

A Comparison of Two Theories of Learning -- Behaviorism and Constructivism as applied to Face-to-Face and Online Learning

Dr. Mary Anne Weegar
Dr. Dina Pacis
National University
San Diego, CA, USA

Abstract

The two theories of learning discussed are Behaviorism and Constructivism. Skinner and Watson, the two major developers of the behaviorist school of thought sought to prove that behavior could be predicted and controlled (Skinner, 1974). They studied how learning is affected by changes in the environment. The constructivists viewed learning as a search for meaning. Piaget and Vygotsky described elements that helped predict what children understand at different stages (Rummel, 2008). Details of both theories illuminate the differences and connections between the behavioral and constructivist theories in relationship to how children learn and how their behavior is affected. How curriculum and instruction work with these theories to promote learning and how educators view learning with respect to both theories are also reviewed.

Introduction

Many students enrolled in institutions of higher education in the United States have had experience with both face-to-face and online classes. Educational researchers have begun to examine the technological characteristics of online classes which contribute to making online classes equivalent to face-to-face classes in relationship to their pedagogical effectiveness. The growth of online learning has changed the traditional learning environment of brick and mortar

classrooms to learning in cyberspace. This environmental change has caused educators to look more closely at the way students' best experience learning in the 21st century. Behaviorism and constructivism are learning theories which stem from two philosophical schools of thought which have influenced educators' view of learning. Skinner and Watson, the two major proponents of behaviorism, studied how learning is affected by changes in the environment and sought to prove that behavior could be predicted and controlled (Skinner, 1974). Piaget and Vygotsky, were strong proponents of constructivism which viewed learning as a search for meaning and described elements that helped predict what students understand at different stages of development (Rummel, 2008). Details of both theories will be highlighted in connection to curriculum and instruction in traditional and an online learning environment.

The two theories of learning discussed in this paper are behaviorism and constructivism. Behaviorists believed that "only observable, measurable, outward behavior is worthy of scientific inquiry" (Bush, 2006, p. 14). Hence, their focus was on learning as affected by changes in behavior. They concluded that given the right environmental influences, all learners acquire identical understanding and that all students can learn. In contrast to the beliefs of behaviorists, the constructivists viewed learning as a search for meaning. They believed that knowledge is constructed by the learner and that the learner develops her/his own understanding through experience. Whereas a behaviorist would continue to look at the content to be learned and the influence of the environment upon that learning, a constructivist would be more interested in knowing how the learner is attempting to construct meaning (Bush, 2006). Given the different points of view expressed by psychologists and educators who advocate for selected theories of learning to increase student achievement, educators have the daunting task of determining from

the research how to design instruction and develop curriculum that will promote student learning in a digital, culturally and linguistically diverse society.

Behavioral Learning Theory

Psychology became an accepted science in the latter part of the nineteenth century and was defined as the science of consciousness. “Behaviorism was, and is, a moment primarily in American psychology that rejected consciousness as psychology’s subject matter and replaced it with behavior” (Leahey, 2000, p. 686). Behaviorism was rooted in the 1880s and continues to evolve in the twentieth-first century and beyond. Although behaviorism has been intensely studied, behaviorists continue to have difficulty agreeing on a definition for behaviorism and identifying who were the true behaviorists (Mills, 1998).

The publication of *The Behavioral Learning Theory* by Watson in 1913 was responsible for the movement towards behaviorism and away from functionalism. This publication was a study of the relationship between organisms and their environment (Overskeid, 2008). Watson used Pavlov’s findings on animal responses to stimuli as a basis for his work. For example, Pavlov rang a bell when his dog was going to be fed. The ringing of the bell caused Pavlov’s dog to salivate, because the dog had been conditioned to feed at this time. This behavior resulted in Pavlov asserting that canines had been conditioned to respond to external stimuli. Hence, Pavlov believed that humans could also be conditioned to respond to similar stimuli. In support of his beliefs, Pavlov demonstrated how a different musical tone, which has never been paired with receiving food, could elicit similar behavior in humans (Thomas, 1997). Watson mirrored Pavlov’s research findings in his conditioning experiment with a young child who he conditioned to fear a white rabbit by repeatedly pairing it with the loud clang of a metal bar. The child’s conditioned fear of a white rabbit was so ingrained in his behavior that he became fearful of

