Book Review: New Science of Learning - Cognition, Computers and Collaboration in Education

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Introduction

This book (ISBN: 978-1-4419-57154-3) is edited by Myint Swe Khine and Issa M. Saleh. It is published in 2010 by Springer, New York, United States.

Robert J. Sternberg who wrote the foreword for the book indicates many important points and approaches of the field. As Sternberg points out, it is seen that the editors of *The New Science of Learning: Cognition, Computers, and Collaboration in Education* have recruited much of the important and top talent in the field of learning to write about the latest developments in the science of learning. In today's world, there are different models for this relationship. One model is the Solarian model, described in the book, of people in isolation with little but virtual contact. A second model is of children working together in a computer laboratory reading lessons presented in a fascinating way via computer. A third model is that of distance learning. One even can do group projects with others, completing the projects without seeing any of the others in the group or having the foggiest idea of what they look like. In extreme cases, one could be involved in an elaborate Turing test, interacting with a computer while one thought one is interacting with others, without even realizing that the others are simulacra. A fourth model is group-interactive projects that use the computer but take place in classrooms or laboratories or libraries with humans in face-to-face interactions. More and more libraries across the world are creating what are sometimes called "learning commons" which are spaces for precisely such interaction to occur.

Parts and Chapters

Part I: Cognition and New Science of Learning

Chapter 1: New Digital Media and Their Potential Cognitive Impact on Youth Learning is written by Margaret Weigel, Celka Straughn, and Howard Gardner.

This study, as the authors indicate, provides a detailed picture of today's digital youth. To betray and solve their main problem the researchers have spoken with the educators from different schools largely within Greater Boston area and represented a broad range of disciplines across the arts and humanities, the social, physical and biological sciences and athletics. The interviews were conducted between May 2008 and February 2009. For post interviews the two sets of notes were distilled into a single master account and a briefer overview focused on key points. After 20 interviews, work began on identifying emerging themes; these themes formed the basis of a detailed project matrix. As the interview

progressed, the matrix was modified as needed to summarize a more nuanced portrait of significant themes. The researchers' findings indicate, despite changes in certain behaviors over time, the motivations driving their students remain unchanged. Given that computers have been incorporated into contemporary homes, workspaces, and classrooms, it is easy to forget that they have in certain ways revolutionized youth learning and educational practices.

As a result, in this chapter the authors cannot determine the extent to which this picture would be obtained with respect to other, less advantaged youth populations, though many of the themes the authors encountered have been reported elsewhere in the journalistic and research literature. Focused interviews of other adult groups, such as camp counselors to therapists, who have had sustained interactions with youth could also be informative. To determine more "in-depth" changes in the era of digital youth, ranging from nature of emotional reactions to the capacity for imaginative leaps, will require both devising of new methods of investigation as well as strategic triangulation of findings from various types of studies.

Chapter 2: Group Cognition as a Foundation for the New Science of Learning is written by Gerry Stahl.

As the author of the chapter points out, the approach to chat interaction analysis emerged in the VMT (Virtual Math Teams). The research question that drives this VMT Project is: What are the distinctive mechanisms or processes that take place at the small-group level of description when the group is engaged in problem-solving or knowledge-building tasks? The researchers are interested in describing the inter-personal practices of the groups that interact in the VMT environment. Understanding how a collaborative group as a whole constructs knowledge through joint activity in a CSCL (computer-supported collaborative learning) setting is what sets the science of group cognition apart from other approaches to the study of learning. Successful collaboration involves not only the incorporation of contributions of individuals into the group discourse but also the effort to make sure that participating individuals understand what is taking place at the group level. The contributions of individuals to the group and of understandings from the group to the individuals cannot be studied by analyses at the individual unit of analysis but only by studying the interactions at the group level. The group knowledge-construction process synthesizes innumerable resources from language, culture, the group's own history, individual backgrounds, relevant contexts, and the sequential unfolding of the group discourse in which the individuals participate.

Chapter 3: An Embodied/Grounded Cognition Perspective on Educational Technology is written by John B. Black.

Perceptually grounded or embodied cognition is an increasingly prominent area of basic cognitive research. This perspective says that a full understanding of something involves being able to create a mental perceptual simulation of it when retrieving information or reasoning about it. Both behavior and neuroimaging experiments have shown that many phenomena that were thought to be purely symbolic, actually show perceptual effects. In learning a mental model for a system, students need to learn and understand the component's functional relations that each describes now as a system entity changes as a function of changes in another system entity. The direct manipulation animation version of the simulation was compared to other versions involving just text, text and pictures (screen shots of the simulation), and a "slide show" showing screen shots, and the more grounded/embodied direct manipulation animation version yielded the best memory, problem solving, and transfer

problem solving to another context. Recent basic cognitive research and theory in perceptually grounded or embodied cognition provides a framework for considering how we can deepen and increase student learning and understanding by having them develop a "feel" for what they are learning in addition to knowing about it. Used in ways guided by this theoretical framework, video game playing together with more formal learning, interactive graphic computer simulations involving movement and animation (and force feedback), video game programming and robot programming can be used effectively to increase student learning and understanding.

