it is important to design a sufficient array of content so it has the means to adapt. And also the means to support varying amounts of practice.

***13. Where do social engagement apps and games fit in?***

An obvious, but easy-to-overlook fact: Nobody can *learn us.* We have to do the work ourselves. And learning is a form of work; it takes focus and energy. It can be fun, however, and quite painless. Games can help with focus and keep us energized for long periods of time, where without the fun and challenge they bring, our focus and energy would expire much more quickly.

Similarly, it's much easier to stick to an exercise program if you have a workout buddy or get together on a set schedule with a group of friends. You don't necessarily need these others to instruct you; you just need them to make it easier and more fun to do what you need to do. Same thing is true for learning.

I see the primary value of games and social learning as motivating influences. They help us focus and divert our attention away from the amount of time being consumed. And social learning can do more. Questions from other learners, for example, can reveal misunderstandings you didn't know you had. Sometimes a learner at your level can clarify concepts more clearly than can an expert. But in the end, each of us has to get active and practice meeting challenges. When games and social learning are designed to make this happen, they are terrific assets.

***14. Let's address some of the specs of*** **ZebraZapps Pro*****—Dynamic Branching and Master Pages—what is involved here?***

I'm continually impressed with the creative capabilities authoring system vendors introduce. There is very clever work going on with many tools. At the same time, however, I admit a lot of disappointment that too little of this work is focused on the tougher and more important needs of effective interactivity.

***Dynamic Branching.*** At the start of e-learning experimentation, the primary interest was overcoming the problems of delivering individualized instruction—instruction fitted to each learner's needs. As the number of simultaneous students a classroom instructor has rises above one, the ability to adapt learning experiences to each learner declines, and declines rapidly. Because e-learning applications responded to each learner individual, researchers saw the opportunity to achieve what wasn't possible through any other delivery.

Individualization comes from adjusting content and challenge levels in response to each learner's current ability. Based on accumulating performance information, is it time to jump or branch ahead? Should we branch to a parallel path that uses different examples? Does it appear we need to back up for some remediation?

Unfortunately, much of today's e-learning is simply content presentation, with no form of meaningful individualization. Although I think the problem is often routed in designers not giving this opportunity sufficient consideration, constraints of time and budget are often blamed. With our system, I wanted to provide authors with ready capabilities for individualization through dynamic branching so it would be much easier to provide if there were such aspirations.

*ZebraZapps Pro* has simple, friendly tables that visualize and control logic, answer-judging capabilities, and the dynamic properties of objects—interlinking and synchronizing changes. Together with the capability of events to call from pools of content instantly (our users know this facility as the *arenas*), dynamic branching has never been simpler to control and manage. I have to say, I'm extremely proud of this achievement, and we're working to give it even more helpful intelligence as we move forward.

***Master Pages.*** All presenters know the utility of master pages. They provide content to be repeated on multiple pages and formats that keep pages consistent. Make a change to a master and many systems will instantly update all pages using the master.

We provided this facility in *ZebraZapps Pro,* of course, but went a step further—and that has turned out to be of greater value than the original utility. As you pointed out, we speak in terms of *events* rather than pages because we hope something more than content presentation is happening. Authors can use events for static information presentation just like pages, if they wish; just know I'll be disappointed. And I should note that you can build spectacular presentations in *ZebraZapps Pro*.

But here's how *ZebraZapps Pro* masters differ: Each master is declared to be either a background or foreground master. It can be applied to all or any selected events in any combination with other masters. And, here's the *pièce de résistance:* masters can contain fully interactive objects.

For example, one master might provide access to a reference library. Another might provide history, scores, and progress information. And another might just provide background graphics and navigation buttons. Objects on masters can talk to any objects, anywhere, whether in other masters or in any event. For example, activities distributed across many events can adjust a single, total progress indicator that's on a master. Masters speed up and simplify development of potentially very complex interactivity, while also helping achieve visual consistency and easing updates and maintenance.

***15. New templates—enable learners to do what?***

Navigation templates now available in *ZebraZapps Pro* provide an instant framework for building everything from a model or quiz to a complete course of instruction with a home page, help information, reference access, and so on. It's very much click-and-go.

Our templates have a couple of unusual characteristics. First, authors can modify them easily and make them behave exactly as desired.

Second, learners can be working with multiple live interactions. Some templates present active thumbnails that zoom up large when the learner clicks them, while others automatically shrink and slide off to the side. The learner is able to observe simultaneous interactions (with animation and all interaction components active and updating) and deal with authentic complexity as is so often required in on-the-job performance.

***16. What do Event Flow screens assist with?***

As much as we strive for more of an adaptive conversation with learners (in contrast to a preset, fixed presentation), we do need modularization; and we do need ways for authors and learners alike to be able to browse through content; e-learning applications typically fail on *both* counts. *ZebraZapps Pro* to the rescue—at least, that's my intent.

Event Flow provides two scrollable stacks of images that are automatically generated from the author's events. The images scroll rapidly and show events in their default sequence. With the use of a clever split scrollbar, the author can alternatively see any two events side by side. Author access to content, even in very large courses, is incredibly fast and done with images that are large enough to review details. Authors can copy and paste events from one project to another, so teams can work simultaneously, use identical layout masters for consistency, and build applications quickly.

Any object in any event can both "talk" to any object in any event and also cause a branch to any other event, complete with smooth, author-controlled transitions. So the conversation with the learner can be as adaptive as the author wishes to make it. Event Flow manages data loading to keep interactions moving along quickly, even when heavy media are incorporated.

***17. Project Properties—what does this enhance?***

Pretty much everything in *ZebraZapps Pro* is an object that has properties. Objects can "listen" and "talk" about their properties. They can change property values in response to received messages. The project as a whole is an object as well and as such can do the same things.

For example, project properties include the current event name and number. If you want to show a different event, you need only change the name or number property and the program will go there instantly. It's pretty amazing that this is all there is to it. Properties also include transition specifications, including tweening options, so you can both tell the project where to go and with what visual effects.

***18. Now, for the uninitiated—what is a SCORM-***

***Compliant Learning Management System, or a Tin Can Learning Record Store?***

SCORM is a collection of standards and guidelines recognized and promoted by the U.S. Department of Defense to allow content applications, such as our applications, and learning management systems (LMS) to communicate and work together. Theoretically, at least, if applications follow the guidelines, they should be compatible with all LMS that also follow the guidelines. Tin Can is a major step forward in standards and technology that overcomes some of the restrictive limitations of SCORM. It is a technology that recognizes the support needed for mobile devices, for example. It recognizes that credit should be given for learning, whether it occurred under the auspices of an LMS or not, whether it was delivered via LMS or not, and so on.

Tin Can's Learning Record Store (LRS) is a place to store information about a person's learning experiences. These records may well exceed any of the information needed by a particular LMS, yet provide critical information needed for courseware to be more fully adaptive. They can feed multiple LMS installations at once, to provide credits across systems. *ZebraZapps Pro* was one of the very first systems to be Tin Can Compatible.

***19. What are the App and Gadget Shopps supposed to do?***

Recognizing all the challenges authors face in developing great applications and then delivering them to audiences, we've tried to go way beyond just providing a first-class authoring system. *ZebraZapps Pro* provides a publishing platform as well. It includes a place where authors can exchange inventions of their own—reusable objects, if you will.

We call them gadgets. Authors can turn anything they do into a gadget. It can be an hourglass timer, a clever drag-and-drop interaction, a live calendar, or really anything that can be built in our system using one or more objects. Authors can give their works away or set a price. The publishing platform handles all the collection and payments.

Similarly, if an author creates an application—do it yourself aids, interactive presentations on popular topics, or in-depth learning topics—and wants to charge for their use, the Shopps at *ZebraZapps.com* can accomplish this all with a few clicks. What we're trying to do here is recognize great authors, give them recognition, and send a few dollars their way, too.

***20. What other innovations have you been working on?***

I'm so excited about all the capabilities that our engineering team is developing! They have a host of major features in the works. Here are a few early glimpses (so as not to reveal too much; you always want to exceed expectations, of course):

***User browsing.*** As I mentioned earlier, one of the major and most annoying limitations of e-learning is the difficulty of rapidly browsing through highly interactive content just to get a feel for what's there and being able to jump around as you see fit. The Event Flow capabilities provide the fundamentals of this feature for authors and will soon be available for application users as well.