other white furry objects such as a Santa mask and Watson's white hair (Watson & Rayner, 1920). Although most psychologists have agreed that psychology is the study of human behavior, the only scientists that consider themselves behaviorists today are those who are followers of Skinner (Leahey, 2000). Skinner based much of his work on the study of Watson's former research. Skinner also did extensive research with animals, notably rats and pigeons, and invented the famous Skinner box, in which a rat learns to press a lever in order to receive food. Consequently, every time the rat pushed the lever, the rat obtained food, which reinforced the behavior. "The behaviorism of Watson and Skinner is based on a positivistic approach to science, that is, a reductionist view in which all that can be addressed is the relation between sensory stimuli and the unique corresponding response" (Webb, 2007, p. 1086). However, Skinner eventually came to the realization that human beings go beyond just responding to the environment. He found that they also react to the environment based on prior experiences (Skinner, 1974).

Rotfeld (2007) suggested that "psychologists 'invented' behaviorism itself as a basis for theoretical explanations, prediction, and testing" (p. 376). From its inception, the term behaviorism provided a "direction for social science research that would allow control and measurement of all relevant variables by ignoring human thought or cognition" (p. 376). Therefore, behaviorists were not interested in what might occur in people's minds; they were only interested in behavioral responses. As a result, these responses were measured in relation to test stimuli. In other words, behaviorists saw this as a way for them to be viewed as scientific in the same way as the hard sciences of chemistry or physics are viewed. By narrowing their focus, the behaviorists provided for greater use of statistical analysis of experimental results. Their goal was to achieve a greater use of scientific methods for developing stronger theories.

Skinner (as cited by Gregory, 1987) stated that the mind and mental processes are "metaphors and fictions," and that "behavior" is a function of the "biology" of the organism. Skinner expressed no interest in understanding how the human mind functioned. He was a behaviorist in the strictest sense as was John Watson. Both Skinner and Watson were only concerned with how behavior is affected by external forces. Skinner believed that everything human beings do is controlled by their experience. Therefore, the "mind" (not the brain) had nothing to do with how people behaved. Furthermore, thoughts, feelings, intentions, mental processes, and so forth have no bearing on what humans do. Skinner was known for making audacious statements in keeping with Watson's tradition of being provocative and controversial to gain people's attention (WGHB, 1998).

The history of behaviorism in educational technology can be found in a teaching machine constructed by Skinner in 1958. Skinner's teaching machine was a rote-and-drill machine where individual instruction was presented in the form of a book; the machine housed, displayed, and presented programmed instruction. This teaching machine can be viewed as a form of early technology which can be compared to today's basic educational software. An example of how the Teaching Machine was used is described by Skinner (1958) as follows: "In using the device the student refers to a numbered item in a multiple-choice test. He presses the button corresponding to his first choice of answer. If he is right, the device moves on to the next item; if he is wrong, the error is tallied, and he must continue to make choices until he is right" (p. 971). Though basic, it is easy to see the similarity between the teaching machine and many of today's educational software programs. Like the teaching machine, computer software designed for students help to reinforce student behavior. Skinner's early work and findings with the teaching machine can be applied to modern day computer programs, they are fundamentally the

same. Skinner's teaching machine provides a connection to today's digital world which can be generalized and described as the roots of behaviorism.

Robert Gagne's early work focused on behaviorism with special attention being given to military training. This notion of order, of drill and practice in the military is very much what modern day instructional computer programs look like. In an online learning environment, behaviorism involves chunking curriculum into smaller instructional steps. These smaller more manageable steps can then be repeated with ongoing monitoring of student learning.

