

Constructivism and Online Education

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Constructivism is a theory of learning that has roots in both philosophy and psychology. The essential core of constructivism is that learners actively construct their own knowledge and meaning from their experiences (Fosnot, 1996; Steffe & Gale, 1995). This core has roots that extend back through many years and many philosophers, including Dewey (1938), Hegel (1807/1949), Kant (1781/1946), and Vico (1725/1968). Philosophically, this essence relies on an epistemology that stresses subjectivism and relativism, the concept that while reality may exist separate from experience, it can only be known through experience, resulting in a personally unique reality. von Glasersfeld (1984, 1990) proposed three essential epistemological tenets of constructivism to which a fourth has been added in light of recent writings.

1. Knowledge is not passively accumulated, but rather, is the result of active cognizing by the individual;
2. Cognition is an adaptive process that functions to make an individual's behavior more viable given a particular environment;
3. Cognition organizes and makes sense of one's experience, and is not a process to render an accurate representation of reality; and
4. Knowing has roots in both biological/neurological construction, and social, cultural, and language based interactions (Dewey, 1916/1980; Garrison, 1997, 1998; Gergen, 1995; Maturana & Varela, 1992).

Thus, constructivism acknowledges the learner's active role in the personal creation of knowledge, the importance of experience (both individual and social) in this knowledge creation process, and the realization that the knowledge created will vary in its degree of validity as an accurate representation of reality. These four fundamental tenets provide the foundation for basic principles of the teaching, learning, and knowing process as described by constructivism. As will be seen, however, these tenets may be emphasized differently, resulting in various "degrees" or "types" of constructivism.

Types of Constructivism

Constructivism is not a unitary theoretical position; rather, it is a continuum. The assumptions that underlie this continuum vary along several dimensions and have resulted in the definition and support for multiple types of constructivism. Typically, this continuum is divided

into three broad categories: Cognitive Constructivism, Social Constructivism, and Radical Constructivism.

Cognitive Constructivism. Cognitive constructivism represents one end, or extreme, of the constructivist continuum and is typically associated with information processing and its reliance on the component processes of cognition. While emerging from the four, previously mentioned, epistemological tenets, cognitive constructivism only emphasizes the first two tenets, that is, that knowledge acquisition is an adaptive process and results from active cognizing by the individual learner. These particular epistemological emphases lead to defining principles that maintain the external nature of knowledge and the belief that an independent reality exists and is knowable to the individual. Knowledge then, from the cognitive constructivist position, is the result of the accurate internalization and (re)construction of external reality. The results of this internalization process are cognitive processes and structures that accurately correspond to processes and structures that exist in the real world. This claim, that reality is knowable to the individual, differentiates cognitive constructivism from both social and radical constructivism.

This process of internalization and (re)construction of external reality is learning. That is, learning is the process of building accurate internal models or representations that mirror or reflect external structures that exist in the "real" world. This perspective on learning focuses on (a) the procedures or processes of learning, (b) how what is learned is represented or symbolized in the mind, and (c) how these representations are organized within the mind.

Cognitive constructivism, as a learning theory, is often considered a "weak" form of constructivism, within the constructivist community, since it only embraces two of the four epistemological tenets. "Weak" in this case is not a value judgement, such as better or worse, but rather merely an indication of adherence to foundational assumptions. Thus, knowledge construction is considered primarily a technical process of creating mental structures, but has little bearing on the nature of the subjective knowledge within the mind. However, cognitive constructivism, and its historical association with information processing, has led to a multitude of significant empirical findings regarding learning, memory, and cognition, including schema theory, working memory models, computational models of learning and memory, and neurological models of brain function. In addition, each of these theoretical advances has led to successful instructional applications, such as the use of advanced organizers, concept maps, teaching for transfer, elaborative practice, teaching for automaticity, and the use reading strategies (e.g., SQ3R; Survey, Question, Read, Recite, Review) and problem solving strategies (e.g., IDEAL; Identify problems, Define goals, Explore strategies, Act, Learn). Thus, while the cognitive constructivist perspective has proved to be quite beneficial to the understanding of learning and instruction, it remains the "black sheep" of the constructivist community since its focus does not include the subjective nature of knowledge.

Radical constructivism. Radical constructivism represents the opposite end of the constructivist continuum from cognitive constructivism. Radical constructivism fully embraces the first three epistemological tenets, that is, that knowledge acquisition is an adaptive process that results from active cognizing by the individual learner, rendering an experientially based mind, not a mind that reflects some external reality. In addition, there is a current movement within radical constructivism to more fully accept the fourth epistemological tenet, thus recognizing social interactions as a source of knowledge (see Larochelle, Bednarz, & Garrison, 1998). These particular epistemological emphases leads to defining principles that maintain the internal nature of knowledge and the idea that while an external reality may exist, it is unknowable to the individual (von Glasersfeld, 1990, 1996). Reality is unknowable since our experience with external forms is mediated by our senses, and our senses are not adept at rendering an accurate representation of these external forms (e.g., objects, social interactions). Therefore, while knowledge is constructed from experience, that which is constructed is not, in any discernible way, an accurate representation of the external world or reality (von Glasersfeld, 1990, 1995).