***Platform independent authoring.*** People want to provide maximum accessibility to their work and they want to take advantage of the unique capabilities of various player platforms. We're excited about a major initiative we have underway that will provide rapid, efficient execution of our applications on a wide variety of devices and also give users the opportunity to use the interface capabilities of those devices to full advantage.

***Stronger performance analytics.*** *ZebraZapps Pro* already has extremely advanced response analysis capabilities—more, I suspect, than any other non-programming development system by a long shot. But because we're extremely interested in adapting learner experiences to each individual and making it practical to do so, were looking at ways to neatly inform the application about the user—their needs, interests, and accomplishments.

***Multiplayer interactions.*** Cloud-based systems are uniquely suited for multiplayer games and team learning activities, both synchronous and asynchronous. In early versions of *ZebraZapps Pro* we experimented with such capabilities, even demonstrating responsiveness at the level of multiplayer Pong, with each player seeing the puck animated on their screen along with the other player's paddle movement. We are expanding the underlying facility for this to include online polling and concurrent user interactivity.

***21.* ZebraZapps *is a rather unique name, certainly quite different than the more self-explanatory* Authorware*. How did you come up with it?***

The name is definitely very unique, but there is a story behind it, and it definitely has significant meaning to us. As you know, we started with *Authorware*—which was a very popular software we created—that just so happened to start with the letter A.

Many years later, after the concept of *ZebraZapps* was born, it was time to come up with a name. Our lead development engineer—Steve Birth—said he wanted to have the product to start with the letter Z, so that we could say we've created software from A to Z. So the code name Z began until, luck would have it, my son, Christopher Allen, product manager for *ZebraZapps*, went on his honeymoon to Africa, where he went on a safari. One of the most amazing creatures he saw on the safari was a zebra, a word that began with the letter Z, and hence the beginning of our name took place.

After much talk, we chose *ZebraZapps*—the name of our newest software today. So just like codespeak—we went from A to Z, and we've created a software from A–Z. □

# Valerie J. Shute

## A Significant Contributor to the Field of Educational Technology

**Larry McCalla**

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***Contributing Editor***

### Introduction

On her Website at Florida State University ***(http://myWeb.fsu.edu/vshute/)***, Dr. Valerie J. Shute sums up her research agenda in just two words: "Enhance Learning." Since completing her Ph.D. in 1984, Dr. Shute has pursued this agenda with passion in diverse settings, including the military, industry, and higher education. She is recognized as a leader in the field of educational technology for her cutting-edge research and development into Intelligent Tutoring Systems (ITS), digital discovery worlds for learning, formative feedback, and most recently, the concept of stealth assessment. What follows is a glimpse into some of her most cited work along with her personal commentary on some of the issues surrounding it.

### Brief Biography

Dr. Valerie Shute grew up in and around the Washington, DC area. Her interest in technology was fueled in part by her father, who worked for the National Security Agency, and provided a home environment filled with the latest technology of the day. Her interests in the intersection of cognitive psychology and computers began in her undergraduate psychology program at the University of Northern Colorado, and extended into her educational psychology graduate program at the University of California–Santa Barbara, where Dr. Shute and her advisor there, Professor James W. (Jim) Pellegrino, conducted experiments involving "...computers measuring individual differences, and experimenting with the assessment and support of cognitive skills, such as spatial abilities" (V. J. Shute, personal communication, August 18, 2013). (Dr. Pellegrino is currently Liberal Arts and Sciences Distinguished Professor of Cognitive Psychology and Distinguished Professor of Education and Co-Director, Learning Sciences Research Institute (LSRI), at the University of Illinois at Chicago.)

After completing her Ph.D. in educational psychology in 1984, Dr. Shute held a two-year postdoctoral fellowship at the prestigious Learning Research and Development Center (LRDC) at the University of Pittsburgh, where she worked closely with Dr. Robert Glaser, the founding director of the LRDC. Subsequently, Dr. Shute worked from 1986 to 1999 at the Armstrong Air Force Research Lab at Brooks Air Force Base in San Antonio, Texas. While employed by the Air Force, Dr. Shute was involved in projects focused on building cognitive tutors and exploring early applications of virtual reality simulations.

She left Armstrong Lab to work in industry for two years, and then she joined Educational Testing Service (ETS), where she bolstered her already considerable psychometric skills while working as a Principal Research Scientist from 2001 to 2007. Currently, Dr. Shute is the Mack & Effie Campbell Tyner Endowed Professor in Education in the Department of Educational Psychology and Learning Systems at Florida State University, where she focuses on "...ways to enhance learning for all types of people, leveraging cutting-edge technology as possible." (V. J. Shute, personal communication, August 18, 2013).

### Major Contributions

It is difficult to sum up the career of any significant contributor to the field of educational technology in a brief article, and inevitably important contributions will go unmentioned. To provide a substantive overview of Dr. Shute's work thus far, we have decided to focus on three areas, formative feedback, intelligent tutoring systems, and stealth assessment. Anyone interested in other aspects of her research should visit her Website, where references to her scholarly work in areas such as mental models, Bayesian nets, and predictive analytics are provided.

#### Formative Feedback

A review of Dr. Shute's published research reveals a longstanding interest in how formative feedback can be used within digital learning environments to improve learner outcomes. Her most highly cited article (660 times according to Google Scholar) was published in the distinguished *Review of Educational Research* journal in 2008. For this paper, Shute took on the formidable task of reviewing "the corpus of research on feedback, with a focus on formative feedback—defined as information communicated to the learner that is intended to modify his or her thinking or behavior to improve learning" (p. 153). More specifically, she described how various types of formative feedback interact with learners to effect learning outcomes, and recommended directions for future research in the area of formative feedback (Shute, 2008). This extensive literature review concludes that while there is no general consensus on what constitutes the "best"

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formative feedback, there is agreement that feedback is most effective for conceptual and procedural learning tasks when it is specific and clear. Further, effective formative feedback is shown to be contextually dependent upon the learning task and learner characteristics. In order to operationalize formative feedback, the features of formative feedback are identified and described in terms of the effects on learners and learning goals. These features are:

- Verification
- Elaboration
- Feedback Complexity and Length
- Goal Directed Feedback and Motivation
- Formative Feedback as Scaffolding
- Timing of Feedback

In general, the qualities constituting the "best" feedback for a given learner are dependent upon certain characteristics of that learner. For example, research suggests that directive feedback may be optimal for learners new to a given content domain, whereas facilitative feedback may best serve those learners who have experience within the content domain. This suggests the idea that formative feedback can be used as scaffolding for instruction.

As the theoretical basis for formative feedback gains clarity with further research, new challenges and opportunities arise. Dr. Shute described in a personal interview the challenge that teachers face in knowing exactly how to optimally provide this feedback as follows:

> Feedback is important to learning (that's not disputed). But figuring out what to say, when to say it, and how to provide the feedback is the tricky part (thus explaining why it's not as widely applied as it should be). To make things even harder, feedback (a) comes in a variety of *types* (e.g., verification of response accuracy, explanation of correct answer, provision of helpful hints, etc.), (b) can be provided at various *times* during the learning process (e.g., immediately after an answer, after some delay), and (c) *interacts* with other variables to differentially affect learning (e.g., learner characteristics and aspects of the task). For teachers in the classroom (who are already overburdened), giving "correct" or "incorrect" feedback is much easier than trying to diagnose misconceptions or procedural errors and address those issues on an individual level. *But computers can be programmed to do this.* (Italics added) (V. J. Shute, personal communication, August 18, 2013)

Combining digital learning environments with research into formative feedback is one of the key characteristics of Dr. Shute's work. This invites a look at the important research conducted by Dr. Shute and Dr. Robert Glaser in the late 1980s and 1990s, when Dr. Shute worked at the Air Force Laboratory at Brooks Air Force Base.