Constructivist Learning Theory

The learning theory of Constructivism evolved from the extensive study of cognitive development (i.e., how thinking and knowledge develop with age) by Swiss psychologist Jean Piaget and the Russian psychologist Lev Vygotsky. Their study of cognitive development provided the foundation for the psychological theory of constructivism. Constructivists believe that children develop knowledge through active participation in their learning. However, Piaget believed that cognitive development was a product of the mind "achieved through observation and experimentation whereas Vygotsky viewed it as a social process, achieved through interaction with more knowledgeable members of the culture" (Rummel, 2008, p. 80). Piaget referred to his work as "cognitive" constructivism (Chambliss, 1996). Piaget's theory was comprised of two major elements "ages" and "stages." According to Piaget, "these elements help to predict what children can and cannot understand at different ages." (Rummel, 2008, p. 80). It is the theory of development that is the major foundation for cognitive constructivist approaches to teaching and learning.

Piaget's theory of cognitive development suggested that humans are unable to automatically understand and use information that they have been given, because they need to

“construct” their own knowledge through prior personal experiences to enable them to create mental images. Therefore, the primary role of the teacher should be to motivate the children to create their own knowledge through their personal experiences (Rummel, 2008). Vygotsky referred to his work as “social” constructivism. Vygotsky’s theory was very similar to Piaget’s assumptions about how children learn, but Vygotsky placed more importance on the social context of learning. In Piaget’s theory, the teacher played a limited role whereas in Vygotsky’s theory, the teacher played an important role in learning. Learning activities in constructivist settings are characterized by active engagement, inquiry, problem solving, and collaboration with others. Rather than a dispenser of knowledge, the teacher is a guide, facilitator, and co-explorer who encourage learners to question, challenge, and formulate their own ideas, opinions, and conclusions. “How constructivism is interrupted and whether the learning strategies account for individual and social diversity are issues that gain limited attention during curriculum development” (Gulati, 2008, p. 184).

Constructivism is more challenging to define historically as there are many educational strategies that can be described as constructivist in nature. Some examples are projects where students learn by discovering on their own, to students collaborating with others and learning through this interaction. Constructivist theories, helped build the foundation for curriculum design. Hypermedia and multimedia are examples of online instructional approaches that are more constructivists in nature and have resulted in an emphasis on problem solving for students. This is a primary characteristic of the constructivism theory, and though positive aspects of Behaviorism in learning have emerged, there has been an ongoing shift toward more Constructivist learning situations involving problem solving (Sutton, 2003). The main argument is that learners actively construct their own knowledge based on their own experiences. This has

resulted in an increase in popularity for the constructivist approach when utilizing instructional technologies. The use of interactive problem based learning (PBL) is an example of the constructivist approach (Camp, 1999). Problem based learning (PBL) is one method which allows students to apply their knowledge to real world scenarios and applications through the use of online learning.

Epistemological Comparison

Epistemology is an area of philosophy that examines questions about how we know what we know. As philosophers attempted to answer questions, they developed answers that are clustered in different schools of thought. “These schools of philosophical thought are somewhat contrived; they are merely labels developed in an attempt to show the similarities and differences among the many answers philosophers develop” (Johnson, Musial, Hall, Gollnick, & Dupuis, 2008, p. 102). Four well known philosophical schools of thought are idealism, realism, pragmatism, and existentialism.

Each of the aforementioned philosophies has implications for education. The idealist is idea centered rather than subject or child centered. The idealist believes that the teacher is central to learning. Therefore, the idealist tends to emphasize lecture, discussion, and imitation. The realist sees the role of the teacher as a person who presents content in a systematic and organized way. Contemporary realists are behind standardized tests, serialized textbooks, and specialized curriculum for each discipline. The pragmatist stresses applying knowledge—using ideas for problem solving. Realists and idealists are most closely associated with the behaviorist’s theory of learning, because they believe in a standardized curriculum centered on academic disciplines. Pragmatists prefer a curriculum that is interdisciplinary, and they are, therefore, most closely associated with the constructivists’ beliefs about how students learn best (Johnson et al., 2008).