Chapter 4: Features of Computerized Multimedia Environments that Support Vicarious Learning Processes is written by Barry Gholson, Roby Coles and Scotty D. Craig.

As the authors wrote, the broad aim of this chapter is to explore how cognitive activities may be facilitated when the goal is to construct new knowledge in computerized environments designed to support vicarious learning. As used here, *vicarious learning* takes place in environments in which learners have no opportunity to control any aspect of the source or content of materials they attempt to master. In these environments vicarious learners are *not* required to engage in collaborative activities to control the flow of input information. Although learners may voluntarily choose to engage in overt activities, no attempt is made to control, monitor, or record them. Thus, as used here, vicarious learning involves *only* covert activities and, of course, any unspecified overt activities in which learners may spontaneously engage while looking and listening. The discussion here highlights how specific features of computer-presented course content that support vicarious learning may be readily implemented in multimedia environments. This chapter explored how cognitive activities involved in vicarious comprehension and learning are supported by identifiable features of multimedia educational environments. Comprehension is, of course, integrally involved in deep learning and the latter would rarely be expected in the absence of comprehension but the two were considered separately for purposes of this report. Several readily implemented manipulations of the input improve comprehension. First, they provide multiple perspectives of the conceptual content, and whether they are presented in dialog or monolog format is of no consequence. Second, research indicates that introducing new content with questions promotes comprehension when contrasted with using simple declaratives, and it may be as effective as participating in goal-directed dialog. Third, the coherence of text plays an important role in comprehension: make ideas in the text explicit by avoiding ambiguous pronouns, linking concepts together by using macro-propositions that tie paragraphs to each other and to topic headings. It seems reasonable to assume that these features would play similar roles when text is spoken, although no direct comparisons were located.

Chapter 5: Human Memory and the New Science of Learning is written by Paul Eggen and Suzanne Schellenberg.

Until about the middle of the twentieth century, behaviorism was the dominant view of learning. Behaviorism explains learning in terms of observable changes in behavior that occur as a consequence of experience with the environment. Behaviorism is able to explain simple behaviors, such as picking up dirty socks, driving slower after being picked up for speeding, or children's attempts to answer teachers' questions because they are being praised for their efforts. However, behaviorism isn't able to explain the development of complex skills, such as problem solving, insights and novel ideas, or the acquisition of language. Factors such as these, combined with the development of computers, all led to a search for different explanations for people's behaviors. The result was the "cognitive revolution," which marked a shift toward

cognitive learning theories, theories that explain learning in terms of changes in the mental structures and processes involved in acquiring, organizing, and using knowledge. The cognitive processes consist of *attention, perception, rehearsal, encoding,* and *retrieval.* Attention and perception move information from sensory memory to working memory. Attention is the process of consciously focusing on a stimulus, and perception is the meaning we attach to the stimulus. Learners use rehearsal to retain information in the phonological loop of working memory, and intensive rehearsal can move information into long-term memory. Encoding represents information in long-term memory.

Chapter 6: Metacognitive Control of Learning and Remembering is written by Jason R. Finley, Jonathan G. Tullis, and Aaron S. Benjamin.

In this chapter the authors discuss the role of metacognition in the learning of simple verbal materials, with a special emphasis on metacognitive control. Learners can regulate their study experience to enhance learning in innumerable of ways. The authors consider forms of control that have been studied in simple laboratory tasks and that generalize in a straightforward way to options available to students studying for tests: self-pacing study effectively, devising efficient study schedules, judiciously selecting items for study and re-study, strategically making use of self-testing strategies, accommodating study to anticipated test conditions, and using successful retrieval strategies. The authors review research that reveals how learners use these strategies in simple laboratory tasks and that suggests how such metacognitive skills can be improved through instruction or experience. The authors end by addressing the supportive role that information technology can play in the processes by which metacognition influences learning and memory. At the end, the authors have reviewed in details cognitive psychological research on self-directed learning in simple laboratory tasks. They indicate that as learners monitor their own learning, they can also enhance it by exercising various forms of metacognitive control.

Chapter 7: Ethnic Differences on Students' Approaches to Learning: Self-Regulatory Cognitive and Motivational Predictors of Academic Achievement for Latino/a and White College Students is written by Robert Rueda, Hyo Jin Lim, Harold F. O'Neil, Noelle Griffin, Shel Bockman, and Barbara Sirotnik.