## Intelligent Tutoring Systems

Anyone involved in the field of educational technology in the 1980s will recall the enormous excitement about the potential of artificial intelligence applications in education at that time. Dr. Shute and her colleague from the Army Research Institute, Dr. Joseph Psotka, published an influential review of Intelligent Tutoring Systems (ITS) in 1996 that has been cited more than 300 times according to Google Scholar. The development of ITS can be traced back to the 1970s, when problem generation and knowledge representation were key characteristics of the developed products. During the 1980s, case-based reasoning systems, discovery worlds, and interactive simulations emerged as exemplars of ITS. In the 1990s, learner control, collaborative learning, and situated learning began to be integrated as more refined components of ITS. During this period, cognitive tools moved to the forefront, and increased levels of learner control were more widely adopted (Shute & Psotka, 1996). Among the benefits of ITS on learning outcomes, ITS often gave learners a more efficient route to understanding new concepts by allowing them to gain experience in applying a concept more quickly than with traditional instructional methods. Shute and Psotka (1996) recommended evidence-based approaches to the design and evaluation of ITS, and including considerations of environment, knowledge domain, and learner characteristics in ITS designs. A systematic evaluation method for ITS was proposed to include several components:

- delineation of goals for the tutor,
- delineation of goals for the evaluation,
- matching the appropriate design to stated goals,
- pilot testing, and
- concurrent planning of primary data analysis and general planning of the study.

A still resonant appeal of the Shute and Psotka (1996) report was the call for more systematic research into ITS in order to keep pace with the ever-increasing availability of computational power and to develop the practical and theoretical knowledge necessary for the best possible applications of ITS in education and training.

*Smithtown*, a discovery world designed, developed, and researched by a research and development team led by Dr. Shute and Dr. Glaser, is an ITS with the main goal being "...to enhance students' general problem solving and inductive learner skills" (Shute & Glaser, 1990, p. 53) and to foster learner skill relating to scientific inquiry, as well as knowledge of the basic principles of microeconomics. In this guided discovery environment, students generate and test hypotheses by manipulating environmental variables and noting the effects. The students can approach the game informally—simply exploring the game world—or they can use the more formal experimental approach in their investigations. The game keeps track of their activities and displays them to the players in a variety of dashboard windows, such as student history, market history, and goal history displays. Key findings from this research illuminated successful and not so successful approaches used by students to "win" the game. For example, hypothesis-driven behaviors such as thinking and planning skills correlated with more successful learners, whereas "...less effective subjects seemed to be limited to a more data-driven (or bottom-up) approach, often falling short of grasping the bigger picture" (Shute & Glaser, 1990, p. 73). A strength of this ITS is that it can monitor and maintain statistics on students' systematic and non-systematic behaviors and adapt to provide more detailed feedback and scaffolding for the students who need it.

Given that *Smithtown* was developed and used for research in 1990, it is not unreasonable to wonder why this instructional approach is not used more ubiquitously in mainstream public education today. In response to this question, Dr. Shute points to a lack of empirical research into the efficacy of these kinds of games, and a reliance on “old-school assessment formats” that rely on familiar, easy to administer, multiple-choice testing formats (V. J. Shute, personal communication, August 18, 2013). Perhaps the biggest obstacle in 1990 was that technology had not yet caught up to the vision of such a game-based learning environment, whereas today performance-based assessments can be less costly to administer and score when using learning games and simulations. Learner data can be gathered and analyzed in real time, and results from this analysis can be used to adapt the instruction for the learner moment by moment as game-play unfolds. The concurrence of research into these kinds of ITS learning environments with increasing technological capabilities allows these kinds of individualized teaching systems to finally reach much more of their potential, as has been anticipated in the academic literature for decades.

### Stealth Assessment

Most recently, Dr. Shute is known for her original conception of stealth assessment and her belief that games and ITS afford the ability to measure player/learner behaviors and respond to them in a way that is embedded in gameplay naturally and unobtrusively. Determining which game variables to define and measure is a part of the process of evidence-centered design (ECD), where the game elicits behavior that informs the establishment of competency models describing “...the set of knowledge and skills on which inferences are based” (Shute, Rieber, & Eck, 2012, p. 328). As variables are identified that reflect competencies that relate to the learner tasks and goals, the game can monitor them while adjusting to individual learner needs as well as predicting learner needs with probabilistic inference via Bayesian nets. Collecting and using this kind of data without the learner explicitly knowing that the data collection is occurring might raise ethical issues, but Dr. Shute summarized a case for stealth assessment that should allay these concerns:

> Stealth assessment, as I define it, is purely formative—with the goal of enhancing learning (as opposed to serving as judge and jury as with summative types of assessment). Like playing any game, you get copious feedback along the way. The same deal holds with stealth assessment—only instead of reporting on your health and weapons status, it is reporting out on your persistence, problem solving skills, etc. (complete with evidentiary arguments, if desired). Again, it is not intended for high-stakes purposes, thus reducing (or removing) ethical concerns (unless one is ethically opposed to support of learning) (V. J. Shute, personal communication, August 18, 2013).

This formative, learner-centered feedback approach to learning assessment could be an alternative to the high-stakes summative assessments wielded by public school districts around the United States. The real power of stealth assessment might not be its stealthiness, but the embeddedness of the assessment, which allows learner states and experiences to be measured, assessed, and shaped in real time—especially within the context of learning games, simulations, and cognitive tools. To summarize the potential of stealth assessments, Shute and Ventura (2013) wrote:

> In the more distant future, we can foresee dynamic and unobtrusive assessments being used in classrooms as well as outside of school. The data from these assessments may be aggregated into rich and valid profiles of students, reducing (or removing) the need for the teach-stop-test model that has governed classroom instruction for too long. (pp. 69–70)

## Conclusion

Dr. Shute’s scholarship demonstrates a sustained passion for assessment that provides formative feedback designed to help learners learn. From her early days working with Jim Pellegrino to measure individual differences and to support the development of cognitive skills, to designing and researching discovery learning environments with Robert Glaser, to her current focus on stealth assessment within games and simulations to create engaging and adaptive learning environments for learners, Dr. Shute consistently creates and tests innovative ideas that benefit both other researchers and the vast population of learners deserving quality educational experiences. Anyone who meets or speaks with Dr. Shute will come away with excitement and enthusiastic anticipation for her research. It is not surprising that her work as been featured in popular press outlets, such as National Public Radio (Chaplin, 2010), the *Chronicle of Higher Education* (Kaya 2010), and *The Washington Monthly* (Tucker, 2012). One question remains: “What’s next, Val?” □

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Interviews with

# Badrul Khan

## Interview with Nobel Laureate Prof. Muhammad Yunus

*I was fortunate to be invited as an e-learning keynote speaker at the Digital World 2012 International Conference (**http://www.digitalworld.org.bd/speakers/**) held at Dhaka, Bangladesh in December, 2012. During my visit there, I had the opportunity to meet Dr. Muhammad Yunus, the Nobel Laureate, at the Yunus Centre. My meeting with him was a most insightful experience. We discussed education in the digital world, and I was impressed and inspired to see his genuine interest in improving education and healthcare using low-cost learning technology. He shared how technology can improve the conditions of citizens in developing countries. I have interviewed many individuals in my life, but sitting down with Prof. Yunus and speaking with him in my own local dialect was especially memorable, as we are both from Chittagong, Bangladesh, and studied in the same educational institutions at different periods: Chittagong Collegiate School, Chittagong College, and the University of Dhaka in Bangladesh. Our discussion of how to improve the lifestyles of people in developing countries was so cordial and satisfying that I wanted to stay longer than my one-hour meeting time, but Prof. Yunus was scheduled to meet and discuss the social entrepreneurship model with students from St. Cloud State University in Minnesota, right after my meeting. I was excited when he asked me to attend the discussion. He eloquently answered students' questions and concerns regarding sustainable entrepreneurship.*

*While discussing low-cost learning solutions in the digital world, I noticed something fascinating: Not only did Yunus show enthusiasm for this idea, but also he demonstrated his passion to make the world a better place. He appeared to me as an accomplished, compassionate individual who genuinely supports low-cost, open learning. He is a proponent of high-quality Massive Open Online Courses (MOOCs). I was amazed at his wide understanding of this interest, and I was also impressed to see the level of thought and awareness of implications of the concept of low-cost learning tools. It was refreshing to see someone whose area of expertise is microfinance and social business show such an engaging interest in digital learning.*

