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The metamorphosis of Constructivism: An investigation of Dimensionalism

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Introduction

Constructivism has been the dominant educational theory describing how individuals learn for half a century. Pioneered by such theoretical giants as Piaget and Vygotsky, it has been the central paradigm of learning for the recent past and suited well the thinking processes of educators who grew up with linear thinking. But constructivism as we know it has entered into a metamorphic stage.

Affirming that individuals "construct" their own understandings based upon their prior knowledge and experiences, constructivism seems tailor-made for the generation of individuals who are used to thinking from point A to point B. But, like the theory of behaviorism which was dominant before it, constructivism no longer adequately describes the processes by which today's individuals acquire and use knowledge. The way individuals learn today is completely different. Perhaps they don't even learn as individuals anymore! It is a socially-constructed paradigm in the beginning years of the 21st Century. Only within the last 20 years has this type of knowledge construction become possible.

Prensky (2001) identified the profound gap existing between today's students and their teachers. Using the analogy of "digital immigrants" (to denote teachers not born and raised in a technology saturated environment) and "digital natives" (to denote students who have never known a world unsaturated by technology), Prensky made a strong argument that today's students learn in a fundamentally different manner from earlier generations. Certainly not everyone agrees with Prensky's conclusions (VanSlyke, 2003 is a prime example); however, as currently practicing college professors, the authors of

this paper feel that there is enough of a difference to justify an exploration into what they choose to call *Dimensionalism*.

The authors of this paper grew up in a world without instant communication, computers, cell phones, satellite television, or the Internet. To know something we had to learn it, and by learning it we mean that we had to acquire it somehow and store it in the only place we could: our brains. We are comfortable as linear thinkers. We are quite comfortable with moving from point A to point B. We can amass huge quantities of information and "construct" our own knowledge based upon our experiences.

Our children, and the children of millions of other linear thinkers, have never lived in a world without computers, cell phones and the Internet. They do not feel the need to hoard information the way we did. If they don't know something, what do they do? They Google the information from the Internet, they instant message (IM) one of their friends, or they call someone on their cell phone. Information, to this generation, is on an as-needed basis.

What is fascinating is that these non-linear thinkers begin with the need to find out information on subject X, they then Google subject X, and, in the process of Googling subject X, they find subject Y. Finding subject Y then causes them to look at what they needed in the first place in a completely different context, sending their quest for information on a different tangent. After awhile today's information seeker (knowledge constructor or "digital native") is making associations that they never intended to when they began looking for information on the original subject.

Today's students conduct a web-search for the information they originally needed. This leads them to a particular website, but while there they click on a link that

interests them, then another and another, until they are 25 web pages away from where they originally started, and have seen their thinking morph from the original desire to something unique.

Instead of linear thinking they employ non-linear (global or dimensional) thinking that features knowledge construction far different than what the authors of this paper would accomplish in their youth. People used to have to physically go where the knowledge was located: to libraries or universities. Today, people can sit at home and the information comes to them. Even in isolation people can build knowledge.

But, the true power of the new paradigm is seen in the social nature of creating knowledge. Even those who decline to participate socially, and can do so because of the Internet, still seek to validate their knowledge through dissemination, either through the Internet or other mass communication avenues. And, for those individuals who do relate socially with others, the power of the new paradigm is profound. Interacting socially with peers leads to more knowledge being constructed and shared, which leads to more topics and more construction.

The sheer amount of opportunities for dimensional thinking is astounding. In recent years new ways to collaborate have proliferated. What began as Weblogs (blogs) has progressed to programs such as Face Book and MySpace. These avenues provide today's students with seemingly limitless opportunities for collaboration and knowledge construction.

The authors have tried to frame a discussion of this new paradigm. Noting that knowledge can exist in many forms (vocational, personal, social, cultural, and traditional) and can be acquired from many sources (technology; vocational, service and leisure

communications; familial, cultural and personal interactions; and traditional formal education); the authors propose visualizing dimensionalistic thinking much like a Rubik's® Cube.