The beginning of the 20th century ushered in the new school of behaviorism. Behavioral psychologists believed that “only observable, measurable, outward behavior is worthy of scientific inquiry” (Bush, 2006, p. 15). Because there appeared to be a link between the effects of reinforcement on learning, scientists were considered to be connectionists reflecting the connection between stimulus and response and conditioning. In other words, scientists believed all students can learn the same information given appropriate environment. The most recognized behaviorist of the time was B. F. Skinner who believed that all learning was measurable through observing changed behavior. As scientific studies in psychology “continued to test the connection between stimulus and response (and classical and operant conditioning), limitations on the explanations of changed behavior developed a rift within behaviorism” (Bush, 2006, p. 16).

According to Morrison, Ross, and Kemp (2004), the behaviorist learning theory placed an emphasis on the effects of external conditions such as rewards and punishments in determining future behaviors of students. The behaviorist learning theory focused mainly on objectively observable behaviors and, consequently, discounts mental activities. This approach emphasized the “acquisition of new behavior” (Bednar, Cunningham, Duffy, & Perry, 1992). Behaviorists believed that all behavior is the result of an individual’s responses to external stimuli (operant conditioning). In other words, behaviorists believed that the external environment contributed to the shaping of an individual’s behavior. Behaviorists also believed that the environment triggered a particular behavior, and whether the behavior occurs again is dependent upon how an individual is affected by the behavior.

In a school setting, teachers use positive and negative reinforcements to either reward or punish a student’s behavior. The behaviorist learning theory relies on extrinsic motivators such

as grades, prizes, and privileges, as well as recognitions and praises, as a means to ensure the replication of the learned activity or behavior. Teachers who followed the behaviorist learning theory would present lesson objectives in a linear fashion. In so doing, the teacher would provide hints or cues to guide students to a desired behavior, and then use consequences to reinforce the desired behavior. Behaviorists begin by introducing lower-level cognitive skills. This is followed by the building of higher-level cognitive skills. The problem with this type of instruction is that lessons are focused on learning skills in isolation (Gonzalez, n.d.). Those who disagree with the behaviorist theory believed that this theory failed to take into consideration the influence the mind has over behavior. Therefore, instead of involving students in solving problems, behaviorists use methods of direct instruction (i.e., lecturing and teaching skills in isolation) and assess their learning based on their responses to questions on oral or written tests.

In the case of online learning the external environment is not a tangible space such as the brick and mortar classroom, but one that must be facilitated and nurtured in cyberspace by online instructors. Many educators do not feel an external online environment can provide the same degree of impact to student learning that is possible in face to face classrooms. From the behaviorists' standpoint, cyberspace does not allow for the instructor to develop a relationship to a deep degree that is possible with face to face courses. However, there are new technologies that are allowing for better synchronous communication. These technologies allow instructors to provide rewards and feedback in real time. Instructors and students, who are challenged by written online communication, may find that this type of synchronous online communication may help them to bridge this gap.

“After being the dominant paradigm in American psychology for some decades, behaviorism was overtaken by a variety of research results that yielded anomalies revealing its

limitations as an overall account of psychological functioning” (Wakefield, 2007, p. 170). As the field of psychology continued to evolve, researchers began to reject behaviorism and seek ways to identify cognitive processes in learned behaviors (Fisher, 2008). This led to the development of the field of cognitive science, which “includes the study of thinking, perception, emotion, creativity, language, consciousness and learning” (Harman, 2008, p. 76).

Constructivism "is the philosophy, or belief, that learners create their own knowledge based on interactions with their environment including their interactions with other people" (Draper, 2002, p. 522). Constructivists understand learning as an interpretive, recursive, building process by active learners interrelating with the physical and social world (Fosnot, 1996). Constructivism has been proven effective in assisting teachers in meeting the challenge of improving student achievement. “Assuming the role as ‘guide on the side’ requires teachers to step off the stage, relinquish some of their power, and release the textbooks to allow their students to be actively engaged and take some responsibility of their own learning” (White-Clark, DiCarlo, & Gilchrist, 2008, p. 44). Furthermore, constructivism involves developing the student as a learner through cooperative learning, experimentation, and open-ended problems in which students learn on their own through active participation with concepts and principles (Kearsley, 1994).