*As an educator, I always wondered what it would take to help individuals become lifelong learners and how to make learning sustainable. I personally believe that the knowledge base from disciplines outside of education should be explored, and these may provide valuable insights into sustainable educational development. I have also wondered what makes "learning that will stick." This type of learning is different in that the learning will provide benefits that last a lifetime—information that is not easily forgotten. My quest for sustainable learning development was answered when I heard Prof. Yunus speak about social business and its sustainability. He described social business as a mode of representation for people to express their individual spirit—it allows people to get involved and find their own way of making a positive difference. When I was listening to Dr. Yunus, I was constantly making connections between critical factors of meaningful digital learning and his sustainability principles in social business. After this discussion was over, I wanted to incorporate his ideas of social business sustainability into my e-learning framework (**http://BadrulKhan.com/framework**) to publish a book; he generously agreed to co-author a book with me. The proposed book will showcase and draw from work on Sustainable Social Business Entrepreneurship perspectives, applicable to my eight dimensions of the e-learning framework, and will be*

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*__Muhammad Yunus__ was born in Chittagong, Bangladesh, and educated at Dhaka University. He was awarded a Fulbright scholarship and received his Ph.D. in economics from Vanderbilt University in 1969. The following year he became an assistant professor of economics at Middle Tennessee State University. In 1972 he went to the economics department at Chittagong University and became the founder and managing director of Grameen Bank. Yunus and Grameen Bank are winners of the 2006 Nobel Peace Prize. He has received global recognition for his efforts to combat poverty and is nicknamed "Banker to the Poor" (__http://www.nobelprize.org/nobel_prizes/peace/laureates/2006/yunus-bio.html__).*

*__Badrul H. Khan__, a Contributing Editor, is an author, educator, and consultant in the field of e-learning. His 1997 best-selling book, __Web-Based Instruction__, was important in paving the way for the field of e-learning. In recognition for his work in this field, the Egyptian E-Learning University Council has appointed him an honorary distinguished professor of e-learning. He has held faculty positions at the University of Texas and the George Washington University (Website: __www.BadrulKhan.com__). He acknowledges the assistance of Anika Alam, a student of Policy Analysis and Management, Cornell University, for this interview, who collected and analyzed Dr. Yunus's social entrepreneurship principles applicable to educational sustainability; for the purpose of this interview, various documents about the Yunus perspectives on digital technologies were reviewed.*

Prof. Muhammad Yunus is presented with the Congressional Gold Medal for his efforts to combat global poverty. He is the seventh recipient of this prestigious award; other honorees of the award include Mother Teresa, Martin Luther King, Jr., and Nelson Mandela. Presenting the award are Rep. Nancy Pelosi, Rep. John Boehner, and Sen. Harry Reid at the U.S. Capitol.

*titled "Sustainable Education Development in the Digital World" (**http://www.igi-gloal.com/newsroom/archive/igi-global-bestselling-author-badrul/1443/**). This book should contribute to a new vision of learning and development in the digital world.*

*In April 2013, I met Dr. Yunus again, in Washington DC, and discussed sustainable education development. Some of the highlights of our conversation are presented below.*

**Khan:** Your social business framework has been used as a model by thousands of companies and organizations around the world. What are the attributes of this model that sets it apart from other business ideas?

**Yunus:** Grameen Bank has harbored social business as a conceptual framework dedicated to solving social, economic, and environmental problems that have long been troubling humans—hunger, homelessness, disease, and pollution. There is no formal set of requirements of a social business framework; there is a simple concept associated with this model, which is to bring a humanistic view to the business world. What makes this model so universal is that it allows flexibility, and it enables people to achieve profits while solving a social problem at the same time. Ultimately, social business widens the scope of free choice, rather than narrowing it. It offers hope to millions of entrepreneurs and customers who want to make a social change in the marketplace. Social business can also help governments be responsible for social change as a stakeholder in society, endorsing corporate social responsibility.

**Khan:** We understand that your social business model is sustainable in various public sectors, especially education. What are the basic, transferable criteria from social business which can be utilized in long-term education development?

**Yunus:** The first criteria of social business is to let people release their entrepreneurial spirit. Social business is a new and exciting form of expression—there is no right way to do it. It provides an outlet for the creativity that millions of people already carry the potential for. It is open to people who may not feel comfortable with the restricted, one-track road to profit, while still being open to traditional business makers. Nobody is excluded from starting a social business. Similarly, education development can easily be rooted in creative startups. Uploading videos and clips of lectures is one example of making learning a sustainable process. There are also many accessible and readily available resources which can accommodate you in reaching your goals. The more you do it, the more sustainable your knowledge. There are limitless ways to transfer information from producer to consumer, and people can achieve this via for-profit or non-profit purposes. In social business, everyone is welcome to find the roles that work for them. The most important thing is to get involved and to find your own way of making a positive difference in the world. Another criterion that is applicable to education development is that it offers an opportunity for individual renewal. It is a great learning process where humans can explore a new world that was totally unknown and help solve a social problem at the same time. Social business can help governments be responsible for social change as stakeholders in society, endorsing corporate social responsibility. This addition to education sustainability can be especially beneficial because there are millions of companies and organizations worldwide who want to promote education development.

**Khan:** Technology is playing an increasingly large role in daily communication for everyone around the world. How can this be of advantage to education development in the future?

**Yunus:** As I mentioned in an interview years ago with CNN (***http://money.cnn.com/2008/04/01/technology/muhammed_yunas.fortune/***), technology is making more changes in our way of life than ever in human history. Technology is an advantageous universal mechanism that eliminates physical barriers between two persons, allowing limitless information to be transmitted. Even as we are becoming increasingly reliant on technology to meet our daily needs, there are still many people around the world who are deprived of these benefits. These technological innovations are flawed in the sense that they do not reach out to the poor. In my book, "Creating a World Without Poverty," I emphasize the need to create new tech tools which will directly benefit the poor. With this pressing need to reach out to the poor worldwide, it will also attack another social problem—education. If given the proper tools and resources to those who were not privileged with technology, not only will it improve their lifestyle but also it will be a teaching tool. Building teaching tools for the poor will benefit both parties—not only will they have readily available access to information and help tools, but we will also have the opportunity to learn from them and see what information they can provide us.

**Khan:** Where do you see education development in the next five years?

**Yunus:** I see education development strengthening enormously. With the Internet in the reach of one's hand, there can be a mutual relationship between producers and consumers based on the exchange of information. Through this form of communication, you become a contributor to the knowledge base. You're not a beggar if you give back; you are a recipient of knowledge, and you are giving back. Sustainable education is a form of expression, and one has to know how to use these resources continuously to sustain new knowledge. If you learn more and contribute more, you have been transformed from the recipient to the contributor. I hope to see the mutual exchange of information move to a high level, where learning information will benefit people for the rest of their lives. It will be something that will be readily available and transferable.

**Khan:** What is your view on the use of information and communications technology tools in rural areas?

**Yunus:** I believe that information and communications technology (ICT) tools are the basic infrastructure for development and sustainability. Access to ICT tools can dramatically change the fate of the poor. Mobile devices with Internet connectivity are especially promising in the sense that they can help integrate the poor into the mainstream economy by extending their market. It can empower the poor by giving them access to information, programs, goods, and services which will improve their lifestyle. Knowledge is a powerful weapon—it helps them deal with their life struggles and helps reduce poverty immensely. In the past, Grameen Bank has provided ICT in rural parts of Africa and other regions.

**Khan:** What do you think about the development of low-cost mobile technology tools, such as mobile phones for education and other aspects, for the citizens of developing countries?

