

EDITORIAL

New Directions in Pedagogy: Design, Playfulness, and STEAM (Editorial)

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Massive technological, social and pedagogical changes are reshaping the nature of learning in the 21st Century. In this session at ICCE, researchers and scholars suggest new directions for education that take into account these innovations and that draw upon the latest theoretical developments about learning.

The world of learning in both K-12 education and postsecondary education has been altered radically and permanently both by new knowledge and by technology during the past twenty-five years. The new educational environment reflects eight dynamics and trends:

- *Advances in digital technology have made powerful new tools available to students and teachers.

- *Communication and education have become global, crossing national boundaries.

- *Educational research has revealed that it is not enough to develop a new app; strategies of successful implementation must be employed.

- *Cutting edge scholarship increasingly is interdisciplinary; it is not limited to disciplinary silos. Science, Technology, Engineering and Mathematics (STEM) often are combined with the Arts (STEAM).

- *Teachers and professors are seen more as facilitators, not as experts pouring knowledge into empty vessels.

- *Students now are much more likely to learn and work in groups or teams.

- *The energy and enthusiasm that students bring to games can be transferred to learning in school.

- *Creativity and design increasingly are a part of the learning process in schools.

The papers in this session confront this new reality with innovative programs and models for deeper learning and creativity, each based upon a strong theoretical foundation. As a cautionary note, in the mid-20th century, a company tried to incorporate computers in education and it failed, partly because digital technology still was in its infancy and partly because it is difficult to change schools, colleges, and universities. There are valuable lessons to be learnt.

Historical precedents about highly touted technological innovations in education have revealed that it is not enough to have a good idea or a new technology. Thoughtful incorporation of the innovation into the learning process is essential. This is especially true when one is crossing disciplinary boundaries or when one is crossing national boundaries. Pham, Garlatti, Lau, Barbry, Vantroys' (2009) investigations into scenarios integrating web service retrieval and orchestration in pervasive teaching-learning systems through semantics are examples of efforts which can open channels for such dialogue.

Interdisciplinary Education and Design. Debates have raged for centuries about the relative importance of science and engineering as compared with the arts and humanities. In the 19th Century, Thomas Huxley debated Matthew Arnold about the value of each area. In the 20th Century, C. P. Snow addressed this divide in his 1959 Rede lecture. Snow was both a scientist and a humanist and compared his conversations among humanities colleagues in both England and the US with

conversations among scientists. “After a few thousand Atlantic miles, one found Greenwich Village talking precisely the same language as Chelsea, and both having as much communication with MIT as though the scientists spoke nothing but Tibetan.” (Snow & Collini, 2012, p. 2).

Recently, policy makers in China, India, and other Asian countries have become quite interested in American liberal arts colleges. India has world-class engineering schools, the Indian Institutes of Technology (ITT). Yet they notice that America remains the world leader in innovations and patents. Perhaps, they speculate, this has something to do with the liberal arts. One speaker at a conference on the liberal arts in Bangalore, a highly successful journalist and author, said that, as a child in India, he had a strong interest in literature. But he saw only one path to success in that country at that time, so he attended the ITT and began his career as an engineer.

In the 25th annual ICCE conference, Drew and Bucciarelli (2017) proposed a new integration of the arts and humanities with engineering education, a "Liberal Studies in Engineering" program. More recently, they reported on some results from a feasibility study they have been conducting with support from the National Science Foundation (Bucciarelli & Drew, 2018). They have found that more progress has been made integrating the arts with technology than integrating the humanities with technology (although they believe that both kinds of integration are needed). Often integrating the arts takes the form of design; the work at the Stanford University School of Design is just one successful example.

In his classic work, *Notes on the Synthesis of Form*, Alexander specifies the design challenge. “It is based on the idea that every design problem begins with an effort to achieve fitness between two entities: the form in question and its context. The form is the solution to the problem; the context defines the problem. In other words, when we speak of design, the real object of discussion is not the form alone, but the ensemble comprising the form and its context. Good fit is a desired property of this ensemble which relates to some particular division of the ensemble into form and context.” (Alexander, 1964, p. 15)

The Globalization of Work and Education. Reich summarizes beautifully the new global, high-tech, world of work. “The software engineer from Belmont, Mass., working on a contract for Siemens, which is financed out of Tokyo, the routine coding of which will be done in Bulgaria, the hardware for which will be assembled in Mexico, is a true symbol of the global economy.” (Reich, 1991, p. 179)

The globalization of scholarship has taken two major forms: new institutional structures and increased attention to lessons about effective education from other countries. The new structures have included, for example, a branch of a major university launched in another country, e.g., NYU Abu Dhabi, and a new institution created by two universities from different countries, e.g., the Yale-National University of Singapore College.

The systems delivering education to a nation’s citizens must be congruent with both the culture and the political system of the country. What works in Hong Kong or Singapore may not work in the United States. Nonetheless, lessons can be learned more the experiences of countries whose students excel.

For years, students from Finland have performed at the top, or near the top, in international assessments of educational achievement. Educators have been anxious to learn about the Finnish keys to educational success. Teachers in Finland must have a master’s degree. Admission to the master’s programs is very competitive; only a small percentage of applicants are accepted. Once they graduate, they are respected and compensated as professionals. They are trusted and given authority over their classrooms. Finnish schools are an integral part of their community; principals know each student and their family. Of course, Finland is a relatively small, homogeneous country. Nonetheless, the stunning success of their schools cannot be denied.

Interdisciplinary projects are a key feature of elementary and secondary education in Finnish schools. More recently, there is a national commitment to dramatically increase the amount of project-based interdisciplinary education in this nation. The whole world is watching.

In a paper prepared for this session, Tenhunen (2018) the founding president of a university in Finland, and a leading scholar about Finnish education, presents a comprehensive overview of education in Finland and why it is so successful.

Transforming the Classroom. “Flipped classrooms” can take different forms, but they all differ dramatically from the traditional model of a teacher or professor lecturing to students in class and then assigning reading and homework problems. For the most part, in the flipped classroom model the transmission of information occurs outside the classroom, often by a video mini-lecture, while active learning, often learning by groups of students, occurs inside the classroom. The new model moves from “the sage on the stage” to “the guide on the side” (King, 1993; Clindenbeard, 2018).

Due to these changes, many research communities, such as the Learning Sciences community have looked into ways to scaffold deeper learning. The maker movement in this playful transfer of knowledge and engagement, further raises the bar in terms of design challenges. Following Resnick’s (2007) novel work, Lee and Wong’s (2014) preliminary design thinking-theorizing among pre-school pre-service teachers also lends promise for different play in emerging economies.

At a higher and deeper level, Wang, Kirschner and Bridges (2016) have led forums to investigate effective learning issues involving complex cognitive processes. This workshop has provided a platform for the participants to share: 1) how deep learning in inquiry and problem-solving contexts can be empowered through effective design and implementation of computer-based learning environments, and appropriate analysis of learning in such environments; 2) the challenges experienced; and 3) useful strategies to deal with the challenges.

The papers prepared for this session address learning for people of all ages, from young children to seniors. Similarly, the topics are varied, from learning Mandarin to physics to a numbers game that teaches logical thinking. The projects also vary in terms of how much they use specialized software. Consistent themes are: a) the focus on creativity and design and b) scaffolding learning strategies upon well-developed theories. In a still-new century, during a period of great innovation, where advancements in multimodal technologies, social networks and cognitive technologies abound, papers like those in this workshop are glimpses of critical success factors highlighting the significance of theoretical foundations and human-computer interaction principles, to design and to STEAM. They are interesting contributions to our knowledge that can help shape the future of education.

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