Teachers, who use constructivist theory, concentrate on showing students relevance and meaningfulness in what they are learning. For example, in the constructivist classroom teachers would pose realistically complex and personally meaningful problems for students to solve. Students would then work in cooperative groups to explore possible answers, develop a product, and present findings to a selected audience (Carbonell, 2004). “Cooperative learning, hands-on activities, discovery learning, differentiated instruction, technology, distributed practice, critical

thinking, and manipulatives are elements that embrace the constructivist educational philosophy” (White-Clark, et al., 2008, p. 41).

Teachers who utilize the constructivist theory of learning online can provide discovery learning as well as critical thinking activities through threaded discussions as well as problem based learning projects. These are activities that can be done asynchronously but can be a more powerful learning experience when done synchronously and collaboratively with other students and/or instructor. These types of activity require online instructors to understand the cyberworld in order for instruction to be effective.

Impact on Curriculum Development

Historically, the application of psychological theories to education was not consistent. John Dewey (1938) was credited for beginning the constructivist movement. In fact, the whole thinking-skills movement began for the most part with Dewey's work (Sternberg, 2008). “The three fundamental learning theories that were found to be most important in the formulation of the learning design model were those based upon behaviorism, cognition and constructivism (including both socio-constructivism and communal constructivism)” (Barker, 2008, p. 130). The behavioral theory has influenced curriculum development for many years. Behaviorists view learning as a process that results from the connections created from a stimuli-response relationship, and the desire to learn is assumed to be driven by these relationships (Kim & Hatton, n.d.). Furthermore, the behavioral theory focuses primarily on objectively and observable behaviors.

Curriculum for the constructivist learning model is designed to actively engage the students in their learning. The learning that occurs for students is considered an internal cognitive activity where students are allowed to construct knowledge (models) from their

classroom experience. The teacher's role is to facilitate and negotiate meaning, rather than to dictate an interpretation (Driscoll, 2005). Kumar (2006) developed a constructivism oriented instructional framework to bridge the gap between theory and practice. This framework suggested a repertoire of heuristic instructional strategies that facilitated students' independent construction of various classes of scientific knowledge. Constructivism promotes learning to be an active process in which learners construct new concepts based upon prior knowledge. Learners select and process information through constructing hypotheses, decision making, and giving meaning and organization to experiences. Appropriate instructional strategies need to be framed to facilitate student learning of declarative and procedural knowledge through constructivist pedagogy.

Impact on Instructional Design

Behaviorists believed that meaning exists in the world separate from personal experience. All instructional goals are framed in specific, behavioral, and observable terms. In this approach, the instructor is the focus of the presentation and interaction. Teachers work with the individual students when they need extra help. The student's role is to absorb instructional presentations and material, and use them to create performances which indicate attainment of correct mental models. Structured assignments are directly linked to the learning objectives. There is minimal or no cohort discussion in this model of direct instruction. Assessment and evaluation are based upon individual tests and performances to demonstrate mastery of entities, activities, and processes.

Many aspects of behaviorism have led to the development of important instructional technologies Sutton (2003). Examples of behaviorism in online instruction are educational software and computer-assisted instruction. Drill and practice tutorials are designed to reward

students “through an encouraging comment before moving on to the next learning objective” (Shield, 2000, p. 1). Shield (2000) concluded that “the student's mastering of basic technological terms, descriptions of components, and understanding of theory behind technical processes can be achieved through structured programs delivered through software programs or similar media” (p. 1). Current behaviorists believe that students learn by memorizing chunks of information before higher-level, problem-based learning can take place (Shield, 2000). Shield (2000) believes that much of today's curriculum focuses on these memorized bits of information and concludes behaviorist practices are still relevant in today's digitized world.