**Yunus:** I 100% agree that low-cost tools would be very beneficial for developing nations. If these tools are utilized appropriately, they can help create effective learning solutions and can revolutionize the educational system in developing countries and beyond. It is revolutionary in the sense that it could be shared not only among the mass population but also with older generations who were typically lagging behind in using such tools. Once they see the various functions and utilities of these technological tools, it will create interest and excitement among the older generations as well—to the extent that they might even compete with the younger generations in usage. However, it is important to keep in mind that the delivered content from these low-cost tools must be well-designed and meaningful. Low-cost learning solutions are therefore not only useful in education, but also in training. Mobile tools such as cell phones can provide greater opportunities. I am interested in the idea of rural populations using mobile devices to receive information and become knowledgeable so that they can improve their health conditions. They would also be able to transfer their knowledge and share it with others, improving their careers, health, business, financial decisions, and more. A great way to support human resources development globally! □

# Looking Ahead Looking Back

## Denis Hlynka

## What's the 'Big Idea'? A View of Technology

One of the recent contemporary concepts in teaching and curriculum is that of the "big idea." A "big idea" is clearly defined by Wiggins and McTighe[1] as not a concept, not a question, not an objective, but rather a kind of culminating sentence of what one is trying to express. These ideas seem to be tied to essential questions and learnings.

Educators are always looking for ways to be precise and accurate about what we expect from students. In recent memory, the classic small programmed text from 1962 by Robert Mager called *Preparing Instructional Objectives*[2] was one of the first guides to such precision. Today, some argue that this approach is as good a starting point as any other, while others feel that Mager has had his day, and we need to move onward, upward, and towards something bigger and better.

I like the idea of " big ideas," though I do not care for the accompanying jargon. I also feel that the phrase is just a little condescending. To me it sounds like the way you might talk to an eight-year-old. I also balk at the suggestion that a "big idea" in the minds of Wiggins and McTighe cannot be written as a question, an objective, or a concept. Actually, according to the Merriam-Webster dictionary, an "idea" has several definitions, including a concept, a thought, or a construct.

Nevertheless, let me wipe away all of my objections for the moment, and turn to what every faculty, school, or college of education offers, namely a course that is optional in some universities, required in many more, but always on the front burner of any faculty, school, or college of education.

In the basic *Teacher and Technology* course offered at my university, I attempt to break down myths and misconceptions about educational technology. I am told that my approach is apparently different from most similar courses, which tend to be heavier on "new technologies," "social technologies," and the

[1] Wiggins, G., & McTighe, J. (1998). *Understanding by design.* Alexandria, VA: ASCD.

[2] Mager, R. (1962). *Preparing instructional objectives.* Belmont, CA: Fearon-Pittman.

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“technical” skills of using these, while my version focuses on theoretic, cultural, philosophical, and historical underpinnings

So, here are the “big ideas” that I use to focus my course at the University of Manitoba. While they may seem common sense, in fact they are often exactly the opposite of what is often the focus of many such introductory “teacher and technology” courses.

**Big Idea #1: Technology is not new.** Students need to immediately break the myth that suggests that technology is computer-based, or that it is an artifact, program, gadget, or app that was invented since the beginning of the 21st century. In pre-course surveys, almost every one of my students initially thinks of technology as narrow, computer-based, and “new” tool-oriented. On the contrary, my students learn that technology has been around as long as civilization itself, and classic educational technologies (as artifacts) include books, pencils, writing, and even language. *This is a critical opening salvo in understanding educational technology.*

**Big Idea #2: The two broad purposes of educational technologies are information and communication.** Together they form information and communications technology, often called ICT. These two functions too often get mixed up. The term confuses more than it helps. At least in the field of teaching and learning, it is essential to see that there are two distinct kinds of educational technologies: those that hold and contain information (DVD, video, books, etc.) and those that contain no information, but transmit it (telephone, pencil, mobile phone, e-mail, etc.). The former are information technologies, the latter are communications technologies. Of course, there is the inevitable technological convergence. Some technologies try to be all-purpose tools, and do everything. What happens when your mobile device is your primary communicator, your major information source, and your personal organizer all in one? The famous Swiss Army Knife with some 87 implements performing 147 functions is the ultimate low-tech equivalent. It needs to be noted that, for all its promise, the Swiss Army Knife, while a curiosity, is hardly ubiquitous.

**Big Idea #3: There is no master medium.** There is no one best way. We are seemingly wired to seek the one solution. Today, in the second decade of the 21st century, we seem convinced that the mobile phone/smartphone is the thing that every student needs. Others think that the interactive whiteboard (smartboard) is the universal tool. Still others think it is the Internet.

Once it was educational television that was expected to change pedagogy; before that it was radio. The classic story is of Archimedes and his king Ptolemy. Ptolemy, the story goes, wanted to learn mathematics, for which Archimedes was famous. So Archimedes became Ptolemy’s tutor. But the king soon got tired of the work involved and the effort that had to be made. So he asked Archimedes whether there might be a shortcut. Today we would ask for a Coles Notes or CliffsNotes version, or in the online world a Spark Notes version. To which Archimedes famously replied, “Sire, there is no royal road to learning.” Some say that the line was “no royal road to mathematics,” and there are other versions as well. But the essence is the same. There is no shortcut, and there is no one best way.

All media have their place and their potential. The elusive search for one best way or one best medium is doomed to failure.

**Big Idea #4: Blogging is a quintessential 21st century communication form, and ideally suited to contemporary pedagogy.** Academically blogging takes the place of the term paper; socially blogging takes the place of the diary. Term papers are typically to be read only by the professor or the marker; diaries are meant for the creator’s eyes only; but blogs invite and indeed require interaction with the world. Classroom blogs from about middle years through to adult are new ways of providing classroom interaction. Because blogging as an extension of the classroom is still relatively new, one can hardly disdain certain uses as “wrong.” Nevertheless, some uses would seem to be counter-productive to the potential unique contribution offered by blogging.

In the case of blogging, there are at least two uses which seemingly miss the mark. One is the almost direct transferring of a formal paper into a blog format, complete with formal justification and logical backup, APA styleguide, perfect spelling and grammar, and the like. These kinds of blogs tend to be onerous and boring to all concerned. A second common use of classroom blogging that misses the mark is using it for nothing more than chatter, linking to YouTube videos, and putting up personal pictures. This likewise diffuses the potential. To me, a “classroom blog” should be an opportunity for students to interact with course content and with each other. In such a blog, everyone gets a chance to comment and let their thoughts and questions be made public for the entire class. This has never been possible before.

Traditional class discussions, even effectively managed ones, are limited to a few speakers. In blogs, *everyone* participates in the discussion. If a class consists of 35 students, then there are 35 blogs all going at once. This has never been possible before. Classroom walls are broken and bridged. A course spills over far beyond the confines of the narrow time and space of an enclosed classroom.

**Big Idea #5: Technology is ubiquitous.** It is everywhere. One cannot avoid technology. It is useless to fight technology because it is *always* there, and wherever you look it is *already* there. Philosophers such as Jacques Derrida like to use the phrase “always already.” The problem occurs when we perceive technology narrowly (as only computer based, for example). Of course we use technology.

**Big Idea #6: “The essence of technology is nothing technological.”** This famous line from Martin Heidegger attempts to argue that the essence of technology is not found in things or machines or stuff, but in human beings.

**Big Idea #7: Technology is personal.** We do not all need or want the same technology. Nor do we all read the same books or see the same movies. Certainly there is some commonality, but the idea that “everyone needs one” is simply not true. Every technological artifact is simply a piece of the larger puzzle of learning. Things will click into place. They will be useful when the user needs them. I give you some of the pieces. You put them together.

**Big Idea #8: Technology is ill-served by hype and advertising and rhetoric.** Far too often, technology is hyped to such a level that only a crash can follow. We are bullied and intimidated into being high-tech technology enabled. Anyone who dares not to follow the hype is called a mere “digital immigrant," or a "Luddite," or a "late adopter," or a "techno-peasant." On the contrary, such individuals should be congratulated, encouraged, and called thoughtful, brave, straight thinkers, and admired as not being lemmings. To negotiate one's way through the language of contemporary marketing is not easy. To separate false claims from bona-fide positives is as difficult a task as one could ask for.

**Big Idea #9: Ockham's Razor.** Educational technology follows the principal discovered by the medieval monk William of Ockham. When there is a choice between two options, chose the simplest, the one with the least corrections or add-ons or changes. The modern version of Ockham's Razor is the inelegantly but accurately described KISS principle: Keep it Simple, Stupid!

**Big Idea #10: The medium gets confused with the message.** Hence, Marshall McLuhan's cryptic phrase that the medium IS the message. The power of his phrase has proven to be elusive, and still only partly understood. Philosopher Jean Baudrillard has called "the medium is the message" the first great formula of the new age. We need to understand the impact of this concept.