The authors of this chapter highlighted that the national move toward accountability in USA primarily focused on K-12 schools has begun to focus on postsecondary education as well. Accountability demands for student academic performance and persistence rates are growing. In addition, postsecondary education is widely seen as only a minimum goal in education, as a high-school diploma is no longer seen as sufficient preparation for contemporary workforce demands. The results of this study provide support for factors that previous literature and theory have shown to be important for self-regulated learning and the relationships to motivational and learning strategy use. From an educational perspective, this is encouraging news, since the motivational and learning strategies of the type examined in this investigation are amenable to instruction and modifiable. This is important because of a tendency of postsecondary institutions, as well as the field of education in general, to consider low achievement a function of unmodifiable student or family deficits.

Chapter 8: Intuitions, Conceptions and Frameworks: Modeling Student Cognition in Science Learning is written by Keith S. Taber.

This chapter is about how researchers (and teachers) can model student cognition to make sense of the learning and understanding of school and college subjects. The suggestion of the chapter is that educational research into student learning has produced a great deal of descriptive material about student ideas; however, it has been seriously handicapped by a lack of understanding of the nature of what is studied. Familiar, but central, terms—such as "knowledge", "thinking", "ideas"—tend to be poorly defined, and the relationships between data elicited in scientific studies and the entities posited by researchers—such as "alternative conceptual frameworks" and "intuitive theories"—have not always been convincing. However, it is argued here that the cognitive sciences increasingly offer useful conceptual tools to better inform such research. Indeed, progress is leading to strong integration between neuroscience and traditional work in experimental psychology, such that knowledge of brain function and structure may soon significantly inform educational practice. This chapter has done little more than offering an overview of an interesting research issue in education, and a glimpse of how cognitive science can support our research into classroom learning and teaching. However, as research in science education has increasingly drawn upon ideas from cognitive science, it has become much clearer why thinking elicited from science students has such variety.

Chapter 9: An Analysis of Design Strategies for Creating Educational Experiences in Virtual Environments is written by Theresa Horstman and Stephen Kerr.

In this chapter the authors analyze and compare e-learning instructional design methodologies with those of video game design methodologies to better understand how differences in design strategies shape the ways in which users engage with video games and e-learning. Although focused on the similarities and differences in design methodologies, they limit their topics to concepts specific to learning and content management. The purpose, through comparative exploration, is to discover potential design strategies that may improve the quality and effectiveness of e-learning courses through increased engagement. Though the authors focus on content design choices, they do not evaluate the difference in designing for different organizations or target audiences. The fundamental differences of designing a course for children versus adults or academic versus workplace remain intact—it is the process by which one designs for the technology that is under evaluation. As conclusion, the authors point out that they examined game design methodologies of treating content through the lens of e-learning in an effort to garner a design perspective that might improve the quality and effectiveness of e-learning courseware. Examining game design methods enables e-learning designers to make a conceptual shift from how content is segmented and organized based on classroom- or instructor-led design to designing integrated content in a virtual space. This includes reconsidering the emphasis on user-centered design practices, integrating content into learner experiences, the visual representation of content in e-learning, and the motivational aspects related to content.

Part II: Computers and New Science of Learning

Chapter 10: Redesigning Testing: Operationalizing the New Science of Learning is written by Zachary Stein1, Theo Dawson, and Kurt W. Fischer.

The goal of this chapter is stated as to begin to reflect on this state of affairs, bring key issues to light, and report on specific avenues of research and design for building a new type of educational testing infrastructure that will bring greater benefit to greater numbers by serving more diverse purposes and populations. The authors have discussed the history of our

contemporary testing infrastructure and explained the need for new approaches grounded in the science of learning. They have also provided an overview of one new approach that combines advances in basic research about learning with new techniques in psychometrics to build embedded formative assessments that are both standardized and richly educative. Thus, the authors have touched on the philosophical issues at the heart of testing reform. The contemporary testing infrastructure set serious constraints on pedagogical options and structures the distribution of opportunities and resources. Moreover, as many scholars have noted, the reward systems of schools act as proxies for the general values of society.

Chapter 11: Self-regulated Learning with MetaTutor: Advancing the Science of Learning with MetaCognitive Tools is written by Roger Azevedo, Amy Johnson, Amber Chauncey, and Candice Burkett.