“The Conditions of Learning” reflecting the behaviorist thought process was created by Gagne who identified five categories of learning. These categories were verbal information, intellectual skills, cognitive strategies, attitudes, and motor skills. According to Gagne, different internal and external conditions are necessary for each type of learning. For example, for Constructivist learning, strategies to be learned, there must be a chance to practice developing new solutions to problems; to learn attitudes, the learner must be exposed to a credible role model or persuasive arguments (Driscoll, 2005).

When reviewing the impact of constructivism on instructional design, much of the research was attributed to the work of Dewey, Piaget and Vygotsky. The overall philosophy of these constructivists holds that learners impose meaning on the world, and so construct their own understanding based on their unique experiences. All instructional goals are framed in experiential terms specifying the kinds of learner problems addressed; the kinds of control learner's exercise over the learning environment; the activities in which they engage and the ways those activities could be shaped by leaders or instructors; and the ways in which learners reflect on the results of their activity together.

Examples of constructivism can be found in a number of instructional designs. In an attempt to formulate a comprehensive adult learning theory Knowles (1973) developed a theory to address the needs of the adult learner. Knowles labeled the instructional design “andragogy”. Knowles' theory of andragogy is an attempt to develop a theory specifically for adult learning. Knowles emphasized that adults are self-directed and expect to take responsibility for decisions. Andragogy makes the following assumptions about the design of learning: (a) Adults need to know why they need to learn something; (b) Adults need to learn experientially; (c) Adults approach learning as problem-solving; and (d) Adults learn best when the topic is of immediate value.

With the growing popularity of online learning, a growing emphasis on incorporating the constructivist approach, when implementing instructional technologies exists. Some examples of how to make this transition is to shift our focus from the design of software packages (which act solely as storehouses of information) to an interactive problem-based environment in which the student is empowered to take charge of his or her own learning. The creation of these rich learning environments will include fully integrated courses complete with texts, reference sources, multimedia and communication (Shield, 2000). Learning, if authentic, provides relevance to the learner, and is a “primary catalyst of knowledge construction” (Camp, 1999, p. 1). Constructivist ideals have a place in today’s educational practices, as real-world constructivist learning situations allow students to use their practical application of knowledge. There is clearly a need for this learning as well as rote memorization, as much of what students will do as adults relies heavily on practical applications.

Conclusion

Overskeid (2008) discussed how psychology was redefined in the late 1950s and the 1960s when many psychologists began practicing cognitive psychology, which examined how people problem solve behaviorism, memorize information, and use language. Others believed that science would gain little from studying mental phenomena instead of behavior, its antecedents, and consequences. This latter group of people, often consisting of behaviorists, and guided by Skinner, continued to attack those who subscribe to constructivism. Those who wished to return to behaviorism viewed cognitive psychology as having a fundamental weakness in thinking that mental processes could be measured.

In education today, there continues to be considerable debate as to whether teachers practice behaviorism, the dispensing of information through direct instruction or through constructivism, the practice of being facilitators of learning. Constructivism has a point of view that is presently considered the more popular of the two theories in “education policies, education models and education practices focus on constructivism” (Brown, 2006, p. 109). Undoubtedly, most educators would agree that neither learning theory is flawless in its perception of how students learn and how teachers should instruct. There are two significant differences between the theories in defining the role of the classroom teacher. In a teacher-centered classroom, the teacher assumes the responsibility for instruction. In a learner-centered classroom, the learner accepts the responsibility for his/her learning. The traditional view of education is rooted in the research performed by Piaget (as cited in Moore, 2001) who believed “students develop according to a maturational unfolding of their abilities. Therefore, the set of cognitive structures possessed at each stage of development defines what they (students) can and cannot do” (p. 49). On the other hand, Fosnot (1996) suggested that constructivism views learning as an interpretive, recursive, and building process by which active learners

interrelate with the physical and social world. Kruse (1998) supported Fosnot's views on constructivism, because he also indicated that this approach has shown to have a positive effect on students' ability to increase their knowledge. Although theorists and educators will continue to debate the strengths and weaknesses of both theories, it is important to remember that there are ongoing shifts in the promotion of educational theories.