A Rubik's Cube is a three dimensional figure consisting of six faces. Each of the faces is divided into several two-dimensional squares comprising different colors. The trick of the Rubik's Cube is to align the squares on each face so that each face is a single color. As anyone who has tried it can attest, this is far harder than it looks. In much the same way, the authors of this paper contend that knowledge creation, or learning, today is quite different than in the past. By grappling with the Rubik's Cube of Dimensionalism and striving to align all of the colors in correct order (attempting to make sense of the numerous possible combinations) we hope to begin a discussion of what today's students need. The authors feel that a new interpretation or revision of constructivism (i.e., a metamorphosis) is necessary to adequately educate students in the 21st Century.

A multilinear perspective

To facilitate a new interpretation of constructivism it is necessary to provide a brief overview of learning in general, along with a more in-depth discussion of how the concept of learning is undergoing a change. This change is exhibited in a focus on multilinear learning rather than more traditional, usually singularly linear models of learning.

Theories about learning focus on how the behaviors of people "change over time and on the environmental conditions that bring such changes about . . . (while) other theories focus more on internal mental processes" (Ormrod, 2003, p. 189). In order "for learning to occur, some types of behavioral change are required (Hellriegel & Slocum,

2007, p. 96). Various theorists perceive "learning as a process by which behavior is changed, shaped, or controlled . . . (and) other theorists prefer to define learning in terms of growth, development or competencies, and fulfillment of potential" (Knowles, Holton, & Swanson, 2005, p. 13). Learning is considered "a relatively permanent change, due to experience, in either behavior or mental associations" (Ormrod, 2003, p. 188).

Learning, therefore, can be characterized "as a process of gaining knowledge and/or expertise" and can include "key components . . . (such as) change, filling a need, learning as product, learning as process, learning as function, natural growth, control, shaping, development of competencies, fulfillment of potential, personal involvement, self-initiated, learner evaluated, independent learning, and learning domains" (Knowles, Holton, & Swanson, 2005, p. 17). Learning includes the concept of schemas which are "described as representations of past experiences that are composed of cognitions and sensory features (olfactory, tactile, taste, etc.) that are both stored and retrieved as coherent units" (James, Reichelt, ClinPsy, Freeston, & Barton, 2007, p. 51). Driscoll (2002) emphasizes that learning occurs in context and that learning is social, active, and reflective. Fennimore and Tinzman (1990) claim that: "leaning is a meaningful activity" (para. 22); "learning is thinking" (para. 22); "learning is active and interactive" (para. 26); and "learning is thinking" (para. 26). Therefore, learning is "the active, goal-directed construction of meaning" and researchers "emphasize in-depth learning; learning oriented to problem solving and decision making; learning embedded in real-life tasks and activities for thinking and communicating, and learning that builds on . . . prior knowledge and experiences" (Fennimore & Tinzmann, 1990, *Can Implementing a Thinking Curriculum Foster New Learning?*, para. 1).

Brown (2002) claims, "the World Wide Web will be a transformative medium, as important as electricity" (para. 2). Individuals "living in an information age . . . are constantly developing new information media and technologies" (Zhong, Liu, & Yao, 2007, p. 89) that provide "dynamic, global information sources" (p. 92). The familiar media such as television and books are *one-way* as they "push their content *at* us. The Web is two-way, push *and pull*" (Brown, 2002, *A New Medium*, para. 1). The challenge is to utilize "the unique capabilities of the Web to leverage the natural ways that humans learn" (Brown, 2002, *A New Medium*, para. 6). Zhong, Liu, and Yao (2007) identifies "the paradigm of Wisdom Web-based computing (that) aims to provide not only a medium for seamless information exchange and knowledge sharing but a type of artificial resource for sustainable knowledge creation, and scientific and social evolution" (p. 94).