The research indicates that the complex nature of the learning content, internal and external conditions, and contextual environment requirements are particularly difficult because they require students to regulate their learning. Regulating one's learning involves analyzing the learning context, setting and managing meaningful learning goals, determining which learning strategies to use, assessing whether the strategies are effective in meeting the learning goals, evaluating emerging understanding of the topic, and determining whether there are aspects of the learning context which could be used to facilitate learning. During self-regulated learning (SRL), students need to deploy at least several metacognitive processes and make judgments necessary to determine whether they understand what they are learning, and perhaps modify their plans, goals, strategies, expectations, and effort in relation to dynamically changing contextual conditions. Students must also monitor, modify, and adapt to fluctuations in their motivational and affective states, and determine how much social support (if any) may be needed to perform the task. The authors here discuss the term metatutor in details. According to them, MetaTutor is based on several assumptions regarding the role of SRL during learning about complex and challenging science topics. Learning with metacognitive tools involves the deployment of key SRL processes. The authors have articulated and explicitly described the metaphor of computers as Metacognitive tools.

Chapter 12: New Learning—Old Methods? How E-research Might Change Technology-Enhanced Learning Research is written by Peter Reimann and Lina Markauskaite.

This chapter discusses existing and emerging technological affordances and their possibilities to enhance learning research. In addition to this, they discuss the nature of information and communication technology (ICT)-enhanced technological innovations and outline some possibilities of how technological affordances could enable and support such practices. Then, in order to illustrate how these conceptual changes could be linked to specific technologies, they sketch the elements of a high-level architecture for a teacher-oriented inquiry platform. As a result, in this chapter the researchers introduced some existing and some emerging technologies and discussed the potential to enhance learning research. Technologies are evocative and open for many interpretations. How technology-enhanced research will be taken up, what kinds of research practices they will support, and for what kinds of tasks they will be utilized for is by large dependent on their use: Neither can technology determine our research practices nor can our research practices determine technologies; they are mutually co-constructed.

Chapter 13: Designing Higher Education Courses Using Open Educational Resources is written by Frank Rennie and Robin Mason.

Universities in countries with limited resources for e-learning face very difficult problems in trying to equip their students with the skills, experience, and online opportunities which the country needs to develop as a knowledge-based economy. In Asia the proportion of the total population participating in the Internet revolution is relatively small but the rate of growth of mobile phone and Internet technology is rapid. In countries where the infrastructure is reasonably well-developed, pressure is growing to use e-learning, partly because of the growing number of foreign universities offering online courses and partly as a perceived solution to offer access to mass education throughout the country. The primary focus of the authors' work stems from the need of the developing country partner institutions to improve the quality of their systems for teaching and academic administration and to do this in a more open and flexible format. In part, these problems arise from the lack of adequate finance for educational resources (e.g. up-to-date literature and new educational technologies) and in part due to the lack of maturity of the current educational systems. As conclusion, the authors say their initial interest in OER (Open Education Resources) was sparked by some of the particular problems faced by universities in less-developed countries, mainly the lack of detailed benchmarked quality standards, the geographical and resource challenges in extending higher education to remote students, the need to provide educational opportunities for remote students, and the lack of know-how in effective course design for Internet-based teaching.

Chapter 14: The Evolution of an Automated Reading Strategy Tutor: From the Classroom to a Game-Enhanced Automated System is written by G. Tanner Jackson, Kyle B. Dempsey, and Danielle S. McNamara*.*

Throughout this chapter the authors have focused on the evolution of a training program designed to teach students effective self-explanation strategies. This training program began as an individual human-to-human intervention (SERT one-on-one), incorporated that same training within a classroom-based collaborative learning environment (SERT group), transitioned into a highly distributable effective self-paced tutoring system (iSTART), and is currently being adapted into a game-based learning environment with collaborative peer-to-peer gameplay (iSTART-ME, with MiBoard). Each transition was designed to address potential limitations from a previous version and to improve upon the overall training effectiveness. This chapter has focused on the evolutionary changes of a training program as it has transitioned from human-based to computer-based and from individualized to collaborative. Each of these transitions helped to improve upon previous versions by addressing specific training limitations found during testing and evaluations. This is likely to be one of the many development trends in the future as our community continues to evolve into an era of electronic education.

Chapter 15: Experiences in the Field: The Evolution of a Technology-Oriented Teacher Professional Development Model is written by M. Brooke Robertshaw, Andrew Walker, Mimi Recker, Heather Leary, and Linda Sellers.

This chapter describes the IA (Instructional Architect) and several iterations of PD (Professional Development) model, as informed by evaluation results and best practices in the literature. While different PD models have been based on different instructional models, the one common feature has been the use of authentic design problems. As a conclusion of this research, the researchers indicate that the competence for this ongoing 8-year-long research project was to enable grade school and secondary education school teachers to have better access to the vast series of free online educational resources available to them. As technology

has evolved, so has the focus of their work. At the beginning of the project their main concern was getting teachers to use online resources and they were not as concerned with the method by which they taught with them.