Behaviorism and Constructivism

Behaviorism and constructivism continue to be relevant in today's world of online education. Implications for online learning need to be determined so that successful practical applications can be identified and implemented to positively affect learning. The use of technology in online courses has slowly shifted the theoretical balance from behaviorism to constructivism due to the increased use of educational technologies. More often instructors are choosing to utilize a combination of these two learning styles in an effort to best meet the learning styles for all students. In summary, there appears to be a theoretical shift more often than not from behaviorist learning practices to constructivist learning practices related to the increased use of educational technologies, and stemming from the fact that many available technologies support constructivist learning platforms. However, there are still many learning practices that focus on more behaviorist learning techniques, and there are arguments in support of their validity as well. The current learning technique with the most support is more of a blending of the two theories, because they can be used in conjunction while utilizing educational technology. There are many factors to be considered when deciding which theory is more valid in certain practices, including curriculum, assessment, and resources. Though there seems to be a shift toward more constructivist learning practices or a blending of the two learning theories, the road ahead in determining precisely what should be done by educators still remains vague.

There are many important factors involved along with challenges to both theories. However, it is possible that these trends may be analyzed but put into practice in a variety of ways without any standardization. There are so many factors involved that this debate seems to fall to the choice of individual educators, and may, in fact, continue along this path as educators look toward the future of educational technology integration.

References

- Arts in Education Institute of Western New York (2002). *Constructivist Learning Theory*. Retrieved January 21, 2008, from, <http://www.artsined.com/teachingarts/Pedag/Dewey.html>
- Barker, P. (2008). Re-evaluating a model of learning design. *Innovations in Education and Teaching International*, 45(2), 127-142.
- Bednar, Cunningham, Duffy, & Perry (1992). Theory into practice: How do we link? Handbook of research for educational communications and technology.
- Brooks, J.G. & Brooks, M.G. (1995). *Constructing Knowledge in the Classroom*. Retrieved January 21, 2008, from <http://www.sedl.org/scimath/compass/v01n03/1.html>
- Brown, T. H. (2006). Beyond constructivism: Navigation in the knowledge era. *On the Horizon*, 14(3), 108-118. Retrieved June 8, 2008, from ProQuest database.
- Bush, G. (2006). Learning about learning: from theories to trends. *Teacher Librarian*, 34(2), 14-19.
- Camp, W. G., & Doolittle, P. E. (1999). Constructivism: The career and technical education perspective. *Journal of Vocational and Technical Education*, 16 (1).
- Carbonell, L. (2004) *Instructional Development Timeline*. Retrieved January 21, 2008, from <http://www.my-ecoach.com/idtheline/learningtheory.html>
- Chambliss, J.J. (1996). *Philosophy of education: An encyclopedia*. New York & London: Garland Publishing Company.
- Dewey, J. (1938). *Experience and Education*. New York, NY: The MACMILLAN Company.
- Draper, R. J. (2002). School mathematics reform, constructivism, and literacy: A case for literacy instruction in the reform-oriented math classroom. *Journal of Adolescent & Adult Literacy*, 45(6), 520-529.