The adaptive nature of knowledge underscores that knowledge is not objective "truth," that is, internal knowledge does not match external reality, but rather is a viable model of experience (von Glasersfeld, 1995). These viable models are created within an individual, influenced by the context within which an activity was experienced, and relative to the accomplishment of a particular goal. Thus, according to Staver (1995), "knowledge is knowledge of the knower, not knowledge of the external world; improving knowledge means improving its viability or fit in, but not match with, an external world" (p. 1126).

An evaluation of radical constructivism results in radical constructivism being considered a "strong" form of constructivism, as it fully embraces three of the constructivist epistemological tenets and at least partially embraces the fourth. That is, radical constructivism is concerned with both the construction of mental structures, the position of cognitive constructivists, and the construction of personal meaning. In this sense, radical constructivism involves a greater degree of construction than does cognitive constructivism, involving two planes of construction, structure and meaning, rather than only one, structure.

Social constructivism. Social constructivism lies somewhere between the transmission of knowable reality of the cognitive constructivists, and the construction of a personal and coherent reality of the radical constructivists. Social constructivism, unlike cognitive and radical constructivism, emphasizes all four of the previously mentioned epistemological tenets. These particular epistemological emphases lead to defining principles that maintain the social nature of knowledge, and the belief that knowledge is the result of social interaction and language usage,

and thus is a shared, rather than an individual, experience (Prawatt & Floden, 1994). In addition, this social interaction always occurs within a socio-cultural context, resulting in knowledge that is bound to a specific time and place (Gergen, 1995; Vygotsky, 1978). This position is exemplified by Bakhtin (1984), "truth is not to be found inside the head of an individual person, it is born between people collectively searching for truth, in the process of their dialogic interaction" (p. 110). Truth, in this case, is neither the objective reality of the cognitive constructivists nor the experiential reality of the radical constructivist, but rather is a socially constructed and agreed upon truth resulting from "co-participation in cultural practices" (Cobb & Yackel, 1996, p. 37).

Like radical constructivism, social constructivism would be considered a "strong" form of constructivism, emphasizing all four of the epistemological tenets. However, social constructivists generally downplay the mental construction of knowledge (not because social constructivists do not believe in mental construction but because it is seen as relatively trivial) and emphasize the co-construction of meaning within a social activity. In this sense, social constructivism is more concerned with meaning than structure.

Constructivist Pedagogy

Cognitive constructivists emphasize accurate mental constructions of reality. Radical constructivists emphasize the construction of a coherent experiential reality. Social constructivists emphasize the construction of an agreed-upon, socially constructed reality. Is there room for common pedagogy?

Constructivist pedagogy, the link between theory and practice, suffers from the breadth of its theoretical underpinnings. Many theorists and practitioners (Brooks & Brooks, 1993; Driscoll, 1994; Jonassen, 1991) have generated constructivist pedagogies with an array of results. While these pedagogies share a set of core design principles, the peripheral principles tend to vary greatly. The general theoretical and practical constructivist consensus, however, across all three types of constructivism, indicates that eight factors are essential in constructivist pedagogy (Brooks & Brooks, 1993; Larochelle, Bednarz, & Garrison, 1998; Steffe & Gale, 1995). It should be noted, though, before the discussion of these principles begins, that these principles are not solely constructivist in nature. Indeed, all of these principles have been proposed by other theories/theorists in other times. What makes this list "constructivist" is the assemblage of these specific principles and the basis/rationale for their inclusion.

1. Learning should take place in authentic and real-world environments. Whether building accurate representations of reality, consensual meanings in social activities, or personally coherent models of reality, experience is paramount. Experience, both socially

oriented and object oriented, is a primary catalyst of knowledge construction. Experience provides the activity upon which the mind operates. In addition, knowledge construction is enhanced when the experience is authentic. For the cognitive constructivist, authentic experiences are essential so that the individual can construct an accurate representation of the "real" world, not a contrived world. For the social and radical constructivists, authentic experiences are important so that the individual may construct mental structures that are viable in meaningful situations.

2. Learning should involve social negotiation and mediation. While only social constructivism emphasizes social interaction as a basis for knowledge construction, cognitive and radical constructivisms do assign social interaction a role. Social interaction provides for the development of socially relevant skills and knowledge, as well as providing a mechanism for perturbations that may require individual adaptation. In some cases, such as cultural mores and culturally arbitrary rituals (e.g., greetings, gender relations, dress), knowledge can only be attained through social contact. In addition, as an individual gains experience in a social situation, this experience may verify an individual's knowledge structures or it may contradict those structures. If there is contradiction or confusion, then the individual must accommodate this contradiction in order to maintain either an accurate model of reality or a coherent personal or social model of reality. Finally, an integral component of social mediation is the use of language. Language is the medium through which knowledge and understanding are constructed in social situations (Spivey, 1997).