Chapter 16: A Dialogic Approach to Technology-Enhanced Education for the Global Knowledge Society is written by Rupert Wegerif and Nasser Mansour.

The basic idea behind the knowledge society is that some societies are in the middle of a new economic revolution in which the nature of work is shifting seriously from the industrial stage dominated by the manufacture and exchange of physical goods towards the post-industrial "knowledge age" dominated by the manufacture and exchange of knowledge and ideas in a global context. Manuel Castells, one of the most quoted commentators on the impact of new technology on society, extends Daniel Bell's earlier analysis of this shift in the economy and in society by bringing out the extent to which it is dependent mainly on new information and communications technology. Many have argued that education needs to respond to the accelerating rate of technological and social change associated with the knowledge age and globalization. The authors of this chapter ends their discussions as following: Both as a real shift in the foundations of economic and social life and as a vision of the future, the idea of the emerging global knowledge age challenges traditional approaches to education. New individual and collective skills and dispositions are required for thriving in the knowledge age. These have been described in terms of skills of communication, collaboration and creativity. Neither cognitive psychology, based on the computer metaphor of mind, nor socio-cultural approaches based on the metaphor of thinking as the use of cultural tools, can adequately account for how to teach effectively for these knowledge age skills.

Chapter 17: Conceptual Representation Embodied in Hypermedia: An Approach to Promoting Knowledge Co-Construction is written by Lei Liu and Cindy E. Hmelo-Silver.

As stated by the authors, their goal in this chapter is to examine the relationship between the conceptual representation used to structure hypermedia and the student's regulation of learning processes. Twenty participants from the educational psychology subject pool at a large public university participated to the research. Participants received course credit for participating in the study. In each session, participants were grouped into dyads and randomly assigned to condition. In this study the researchers used two different versions of hypermedia to teach about the human respiratory system: the function oriented version (F-hypermedia) and the structure-oriented version (S-hypermedia) of hypermedia about the human respiratory system. Both versions present similar content; the major difference is in the underlying conceptual representations. After the authors got both quantitative results and qualitative results or the research that they conduct their discussions are as follows: Because of the small sample size, the authors considered this to be an exploratory study. Because the content was controlled across both versions of hypermedia, they argue that it was the alternative conceptual representations underlying the hypermedia that made such differences. It is important for students to be aware of their own thinking and to use such metacognitive knowledge to guide their learning plans and selection of learning strategies. According to findings exploratory study indicate that the function-oriented conceptual representation helped problematize the content, encouraging students to set and monitor their learning goals as they explored the hypermedia.

Chapter 18: Virtual Worlds for Young People in a Program Context: Lessons from Four Case Studies is written by Marina Umaschi Bers, Laura Beals, Clement Chau, Keiko Satoh, and Nauman Khan.

The authors say that in 2007 a report by the Pew Internet and American Life Project revealed that 93% of Americans between the ages of 12 and 17 years are Internet users "and more of them than ever are treating is as a venue for social interaction—a place where they can share creations, tell stories, and interact with others". In addition, the report found that 55% of online teens (ages 12–17 years) have a profile on a social networking site (e.g., Facebook or MySpace). It is reported that of the five most frequented virtual worlds sites, four of them were youth focused and furthermore, were ranked higher than adult oriented equivalents such as *Second Life* and *World of Warcraft*. Based on the differences of the sites and experiences, the chapter provides guidelines for understanding how to design and evaluate intervention programs that use virtual worlds for children by taking into consideration eight different dimensions: (1) curriculum, (2) mentoring model, (3) diversity, (4) project scale, (5) contact with participants, (6) type of assessment, (7) access environment, and (8) institutional context of usage.

Chapter 19: New Technologies, Learning Systems, and Communication: Reducing Complexity in the Educational System is written by Helle Mathiasen and Lynne Schrum.

In this chapter the researchers consider three foci regarding the research on teachers; (1) their ICT skills and their didactical as well as pedagogical skills in relation to use different types of learning resources, (2) different types of contexts including reflection on students' learning with media and technology, and (3) parameters concerning management, culture, and use of technology. The authors reached to the conclusion as; different communication forums including digital and non-digital learning resources can be fruitful for knowledge constructions, the challenge is then to empower teachers to rethink their ways of organizing teaching including the use of ICT in the light of the premise of communication, complexity, contingency, and the risk involved. They invite the conversation around these topics and encourage research to explore the issues raised in this chapter. The voices that must be considered include those of the teachers, the learners, and the school leaders who help implement ICT in an effort to promote the goals of all educational systems. The educational community, and in particular the current and future learners, will all benefit from this collaborative conversation.