## Conclusion

These are all big claims, or "big ideas." A basic course for teachers is inauthentic if it demonstrates technical skills without presenting the whole picture. A basic teacher education program is equally inauthentic if it hides technology behind the curtain of "infusion" and "integration." To understand technology, it is critical to pull it out from its hiding place and to examine it on its own ground, to marvel at its strengths and promises, and to expose its threats and weaknesses. Marshall McLuhan famously pointed out that "we don't know who invented water, but it certainly wasn't a fish." The point is that we are so immersed, so infused, and so integrated into the technological way of thinking that we cannot negotiate or navigate within that maelstrom.

These, then, are the goals for my courses; these are my "big ideas" that I hope students will begin to accept. I am content to say *begin*, because technology is complex and fuzzy and full of contradictions. For too long technology has been treated with reverence, and we are now beginning to see that technology is a two-sided coin. In fact, technology has even more than two sides. The multiple contradictions of technology are the contradictions of humanity.

This is my set of "big ideas." This is my manifesto. Technology is here to stay. From the beginning of time, humanity has struggled to understand the world we live in. Whether through science, the arts, technology, or religion, we are still trying. As technology explodes at warp speed, sciences get stronger, the arts become more dynamic, and even once stable religions change and morph into new ways of being ethical.

That is what I want my students to learn in their first course in educational technology. Whether it is called mission, goals, objectives, or "big ideas," it is imperative to think out what is really important, as technology continues to bombard the gates of learning. □

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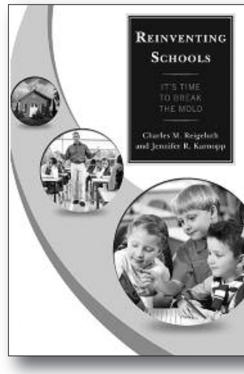
***Acknowledgments.*** *Special thanks to my students of the fall 2013 cohorts, whose constant questions inspired this column.*

# Book Review




## Proposing a New Paradigm of Education for 'Information-Age' Students and Schools

*Book Review: Charles M. Reigeluth and Jennifer R. Karnopp.* ***Reinventing Schools: It's Time to Break the Mold****; Rowman & Littlefield; 162 pages; 2013; $20.95 (hardcover, $50.00; e-book, $19.99).*

## Reviewed by Michael F. Shaughnessy

Charles M. Reigeluth and Jennifer Karnopp have written a book that should be read by educational leaders sincerely and devotedly concerned about the future of education in the 'Information Age' and enhancing the thinking skills of their students.

This book starts off by declaring that "The U.S. Education system is under fire for many reasons" (p. 1), and the book discusses some of these. We are using an older model or paradigm of education, the authors note, preparing kids for the industrial world of the past, rather than for the world of the future. The problem is that no one knows exactly what kinds of skills, abilities, knowledge, and information will be needed in, say, 2025.

Certainly, the U.S. education system is being criticized—as well it should be—and the reasons for the decline of the American educational system can be found in many places—the culture, the family, movies, violence, and the like. The authors tangentially refer to some of the problems, but they never attack them head-on. Instead they focus on the thinking skills, reasoning skills, and processing skills that might bode well for future generations.

The authors delve into several areas: the case for fundamental change (yes, we all agree that change is needed, but who is going to provide the leadership?); a vision of 'information-age' education (yes, let's all try to predict what kids are going to need in the year 2025); and they provide some successful examples of the new paradigm in practice (thanks to charter schools and

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private schools willing to take some risks with education and learning). A chapter on "how to get there from here" is provided but leaves one with questions as to who will fund all this—the government of the United States of America is now in debt for about 17 trillion dollars. Their suggestions, however, are not fiscally dependent but focus more on the re-training of teachers to focus on thinking skills rather than rote learning.

A chapter on "what governments can do" is almost superfluous—having been involved in education since *A Nation At Risk*, I have seen very little done by the government, other than to make things worse.

One Appendix ponders the question "So What if Paradigm Change Takes a Long Time?" This is one of those questions upon which much change hinges. It is going to take a *long time* to retrain teachers—to get teachers into the 'Information Age'—and to ascertain what skills are going to be needed in the future.

I know that things are going to change, but the issue is, can we assist with some of those changes so that change happens in a more efficient, effective manner? That is the real question. There are some idealistic ideas embedded in this book and some tools for paradigm change—providing mentors and a nurturing environment, and who could argue with those lofty goals? And, like many other reform books, the authors seem to neglect the ever-increasing population of students with special needs and exceptionalities.

While this is a good book, the authors neglect to mention the Common Core juggernaut which is impacting schools, curriculum, and teachers as well as contributing to stress across America.

I should also mention the behemoth of standardized testing that is impacting America and which "drives" instruction, remediation, and pedagogy. In addition, teachers are confronted with the nightmare of AYP (Annual Yearly Progress) that they face in the schools as well as all the legalities regarding children with special needs that are now entrenched in American schools.

It seems that the legal system has also become entrenched in our American educational system, causing schools to focus more on being "in compliance" than in educating for higher-order thinking skills, critical-thinking skills, or mentoring students with potential. I suspect that some superior teachers may read this book and understand the "new paradigm" that the authors are talking about. I would hope that some enlightened principals and educational leaders would absorb some of the core ideas of the book, such as "an attainment based system" and "learner centered instruction," and try to adopt a "nurturing school culture."

Perhaps some principles of this book would be adopted by school boards (some have already), such as a different mindset (as written about by Carol Dweck) and consensus-building principles and technology. Apparently some schools have already adopted some or all of the principles and ideas expounded upon in this book. An Appendix provides a list of such forward-thinking schools. The book itself contains many Websites helpful in the revision process or the adoption of a new paradigm or at least a modified paradigm.

I suppose if one had lots of enthusiastic teachers and the desire to open a private or charter school, this book might provide a nice handbook on how to proceed. However, for most public schools today, the authors offer idealistic ideas, but not necessarily viable, feasible, do-able, or work-able solutions in the current *zeitgeist* of testing, testing, and testing. But truly progressive, charter, and private schools could benefit greatly from some of the ideas in the book. □

# *Educational Technology Classics*

## The Generalist: Vanishing Instructional Developer

### J. Warren Anderson

An inevitable, yet disturbing, trend in graduate training of instructional developers is the push toward increasing specialization in one or another instructional category. The intent of the following comments is to provide some balance to this trend, and, at the same time, to express cautiously, yet optimistically, the view that some room be left for the role of the generalist-instructional developer.

If ever there was a person who needed to be a jack-of-all-educational-trades, it is an instructional developer. He must be instructional analyst, designer, evaluator, and researcher all rolled into one.

Some view instructional development, and rightly so, as a team effort where the contributions of several instructional specialists are focused on creating instructional conditions that effectively facilitate learning. Accordingly, we might coordinate the special skills of task and learner analysts, instructional designers, and the recent breed of educational evaluators, and throw in a psychologically trained researcher and change agent for good measure.

If one can assemble this sort of development team, fine. It may strain the institutional budget somewhat, but some great development probably is in the institutional future.

Now let us become a little more realistic about two approaches to instructional development—the single developer and the development team approaches—and see what each implies for the role of the professional developer.

First, let us dispel the myth that a team of instructional specialists will soon come one's way. The institutions that can financially support in excess of one or two such specialists are few indeed. These people are entering the job market with doctoral and specialist degrees and now command salaries which may be somewhat out of proportion with what they can reasonably be expected to deliver in instructional returns. In any event, present fiscal realities suggest that the kind of money needed to launch serious instructional research and development teams simply is beyond the pocketbooks of all but a few institutions. This is true now and

*This article appeared originally in this magazine in June, 1972. The author, **J. Warren Anderson**, at that time was a graduate research fellow in instructional systems technology at Indiana University–Bloomington.*

there is little reason to anticipate significant improvement in the near future.

What this means for instructional development is fairly clear. Colleges and universities, if they go the development route at all, will be forced to do so with one or, infrequently, two full-time developers. Some universities may field large teams if the specialist members take joint appointments that involve additional academic or administrative activities elsewhere in the university. This arrangement eases the purse strings but carries with it the very real danger that team development activities may suffer, particularly if joint appointees find that promotion appears to hinge on their nondevelopmental pursuits rather than on their developmental success.