- Driscoll, M. (2005). *Psychology of Learning for Instruction*, (3rd ed.). Boston, MA: Pearson Education Inc.
- Fisher, P. (2008). learning about literacy: from theories to trends. *Teacher Librarian*, 35(3), 8-13.
- Fosnot, C.T. (1996). *Constructivism: Theory, perspectives, and practice*. New York: Teachers College Press.
- Gagne, R., Briggs, L. & Wager, W. (1992). *Principles of Instructional Design* (4th Ed.). Fort Worth, TX: HBJ College Publishers.
- Gonzalez, J.C. (n.d.). *Constructivism vs. direct Instruction*. Retrieved January 21, 2008, from, Harlandale Masters On-Line.
- Gregory, R.L. (1987). *The Oxford Companion to the Mind*. Oxford: Oxford University Press.
- Gulati, S. (2008). Compulsory participation in online discussions: Is this constructivism or normalization of learning? *Innovations in Education and Teaching International*, 45(2), 183-193. Retrieved May 20, 2008, from ProQuest database.
- Harman, G. (2008). Mechanical mind. *American Scientist*, 96(1), 76-79.
- Johnson, J. A., Musial, D., Hall, G. E., Gollnick, D. M., & Dupuis, V. L. (2008). *Foundations of American education: Perspectives on education in a changing world* (14th ed.). Boston, MA: Pearson Education Inc.
- Kearsley, Greg (1994). *Constructivist Theory*. Retrieved January 21, 2008, from <http://tip.psychology.org/bruner.html>
- Kim, C., & Hatton, N. (n.d.). Cognitive theory and curriculum application. Retrieved January 21, 2008, from <http://www.umm.maine.edu:300/education/students/curriculumDesign/Hatton.htm>
- Knowles, M.S. (1973). *The Adult Learner: A Neglected Species*. Houston: Gulf Publishing Company.
- Kruse, G. D. (1998). Cognitive science and its implications for education. *NASSP Bulletin*, 82 (598), 73-79.
- Kumar, M. (2006). Constructivist epistemology in action. *The Journal of Educational Thought*, 40(3), 247-262.
- Leahey, T. H. (2000). Control: A history of behavioral psychology. *The Journal of American History*, 87(2), 686-687.
- McBrien J.L. & R.S. Brandt (1997). *The language of learning: A guide to education terms*. Alexandria, VA: Association for Supervision and Curriculum Development.

- Mills, J. A. (1998). *Control. A history of behavioral psychology!* New York, NY: New York University Press.
- Moore, J. (2001). On certain assumptions underlying contemporary education practices. *Behavior and Social Issues*, 11, 49-64.
- Morrison, G. R., Ross, S. M., & Kemp, J. E. (2004). *Design effective instruction*. Wiley Jossey-Bass. Hoboken, NJ.
- Overskeid, G. (2008). They should have thought about the consequences: The crisis of cognitivism and a second chance for behavior analysis. *The Psychological Record*, 58(1), 131-152.
- Rotfeld, H. H. (2007). Theory, data, interpretations, and more theory. *The Journal of Consumer Affairs*, 41(2), 376-380.
- Rummel, Ethan. (2008). Constructing cognition. *American Scientist*, 96(1), 80-82.
- Shield, G. (2000). A critical appraisal of learning technology using information and communication technologies. *Journal of Technology Studies*.
- Skinner, B. F. (1948). *Walden Two* Indianapolis, IN: Hackett Publishing Company.
- Sternberg, R. Applying psychological theories to educational practice. *American Education Research Journal*, 45(1), 150-166).
- Thomas, R. K. (1997). Correcting some Pavlovian regarding "Pavlov's bell" and Pavlov's "mugging." *American Journal of Psychology*, 110, 115-125.
- Wakefield, J. C. (2007). Is behaviorism becoming a pseudoscience? Replies to Drs. Wyatt, Midkiff and Wong. *Behavior and Social Issues*, 16(2), 170-190.
- Watson, J. B. & Rayner, R. (1920). Conditioned emotional responses. *Journal of Experimental Psychology*, 3, 1-14.
- Webb, J. L. (2007). Pragmatisms (Plural) part I: Classical pragmatism and some implications for empirical inquiry. *Journal of Economic Issues*, 41(4), 1063-1087.
- WGHB (1998). *A science odyssey: People & discoveries*. Retrieved May 20, 2008, from, <http://www.pbs.org/wgbh/aso/databank/entries/bhskin.html>
- White-Clark, DiCarlo, M., & Gilchrist (2008). "Guide on the side": An instructional approach to meet mathematics standards. *The High School Journal*, 91(4), 40-45.