Siemens (2004) questions how "learning theories (are) impacted when knowledge is no longer acquired in the linear manner. . . (and) . . . what adjustments need to be made with learning theories when technology performs many of the cognitive operations previously performed by learners (information storage and retrieval)" (*Limitations of Behaviorism, Cognitivism, and Constructivism*, para. 4). Competence is derived from forming connections (Siemens, 2004, *An Alternative Theory*, para. 1). Siemens (2004) cites several significant developments in the research of learning including the fact that a majority of learning occurs at the informal level instead of through a formal organization. Trends in learning indicate, "Technology is altering (rewiring) our brains (and) the tools we use define and shape our thinking" (Siemens, 2004, *Introduction*, para. 3).

The electronically mediated world, according to Lynch and McConatha (2006), may be redefining the "understanding of human interaction . . . (and) a significant

alteration in human behavior and interaction" (p. 88). Members of modern society are frequently "multiprocessing - they do several things simultaneously-listen to music, talk on the cell phone, and use the computer, all at the same time" (Brown, 2002, *Digital Learners*, para. 2). Pervasive Digital Reality (PDR) considers the global pervasiveness "of digital data, imagery, sound and knowledge that so define our world today" (Lynch & McConatha, 2006, p. 93). Benson and Mekolichick (2007) document the extensive "use of digital technology devices in American higher education" (p. 498) and the levels of commitment and comfort associated with increased "use of various digital technologies" (p. 505).

However, even though researchers claim that technology has the capability of increasing personal and professional effectiveness, technology is solely a single dimensional tool if educators do not "intertwine the teaching of advanced thinking skills with the use of technology – and make students comfortable with this interconnected use" (Stover, 2007, p. 29). Kingsley (2007) states, "technology can provide new and exciting pathways for students to demonstrate their mastery of a topic or concept" (p. 54). Technologically based assignments include "interactive multimedia to demonstrate skills and competencies for real-life situations and real-world applications involving critical thinking and complex problem solving" (Kingsley, 2007, p. 54).

The progression of online learning has reached a level of sophistication to now "integrate technology and critical thinking skills by insisting students complete online work assignments, e-mail teachers, videoconference with fellow students, and present projects and reports in a variety of multimedia formats" (Stover, 2007, p. 30). Distance education in the institutions of higher education emphasizes flexibility and collaboration

between students and faculty (Angelo, 2007). The context of face-to-face instruction is redefined, as space and time are no longer legitimate learning constraints. The social structures that once assigned absolute academic power to the teachers now is shifting "more power to students … (as) they're no longer passively waiting for professors to push information at them" (Angelo, 2007, p. 84).

Hawkes (2007) confirms that the "online learning environment (which) integrates multimedia (audio, video, graphics, etc.) and instructional content into a single delivery system under computer control" (p. 95) creates a unique instructional environment for both teachers and students. The "Internet portals represent an extension of knowledge transfer for the users" (Rodgers & Negash, 2007, p. 117) and knowledge transfer is "embedding knowledge in interactions involving people internal to an organization" (p. 119). Research completed by Rodgers and Negash (2007) "indicated that students' learning is affected by many Web-based services tools (including forums, FAQs, search, tutorial, online chat rooms, downloads, and upgrades)" (p. 118). Data collected through a survey supports that "individuals are more likely to learn, become more innovative, and increase their problem-solving skills when using enhanced Web-based technologies" (Rodgers & Negash, 2007, p. 121).

Practical applications manifested in a Cohort delivery model

Research outcomes reviewed in the previous sections support the conclusion that education is no longer characterized as a linear process of transferring knowledge from teacher to student. Although the notion of learning as an "interdependent, socially constructive, conversational process" (Bruffee, 1995 p. 115) is not new, students' access to educational technology in today's classrooms and the exponential growth in the world

store of knowledge necessitate a revised definition of social learning as a multidimensional construct. Gonzalez (2004) describes the half-life of knowledge as the span of time from acquisition of information to the time when it becomes obsolete. "The amount of knowledge in the world has doubled in the past ten years and is doubling every eighteen months according to the American Society of Training and Documentation" (para1). To counteract this rapid deterioration of information plausibility, institutions of higher learning are compelled to offer innovative instructional delivery options to address the learning needs of an increasingly diverse student body across vast distances.