Part III: Collaboration and New Science of Learning

Chapter 20: Fostering Higher Levels of Learning Using Diverse Instructional Strategies with Internet Communication Tools is written by Heather Kanuka.

This chapter explored the relationship between instructional methods and patterns of cognitive presence. The data revealed that students engaged in a WebQuest produced more messages that reflected the highest levels of cognitive presence than students engaged in (in order of effectiveness) debate, deliberative inquiry, nominal group technique, and invited expert. The theory of deindividuation asserts that being in a group provides a degree of anonymity that, depending on the size, allows one to avoid responsibility for actions. The Foucauldian metaphor of the panopticon asserts that the mere knowledge of surveillance is enough to induce conformity without imposing force or physical confrontation. It can, and has, been argued that the absence of social and paralinguistic cues through the use of Internet

communication tools, coupled with isolation at one's computer terminal and the ability of learning management systems to track student participation, results in a greater degree of deindividuation and panopticon. Hence, it is possible that anonymity and group conformity are actually being reinforced within online fora; this, in turn, could be a reason for why it is difficult for students to achieve high levels of learning using Internet-based communication tools. Specifically, the effects of anonymity and group conformity pressures may be inhibiting critical aspects to achieving higher levels of learning such as challenging, arguing, debating, and discussing of conceptual conflicts. It may be that certain pedagogical interventions, such as the WebQuest and debate, not only permit—indeed, require—students to actively challenge, argue, debate, and discuss the conceptual conflicts presented. The research this study builds on—both the WebQuest and debate require students to confront conceptual conflicts and dilemmas, defend positions, make judgments, and question or rethink current assumptions of their own as well as their peers.

Chapter 21: Windows into Teaching and Learning through Social Annotation Practices is written by Hope J. Hartman.

Web-based instruction is having a major impact on teaching and learning because of its pervasive access and ability to enhance meaningfulness by facilitating learner centered approaches and social networking, the essence of Web 2.0 applications. WebQuests, Project-Based Learning, Wikis, and authentic multiuser virtual environments such as ActiveWorlds, River City, and Second Life allow learners to immerse themselves in intellectually stimulating, highly motivating social interactions as they learn from and with each other and experts. Using innovative social annotation software, HyLighter, participants connect with each other, interacting as a virtual learning community. Multiple readers comment on selected areas or objects within a single document (or multiple documents), view each other's comments through a composite display, and comment on each other's comments thereby creating a collective annotation of the document. This system enables teaching and learning to achieve greater breadth and depth as users collaboratively analyze information and share their thoughts and experiences. It operationalizes conception of documents building and maintaining social groups as meaning is constructed and negotiated. HyLighter, a hybrid social software and hypermedia annotation system, provides a unique learning environment. HyLighter used technology to create, support, and mediate relationships among learners and between the professor and the students while making learning deeper, broader and more meaningful. It enhanced complex cognition and metacognition, such as critical thinking, self-regulation, and self-directed learning, which contributed to learners transferring what they learned from one situation to another. Also it made learning more enjoyable, satisfying, and memorable, thereby enhancing motivation and feelings of self-efficacy. The social network feature has the potential to maintain relationships so students can continue to learn from and with each other in the future, as both students and as teachers.

Chapter 22: Orchestrating Learning in a One-to-One Technology Classroom is written by Jitti Niramitranon, Mike Sharples, and Chris Greenhalgh.

Researchers in the field of technology-enhanced learning have developed a number of approaches in using personal, portable, wirelessly-networked technologies to enhance teaching and learning both inside and outside the classroom. The low cost and ease of integration into everyday classroom routines make mobile devices attractive for school learning. The educational potential of a one-to-one classroom where each child has access to a personal computer has prompted researchers to investigate effective strategies and scenarios

for learning mediated by the technology. Computer-Supported Collaborative Learning (CSCL), built on a foundation of learners collectively forming a meaningful context to purposefully seek and construct knowledge, is another field of research that can be applied to a face-to-face classroom mediated by mobile technologies. Research in this area aims to design and develop software for mobile devices to support collaborative activities amongst students for individual, small group, and whole class learning. The authors have carried out a pilot study with 18 master students in three classes to establish proof of concept and to identify usability problems. After modifications to SceDer based on the problems found in the pilot study, they carried out the main evaluation with four classes of 20–30 students (aged 11–14) at a school where all students routinely used tablet PCs in the classrooms.

Chapter 23: Designing Online Learning Environments for Professional Development is written by Kedmon Hungwe.