I have heard one argument that calls for the training and placing of specialists in the superb teams that now exist at eight or ten of our largest universities. This strategy suggests that educational products and replicable instructional processes be developed at these sites and packaged for dissemination to other colleges and universities, where a developer-generalist would implement them. This idea preserves development roles for generalists and specialists, and makes fiscal sense—but probably would not work. Whatever the reasons are that prevent departments within the same university from sharing jointly development courses, their effects are even stronger between different colleges and universities, so that amortization of development costs over several institutions seldom occurs.

My concern in this short article is that some of our finest graduate programs in instructional technology are selling short the role of a desperately needed professional—the generalist-instructional developer. When trained *generally,* in the best sense of the word, the generalist-developer fills a vital role, whether in an individual or team setting.

To illustrate the role of the developer among a team of instructional specialists it is necessary that we examine the definition of instructional development. If we disregard for the moment differences in educational jargon, we recognize that most people view it as the over-arching set of activities whose result is the facilitation of learning. Any individual who goes by the title *instructional developer,* by definition, must be aware of and have authority over all such activities. If this seems an unrealistic role, perhaps our conception of instructional development is at fault or maybe we are suggesting that only managers or project directors qualify as instructional developers in team settings. In either case, a special set of skills is called for.

The role of the lone developer is complicated by his relative isolation from instructional specialists. He may find himself in the awkward position of doing the specialty tasks and, unfortunately, doing none of them very well. Even more tragic is the specialist-gone-developer who is so enamored with his specialty training that he tends to ignore the other important activities in development.

Unless I am being extremely inaccurate, it appears that many, perhaps most, instructional developers are not instructional developers at all. They are instructional specialists who are finding their way into an as yet generalist profession. It seems obvious that consumers of the development process are judging the potential of instructional development by the professionals we now field from specialist graduate programs. ☐

# Point of View

## Education for Innovation: Beyond ‘21st Century Skills’

**Marlene Scardamalia**
***Contributing Editor***

**Carl Bereiter**

### The Innovation Imperative

The Organization for Economic Co-operation and Development (OECD) has started referring to contemporary societies as “innovation-driven.” Innovation is becoming recognized as not just a priority for individual organizations but as an imperative for whole nations and regions. At the same time, it is becoming recognized as an educational imperative. Governments can do only so much by establishing innovation centers, providing stimulus funds, and removing barriers. Beyond that it depends on the innovativeness of the people.

Improving human capacity for innovation represents a huge educational, child rearing, and even cultural challenge. It ought to be the occasion for deep problem analysis, adventurous experimentation, and new kinds of technological support. We see some of this, but far less than the situation seems to demand.

We propose an *international design lab* to advance the social and technological innovations needed to provide an effective alternative to the currently dominant “21st Century Skills” movement.

No one seriously advocates innovation for its own sake, of course. In current usage, “innovation” stands for a whole cluster of endeavors. These include knowledge creation, problem solving, invention, discovery, imaginative expression, and entrepreneurship. Together they constitute the

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creative aspect of progress, progress achieved through the production and application of new knowledge and not limited to the economic sphere but inherent in the whole contemporary effort to improve the human condition through creativity. When we use the terms "innovation" and "education for innovation," we reference this larger conception, which we believe is the one that needs to inform educational policies.

## 21st Century Students: Learners of Testable Skills, or Thinkers of Significant Thoughts?

The models guiding education's response to the 21st Century innovation challenge date from the early 1950s. This was an in-between period in education. John Dewey had published his last major work in 1949, and the wave of innovations in science education inspired by Sputnik had not yet begun. The gap was filled by statistics and measurement specialists, with factor analysis as the most influential technology. Factor analysts identified a set of testable mental abilities, which many educators relabeled as thinking skills and set about trying to teach.

In the days of Dewey, Whitehead, and Russell, "teach children to think" meant help children develop into serious, productive thinkers. A statement appearing frequently on the Web and attributed to Bertrand Russell expresses the classical view:

> *When you want to teach children to think, you begin by treating them seriously when they are little, giving them responsibilities, talking to them candidly, providing privacy and solitude for them, and making them readers and thinkers of significant thoughts from the beginning. That's if you want to teach them to think.*

There is no mention of skill here. The classical view regarded learning to think as a matter of what in contemporary parlance would be called a mindset—a way of relating to the world of ideas. The explicit treatment of thinking as learnable skilled behavior can perhaps be dated from 1947 and the publication of the first in a series of curriculum materials titled *Learning to Think,* authored by T. G. Thurstone, whose career up to that point had been in mental test development. The itemization of thinking skills received a major boost in the 1950s from the publication of Bloom's *Taxonomy of Educational Objectives,* which proposed a ladder of skills, with Knowledge as the lowest rung and Evaluation as the highest. During the same period, J. P. Guilford published a series of factor analytic studies that defined a matrix of more than a hundred mental abilities for educators to grapple with as learning objectives. By 1987, B. Z. Presseisen summarized school policies and practices in terms that stand in sharp contrast to the terms used by Russell:

> *The most basic premise in the current thinking skills movement is the notion that students CAN learn to think better if schools concentrate on teaching them HOW to do so.*

There is no disputing the value of creativity, problem-solving ability, critical thinking, and other such traits, but when these personal attributes are designated as "skills," serious questions arise concerning teachability and transfer. It is certainly possible to raise test scores by direct means, such as strategy instruction and practice exercies, and less certainly by indirect means, such as project-based learning. But it has not been demonstrated that such test score gains have any real-life significance, and a century of research on transfer of learning gives little reason for optimism. What is worse is that activities devoted to "21st Century skills" may actually lower educational quality. They constitute additions to the curriculum that, besides overloading it, may actually disrupt the pursuit of understanding.

One can find examples on the Web of teachers proudly using a checklist of skills to be covered in subject-matter lessons, with special activities designed to exercise those skills. If carried too far, this cannot help but produce fragmentation and disruption of the coherent building up of complex concepts. Equally important from the standpoint of education for innovation, the 1950s style of thinking militates against the discovery of new competencies arising from new possibilities and new challenges.

The 1950s style of thinking presupposes that learning goals are to be set in advance by experts and stakeholders, after which means of testing and teaching them are to be worked out empirically. That way of thinking, which is still to be found explicitly in some "21st Century skills" approaches, may have been appropriate during a period of relative stability but is radically out of synchrony with today's world.

## Learning to Innovate by Innovating: Enculturation into Knowledge-Creating Communities

What alternative is there as a means of educating for innovation, other than naming, testing, and attempting to teach relevant skills? The time-honored fallback is *learning by doing.* It is the way we pick up most of our everyday skills and knowledge. It is also the mainstay of doctoral study in research universities, where students do research or design things that are not merely novel but that advance the state of the art or knowledge in their field. Of course, the "doing" must faithfully capture the essence of the targeted competency. You do not learn to be a pastry chef by making mud pies. Unfortunately, "learning by doing" has become a cliché tied to concrete actions involving concrete objects. To understand learning to innovate by innovating, it is essential to recognize that *working with ideas is also learning by doing*.

In order to actually "do" research, students must venture beyond potted experiments designed to teach control of variables and operate in what we have termed "design mode"—tackling ill-structured authentic and complex "why?" questions, identifying promising possibilities, and carrying out research to find better ways.

Social and technological innovations are required to support sustained creative work with ideas and to help student communities self-organize around goals of advancing their collective state of knowledge. Such technology needs to be maximally supportive of knowledge creation, with feedback that empowers students and teachers. Bertrand Russell, as quoted above, called for enculturating students into the society of "thinkers of significant thoughts." The 21st Century challenge is to ensure that students become creators of significant thoughts themselves. The creative role of dialogue is widely recognized in the knowledge-creation literature as an essential component. Technology must support students in knowledge-creating dialogue throughout their educational interactions and overcome the loss of continuity that results form separate and only loosely connected discourses scattered across wikis, blogs, text messages, online forums, and multiple devices.

Black-box intelligent technologies and learning analytics need to shift from charting and directing skills acquisition to enabling students to do the thinking. Assessment must become internal to the collaborative knowledge-creating process.