This paper describes the development and implementation of one such model by university faculty. A cohort model was designed to provide graduate instruction to candidates seeking state teacher certification in special education. The two-year program combined instruction offered in seated classes with e-learning delivered through WebCT in a blended format. This instructional design aimed to address candidates' needs to learn the most current educational practices, to preserve opportunities for personal interaction during learning and to create an ongoing network for maintaining their connectivity as a learning community after program completion.

The potential impact of electronic networking on knowledge acquisition is interminable. A single student's store of knowledge may be limited by experience, personal interpretation, interest, or perception. However, when one student's expertise is combined with that of many others, the tapestry of their collective learning becomes richer, more varied, and more inclusive. Students can no longer be expected to achieve competence as independent learners. Siemens (2004) contends that competence is derived from the connections we develop with other learners and with numerous sources of

knowledge. The tightly coupled networks formed when students learn collaboratively may provide some assurance that their knowledge remains current and pertinent as long as the network is active. The constant tension between what educators know and what they need to know to be effective practitioners may be partially equalized through time sensitive learning networks. Because delivery of educational services to students with disabilities is closely regulated by state and federal legislation, this obligation for maintaining compliant practice is especially pertinent to special educators.

From a review of research history the element of interaction is regularly identified as integral to effective learning (Perry, 1968, Fish, 1980, Bruffee, 1995). Communities of learners are described as "ensembles of agents who share a common language, world, values in terms of pedagogical approach and knowledge to be acquired. They pursue a common learning goal by communicating and cooperating through electronic media in the learning process" (Seufert, Lechner, & Stanoevska, 2002, p. 47). The blended format of instruction used in the demonstration cohort model described herein afforded candidates the opportunity to develop a strong sense of connectivity as the vehicle through which effective online learning occurred. Palloff and Pratt (1999) reason that "without the support and participation of the learning community, there is no online course" (p.29). Two years following the completion of their program of study ten of the twelve cohort members still maintain an electronic communication network for professional and social interaction.

Because e-learning models vary widely in design, purpose and function, measuring their success is complicated. ONeal, Jones, Miller, and others (2007) suggest as a measurement of success the degree of satisfaction expressed by members of the

learning community. Russell (1999) reviewed 355 studies of effectiveness of distance education. His results indicated that the learning outcomes of students in e-learning models were similar to the outcomes for students receiving instruction in traditional classrooms. Phipps and Merisotis (1999) concluded that distance education and traditional classroom instruction produced similar outcomes in terms of student attitudes and satisfaction.

One author of this paper surveyed completers in the initial cohort to determine their satisfaction with the blended format. Comments such as the following were recorded:

> "I like personal interaction in my classes. The online component gave me the flexibility I needed for my family and the seated component let me discuss my ideas face to face with other students". "I liked being able to express my true feelings and ask questions without feeling embarrassed in the online sessions". "I came to depend on the immediate access to the teachers, other students and assignments using WebCT". "I felt more comfortable expressing my opinions in class and online because I knew all of the other students. I didn't have to adjust to new students with every class". "I got so much more from the theory by hearing other student's (sic) give their own examples and interpretations when we posted our reflections online". "I felt like everyone in our group was truly interested in learning and helping the other students because we studied together for so long. "I didn't like using WebCT at first, because I'm a `people person`, but I got used to the online discussions instead of the classroom discussions. I still prefer the live discussions in class". (Special Education cohort surveys, 2005)

The conclusions drawn from an analysis of the outcomes of the cohort model/blended format graduate program are these:

- Candidates favored the flexibility for scheduling their study time offered by the online component of the program.
- Candidates favored the preservation of personal interaction with one another allowed by the seated component of the program.
- Candidates were allowed time for shared knowledge building during online discussions.
- Candidates developed additional skill in accessing, evaluating and sharing a broad spectrum of resources through Internet searches.
- Candidates successfully developed and maintain a sense of community as professional colleagues. This network has been maintained following completion of their graduate program through electronic communication.