Web-based Internet technologies afford expanded options for the design of online learning. As stated by the author, the premise of this work is that the design of online professional development for teachers should encourage reflections about practice through participation in networks of peers. It has been argued that reforms in education must contend against deeply entrenched pre-understandings that may have to be replaced or modified. Teachers tend to innovate ad hocly, piecing together ideas and activities picked up from textbooks, colleagues, workshops, and conferences. This results in instructional practices that lack an adequate conceptual base and structure. In this research adult learners participating in professional development programs are, by virtue of their backgrounds, established in careers where their positions are defined in terms of specific competencies and roles. New learning experiences always have the potential to introduce some disequilibrium into those roles and competencies. The design of instructional programs for adult learners should therefore provide opportunities to reflect on personal concerns about change as an integral part of the teacher-learning process.

Chapter 24: Knowledge Building/Knowledge Forum®: The Transformation of Classroom Discourse is written by Thérèse Laferrière and Mary Lamon.

Several studies have indicated that meaningful discourse is the most relevant classroom variable for learning but it is not pervasive in North American schools. Traditionally, and unlike conventional conversation or dialogue in research or professional communities, classroom discourse typically conforms to a participation structure controlled by the teacher. Teachers ask most questions, call on students to answer, and allocate turns. The discourse between teacher and students is then limited to a format with the purpose of transmitting information where the teacher already knows the answer. The typical classroom discourse structure has three turns and is composed of the following moves*: teacher initiation* (e.g., ask a question) (I), *student response* (R), and *teacher feedback/comment* (F) or *evaluation* (E) of the student's response (IRF/IRE). As stated by the authors, this chapter on knowledge building engages students in accountable talk. Accountable talk encompasses three broad dimensions: one, accountability to the learning community, in which participants listen to and build their contributions in response to those of others; two, accountability to accepted standards of reasoning, talk that emphasizes logical connections and the drawing of reasonable conclusions; and three, accountability to knowledge, talk that is based explicitly on facts, written texts, or other public information.

Chapter 25: Digital Video Tools in the Classroom: How to Support Meaningful Collaboration and Critical Advanced Thinking of Students? is written by Carmen Zahn, Karsten Krauskopf, Friedrich W. Hesse, and Roy Pea.

Whether in the arts, at home, or in the workplace—digital video and web-based video systems have brought about a large variety of filmic expression in many areas. In the workplaces, digital video technology is used for professional video analyses, as well as computer-supported collaborative work. Additionally, in the realm of Web 2.0 and the SemanticWeb, users can actively participate by creating and broadcasting their own digital videos and by designing complex information structures based on video. The annotation feature of YouTube constitutes a very recent example for this development. It enables users to add audiovisual or text-based commentaries, or to add hotspots to videos and then publish the results. In sum, in our everyday life we find many examples of video tools that include the selection of single scenes or objects from existing video information, and even the direct integration of video scenes with e-communication tools, so that the "constructive" use of video has become widely available. Concerning the practical implications of the researchers' findings, they infer that constructive video tools can be directly integrated into regular educational practice and respective curricula support learning processes and new media/visual skills acquisition. However, the effects of implicit guidance by technological affordances need to be considered as an important factor in computer-supported learning by teachers with regard to the educational goals and applied teaching strategies. As a result, the authors, in future studies, want to seek to investigate the when and how of explicit instructional support of teachers and thus address their role as facilitating catalyst for (a) optimizing learners' problem solving within the joint problem space of a complex visual design tasks, and for (b) successful integration of these tasks into classroom instruction.

Chapter 26: Technology for Classroom Orchestration is written by Pierre Dillenbourg and Patrick Jermann.

On a regular basis, new metaphors emerge in the field of learning technologies. Are they "old wine in a new bottle" or do they convey a novel idea? Is "inquiry-based" learning more than "learning from simulations"? Is "educational data mining" different from "student modeling"? Is "orchestration" just a new buzzword? It probably is but nonetheless this chapter argues that the idea of "orchestration" conveys a new approach to the relationship between classrooms and technologies. First, the authors explain why this relationship should be analyzed in terms of classroom life and not only in terms of learning outcomes. Then, they decompose this relationship by extracting 14 "design factors," first from the metaphor of "orchestration" and then from the idea of viewing a classroom as an "ecosystem". These factors relate pedagogical and technological design choices with classroom life. In the next three sections, they illustrate these factors with three learning environments they have developed and tested in real contexts. Their conclusions revisit orchestration as the management of constraints systems. This analytical chapter is restricted to the domain of formal education in co-present settings. It does not deny the interest of research on informal learning as well as on distance education but stresses the social responsibility of the research community to contribute to schooling. Their goal in presenting these examples was to show that the orchestration model, although being somewhat abstract and metaphorical, can be turned into concrete implementation choices. No method "works well" if students don't have the prerequisites. The authors indicate that they could build a long list of constraints.