Beyond these innovation challenges, the main obstacles to doing genuine knowledge creation at lower educational levels are two beliefs: a belief that knowledge creation, which generally amounts to some form of theory building, lies beyond young students' abilities and interests, and explicit or implicit adherence to a traditional principle that reduces to "learn first, innovate later."

We have devoted most of our past 35 years of research to showing that these beliefs are wrong-headed. There is some truth in them, but not enough to justify turning our backs on an approach that characterized knowledge-creating organizations and that made research universities engines of progress in the modern world.

Children can invent, tackle authentic problems, and produce explanations that account for facts. They can modify or replace their ideas on the basis of new information. This does not make them Curies, Edisons, or Einsteins, but it does mean they differ only in degree from scientists, inventors, designers, and scholars who earn their livings as knowledge creators.

"Innovate from the start, learn in the process" is a viable alternative to the learn-first rule, and one that is more in the spirit of an "innovation-driven" society. An educational approach that embodies this alternative principle and that makes innovation, in its most inclusive sense, the heart of the curriculum goes by the name of "Knowledge Building." In Knowledge Building the emphasis shifts from personal knowledge acquisition to the production of public knowledge. We suggest that Knowledge Building can serve as the platform for designing educational methods that bring all the varied meanings of "innovation" into the educational program: knowledge creation, problem-solving invention, discovery, creative expression, and entrepreneurship.

Highly compatible with Knowledge Building are most of what bear labels such as "constructionism" and "design thinking." While Knowledge Building is compatible with a number of activities intended to modernize schools, simply adding activities, regardless of how powerful they may be, to the current structure will not produce the level of change needed. For that we need to reshape schools into knowledge-creating enterprises, occupying the same multifarious problem space as those in the world beyond the school.

New social and technological environments will play an essential role, but the focus must be on supporting sustained creative work with ideas—and supporting it so effectively that collaborative knowledge-building interactions become the norm for educational engagement. This norm must be understood and maintained by students, as they are the ones who need to generate ideas, identify the most promising, and improve them through sustained creative work.

If problem formulation and idea improvement remain the responsibility of teachers and curriculum and technology designers, this excludes students from essential parts of the innovation/knowledge-creation process.

Thus, the principal challenge in designing more powerful knowledge-building communities and technology is support for users in taking collective responsibility for knowledge advancement. Ideally there should be an unbroken continuity between schooling and adult creative knowledge work, and both the pedagogy and the technology should be designed to make such continuity possible.

## Building Cultural Capacity for Innovation: An International Design Lab

"Building Cultural Capacity for Innovation" (shortened to "BCCI") is an international design, research, and development initiative to build cultural capacity for innovation in developing and developed nations, at all educational and socioeconomic levels. International partners are united by the idea that large increases in a society's innovativeness requires building cultural capacity for it, starting in early childhood, aimed at democratizing knowledge creation, and continuing through progressive development toward adult life and work in knowledge-based societies. BCCI is a research-intensive enterprise dedicated to the 21st-Century principles of *a place for everyone and knowledge for public good.* BCCI research not only tests but creates innovations.

Although different cultures and different conditions call for different practices in education and child rearing, education for innovativeness implies certain common goals. Regardless of how they go about it, societies seeking to become more innovative in today's world must develop citizens who:

- Enjoy taking risks with ideas and work at improving their own and their community's ideas.
- Carry out sustained work with ideas rather than being limited to brainstorming and other short-term efforts.
- Have distinctive personal ways of contributing to collaborative knowledge creation, adapted to their individual capabilities and dispositions.
- Are well-grounded in science and humanities and appreciate their role in a progressive society.
- Thrive on complexity and idea diversity.
- Identify personally with the worldwide effort to advance knowledge frontiers.

BCCI aims to provide a relatively clear-cut way of going beyond the teaching and assessment of "21st Century skills." By engaging students and teachers as active participants, along with researchers, engineers, and policy-makers, we aim to provide sustainable and scalable pedagogical and technological models with potential to exceed existing curriculum standards and expectations. □

# New Issues, New Answers

## Marc Prensky

## Innovation, Experimentation, and Courage in the Education of Students for the Future

Let's talk about educational innovation. Because "innovation" is a big buzzword at the moment in education—with lots of pressure to sign our people up to do it—we have to be careful not to just rush onto the bandwagon. All "innovation" is *not* created equal. In particular, innovation does not automatically imply preparing our youth better for the future.

MOOCs, for example, are definitely an innovation in the distribution of higher education. But they do not change the way the education is done at all—it's still a combination of lectures, textbooks, exercises, and discussion. The sorts of innovations that our education system really needs are different.

The reason is context. I suspect people were innovating to make a "better cruising experience" on the Titanic—right up until they hit the iceberg. At that point the context changed, and so the value of that kind of innovation went to zero.

Many of the so-called innovations being undertaken today—such as the Common Core curriculum, purchasing iPads and tablets, and developing new electronic curricula —are extremely expensive. We need a compass to be sure that our innovations are worth our time and effort, and that they move us in the right direction. Innovation should be not just doing things differently—but rather doing things that are *valuable*.

I propose these two criteria for evaluating whether any innovation in education, large or small, should be accepted and implemented:

1. Does this make people's lives and jobs better or easier? Will almost everybody, once this innovation is implemented, refuse to go back to doing things the old way?
2. Will this "innovation" move us towards a new kind of education? (Or is it just a new—and perhaps even better—way of doing what we could do before?) In other words, is this innovation *also* Future•cation?

Meeting *both* of the criteria is crucial, because it is possible, and even easy, to innovate and still Past-ucate. The Common Core, I believe, fails on both counts—few, if any, think it makes life better or easier, and it is mostly oriented toward improving what we did in the past.

Other innovations that do not go far enough include:

- Devices that are constrained to a pre-determined network and curriculum, such as the iPads in Los Angeles, or the Amplify tablet. It is not "useful" innovation to give the kids new tools unless you let them *do new things.*
- Whiteboards, even interactive ones. Yes, much cleaner than chalk, with access to multiple images–but generally the same old pedagogy.
- Sending e-mails to parents, instead of letters. Much faster and easier, but typically the same communications as before.
- Moving "traditional" research from the library to online—so much quicker, but we also need *new concepts about information*.

There are an infinite number of ways to make what we now do easier and more efficient using technology, but that kind of innovation is not our job. We must not get distracted from the goal of making education better for the future by the idea of "becoming innovators."

This is because meeting the second criterion is much more difficult. For one thing, it involves admitting what we currently do—no matter *how* we do it—doesn't work in the current and future context. For another, it means thinking up new ideas not for just what we do, but for what we should do, given our rapidly changing context and environment.

The big danger—and the place where we must be vigilant—is that it is easy to use technology to make life easier and to think that we are making it *better.* I have never met anyone from the younger generation who has used computers in school who prefers to go back to *not* using them to do old stuff like writing and research. But, typically, instead of innovations opening up totally new possibilities and experiences for students in the future, they offer new ways to give students *the same education as in the past.*

Is the move to online textbooks, for example, a valuable innovation? We can be sure no one from the Internet generation will want to go back to carrying heavy paper-based texts, and it might even be cheaper—assuming we get publishers to do cost-based pricing or that teachers write open-source textbooks.

But it fails the second criterion. Online textbooks—even enhanced with multimedia, games, and simulations—are merely an old way of looking at content in the Internet age. They are not innovative expenditures—we should be looking much further. The true innovation is that we don't need textbooks at all. But because we do not yet know exactly what works in their place, we must be totally open to experimentation.

I have head the comment—*"Don't experiment with my kid!"* —from numerous parents. It is certainly understandable that every parent wants their kid to succeed. But it is also our greatest barrier to moving education forward, and our greatest danger.

We may need—given that attitude—to begin with one big innovation: we can design—and universally use—effective, easy-to-make (and fun-to-use) apps that prepare kids well for our current tests (just as we have done for the SATs and other exams). Doing the old stuff quickly and efficiently in a 21st Century way—and in half the time—should be, perhaps, our first innovation priority.

But let's get this done quickly, and then let's spend our "innovation energy" figuring out how to really *educate for the future.* It will take much experimentation, and lots of courage. □

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