Results of statistical analysis

To determine differences between "digital immigrants" and "digital natives" a survey was developed and disseminated to graduate students (n=39) at Drury University during the fall 2007 semester. Participants were asked to respond to a questionnaire ranking the effectiveness of nine items for learning and study effectiveness. Participants were asked to rank these items for effectiveness during their high school and college educational experiences. Rankings were to be assigned through a Likert scale (1=not effective at all; 2=occasionally effective; 3=no opinion; 4=usually effective; and 5=most effective).

Participants were asked to provide demographic data indicating their age level, resulting in four age groups: 21-30 years (n=11), 31-40 years (n=9), 41-50 years (n=9) and over 50 years (n=3). The authors conducted an ANOVA to determine if there were statistically significant differences in the means for each of the nine items for learning and study effectiveness. Table 1 presents the results of the ANOVA for rankings at the high school level. Table 2 presents the results of the ANOVA for rankings at the college level.

Table 1 Results of ANOVA High School rankings

Learning and study effectiveness item	Probability
Traditional lecture type classes	0.489
Cooperative learning	0.016*
Internet/online information retrieval	0.637
Reading textbooks	0.231
e-books	0.598
Class discussions	0.472
Independent study	0.382
Online classes	0.523
Study sessions outside of class	0.489

Table 2 Results of ANOVA College rankings

Learning and study effectiveness item	Probability
Traditional lecture type classes	0.022*
Cooperative learning	0.246
Internet/online information retrieval	0.530
Reading textbooks	0.055
e-books	0.343
Class discussions	0.540
Independent study	0.196
Online classes	0.275
Study sessions outside of class	0.214

The results of the ANOVA do not provide overwhelming differences between the means of the four age groups. Only two items, cooperative learning at the high school

level and traditional lecture type classes at the college level, were significant at the 0.05 level. One additional item, reading textbooks at the college level, almost met the 0.05 significance level.

It is intriguing to note that the two areas where statistical significance was manifested were areas that typically are associated with differing pedagogical strategies. The lecture type method of teaching was very predominant in American education through most of the 20th Century being gradually replaced by other pedagogical forms, especially cooperative learning near the end of the period.

Further statistical analysis was conducted through a series of t-tests to determine if there were any statistically significant differences within each of the four age groups on any of the nine learning and studying effectiveness items. Table 3 presents the results of this analysis.

Table 3 Results of t-test analysis

Learning and study effectiveness item	Age group			
	21-30	31-40	41-50	50+
Traditional lecture type classes	0.465	0.447	0.111	0.184
Cooperative learning	0.013*	0.397	0.169	0.423
Internet/online information retrieval	0.010**	0.011*	0.002**	0.225
Reading textbooks	0.167	1.000	0.438	0.184
e-books	0.167	0.594	0.594	0.423
Class discussions	0.082	0.347	0.760	0.423
Independent study	1.000	0.282	0.559	0.423
Online classes	0.441	0.030*	0.139	0.225
Study sessions outside of class	0.025*	0.219	0.111	0.423

As shown in Table 3, there are several areas of statistical significance within the means for the various age level groups. These learning and study effectiveness items included cooperative learning (21-30 age group 0.05 level), online classes (31-40 age group 0.05 level), and study sessions outside of class (21-30 age group 0.05 level). It is

particularly insightful to look at the Internet/online information retrieval item. This item yielded statistical significance for three age groups (21-30, 31-40, and 41-50) at the 0.01 level. Surprisingly, the 50+ age group had no statistically significant differences. This is due, no doubt, to the extremely small sample size (n=3).

The 21-30 age group showed the most differences, meeting statistical significance in three areas. These results provide support that there is a difference in the learning process, especially when the youngest participants are compared with the other age groups.

While the study was conducted with small sample sizes it seems apparent that statistically significant differences exist among and within the age groups. The results should encourage further study on the metamorphosis of constructivism into dimensionalism.

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