Chapter 27: Knowledge Building in Society 2.0: Challenges and Opportunities is written by Jingyan Lu, Ming Lai, and Nancy Law.

This chapter first introduces how knowledge building has been used as a pedagogy to develop classroom communities; second, Web 2.0 is introduced with respect to how it transforms perceptions of knowledge as artifacts and how it is spawning modes of collaborative knowledge creation rooted in knowledge building; third, contemporary learning theories that support the understanding and application of Web 2.0 are introduced; fourth, Web 2.0 technologies, such as blogs, wikis, and social bookmarking, are discussed with respect to how their design can be informed and enhanced by knowledge building theories of learning; finally, the challenges and opportunities of web 2.0 for advancing our understanding of the new sciences of learning are discussed. Web 2.0 technologies support not only cognitive processes but also socioemotional processes by involving students in "getting to know each other, committing to social relationships, developing trust and belonging, and building a sense of on-line community". Web 2.0 technologies support learning environments that require new skills such as searching, sorting, and synthesizing wide varieties of information. Many people have witnessed great changes in educational technology. For instance, computer-assisted learning, intelligent tutoring system, computer-based learning environments, computer-supported collaborative learning, computer-supported knowledge building, and computers as cognitive tools all somehow refer to underlying changes in educational philosophy. Because information technology typically evolves faster than pedagogy they cannot guarantee the success of learning applications and Web 2.0 is no exception. The authors hypothesize that Web 2.0 technologies have the potential to facilitate knowledge building but these technologies need to be guided by theories of learning that are task and context relevant.

Chapter 28: Innovations in Culturally Based Science Education Through Partnerships and Community is written by Megan Bang, Douglas Medin, Karen Washinawatok, and Shannon Chapman.

This chapter seems to be at a different grain size and perspective than the focus of typical innovations in learning science research. The authors think it is useful to represent this side of innovative work. If learning sciences research is to have significant impact in the world on the learning and achievement of students from nondominant backgrounds, researchers must begin to recognize the real-world dynamics of community-based research. Often research projects are organized and planned around university-based models and expectations that may not be sensitive to socio-historic community contexts and relationships with science and science education. Hindsight reveals that they have made many false steps but it is also true that they seem to be moving in the right direction. Their project has not only had positive results in the areas of their initial focus but also it has had ripple effects that they did not predict.

Chapter 29: New Science of Learning: Exploring the Future of Education is written by Myint Swe Khine and Issa M. Saleh.

There is a coherent and strong opinion among educators that education in the future needs to offer qualitatively different approach to meet the demand of twenty-first century skills. Many argued that existing pedagogies and practices are unable to address the new paradigms in education. Profound needs to understand the complex processes of learning transformed by the emerging technologies and social interactions are widely debated in the academia as learning is becoming ubiquitous. In the very midst of dynamic changes and the confluence of

computers, communication, media, and culture, the notion of learning in schools as well as in communities and in social networks need to be freshly examined with theoretical lenses from interdisciplinary and transdisciplinary perspectives. Educators and research centers around the world are working to better understand the new kind of learning, the place of computers, cognition, and collaboration; they are also trying to redefine the role of teaching in enriched, engaged, and robust educational settings. The common goal is to foster deep learning and maximize the potential of next generation students in constructing knowledge, understanding, supporting, and advancing skills in their chosen fields. The chapters in this book critically examine the scientific understanding of future learning and present thought-provoking ideas, innovative approaches, systemic explorations, exemplary and promising efforts, and future-oriented scenarios in framing the new science of learning.

Conclusion

The chapters in this book are written by leading educators and researchers from well-known institutions, sharing their experiences in providing theoretical frameworks and contemporary research in the role of cognition, computers, and collaboration in education. In the last chapter the major contributions and salient features are summarized from a different perspective with a view to inform the readers about the new developments in this area. To consolidate the theoretical perspectives and advances in applications, researchers have shared their recent findings in this book. It is hoped that the chapters in this book would provide information on trends and the latest developments and thus will serve as a competence for future effort in understanding learning.

Since the developments in the area of educational communications including technology-enhanced learning are very fast, it is really difficult to follow them all. The books and chapters that are written in this field can be accepted as “out of date” too quickly. Especially any forms of online learning and the ways of using computers are “dangerous” to be accepted as current or contemporary. Conducting a research and reaching to a conclusion can become old even while you are still doing your research. In this book, although it was published in 2010, there are no chapters about Facebook in particular or more maybe importantly there are no chapters related to Twitter. These two tools are used immensely today by particularly young learners. These two environments formulate the lives of youth in these days. Lack of relevant chapters and studies about these tools make the book “out of date” in some sense. However, despite this fact, the book is valuable for people who are studying in the field of educational communications. It may be considered a starting point for young researchers.

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