3. Content and skills should be made relevant to the learner. All three types of constructivism emphasize the concept that knowledge serves an adaptive function. If knowledge is to enhance one's adaptation and functioning, then the knowledge attained (i.e., content and skills) must be relevant to the individual's current situation, understanding, and goal. This relevancy is likely to lead to an increase in motivation (Pintrich & Schunk, 1996), as the individual comes to understand the need for certain knowledge. Ultimately, experience with relevant tasks will provide the individual with the mental processes, social information, and personal experiences necessary for enhanced functioning within one's practical environment.

4. Content and skills should be understood within the framework of the learner's prior knowledge. All learning begins within an individual's prior knowledge, regardless of constructivist affiliation. Understanding a student's behavior requires an understanding of the student's mental structures, that is, an understanding of the student's understanding. When a student replies that the answer to $54 - 38$ is 24, the teacher must not think "Oh, that is wrong," but rather "What is the student's understanding of subtraction that has led to this answer?" In this case, the student appears to be using the following rule of subtraction, "subtract the smallest from

the largest." While this rule is "incorrect" given our current system of mathematics, it is, none-the-less, the rule the student is using. Understanding the student's rule usage makes it much easier for the teacher to demonstrate, using manipulatives of some type, the non-viability of the student's understanding (i.e., have the student count out 54 blocks, then take away 38 blocks from that pile, and finally count the remaining 16). Only by attempting to understand a student's prior knowledge will the teacher be able to create effective experiences, resulting in maximal learning.

5. Students should be assessed formatively, serving to inform future learning experiences. Cognitive, social, and radical constructivism all assert that the acquisition of knowledge and understanding is an ongoing process that is heavily influenced by a student's prior knowledge. Unfortunately, knowledge and understanding are not directly visible, but rather must be inferred from action. Thus, to take into account an individual's current level of understanding in this ongoing teaching and learning process, a teacher must continually assess the individual's knowledge. This formative assessment is necessary to accurately create the next series of experiences and activities for students.

6. Students should be encouraged to become self-regulatory, self-mediated, and self-aware. The underlying tenet of constructivism, and the main thread that holds together this array of theoretical positions, is the claim that learners are active in their construction of knowledge and meaning. This activity involves mental manipulation and self-organization of experience, and requires that students regulate their own cognitive functions, mediate new meanings from existing knowledge, and form an awareness of current knowledge structures. Within a cognitive constructivist perspective, self-regulation, self-mediation, and self-awareness would be subsumed under the construct of metacognition. Metacognition is considered an essential aspect of learning and consists of (1) knowledge of cognition (i.e., knowing what one knows, knowing what one is capable of doing, and knowing what to do and when to do it) and (2) regulation of cognition (i.e., the on-going task of planning, monitoring, and evaluating one's own learning and cognition) (Brown & Palincsar, 1987).

While cognitive constructivism would emphasize self-regulation and self-awareness, social and radical constructivism would emphasize self-mediation. Self-mediation is represented within social and radical constructivism by Vygotsky's (1978) concept of the psychological tool, and Piaget's (1977) concept of reflective abstraction, respectively. Vygotsky (1978) believed that students construct mental signs, or psychological tools, to represent concepts and relationships, and that these tools are used to mediate "intermental" cognition. Similarly, Piaget (1977) theorized that students mentally reflect on the use and nature of objects and then construct new knowledge by generalizing, or abstracting, new relationships. The importance of the thought and self-regulation relationship was expressed by Vygotsky (1978), "The system of signs

restructures the whole psychological process and enables the child to master her movement" (p. 35).

7. Teachers serve primarily as guides and facilitators of learning, not instructors.

The role of the teacher in the learning process has often been a major factor in the apparent division between cognitive constructivism and social/radical constructivism. Teachers, in the cognitive constructivist perspective, are usually portrayed as instructors who "transmit knowledge." The teacher instructs, while the learner learns. In actuality, in the cognitive constructivist perspective, the role of the teacher is to create experiences in which the students will participate that will lead to appropriate processing and knowledge acquisition. Consequently, cognitive constructivism supports the teacher as a guide or facilitator to the extent that the teacher is guiding or facilitating relevant processing. Contrarily, since social and radical constructivism eschew any direct knowledge of reality, there is no factual knowledge to transmit and the only role for the teacher is to guide students to an awareness of their experiences and socially agreed-upon meanings. This teacher as guide metaphor indicates that the teacher is to motivate, provide examples, discuss, facilitate, support, and challenge, but not to attempt to act as a knowledge conduit.

8. Teachers should provide for and encourage multiple perspectives and representations of content. The relationship of multiple perspectives and multiple representations is one of cause and effect within cognitive constructivism. Experiencing multiple perspectives of a particular event provides the student with the raw materials necessary to develop multiple representations. These multiple representations provide students with various routes from which to retrieve knowledge and the ability to develop more complex schemas relevant to the experience. In addition, in social and radical constructivism there is no privileged "truth," only perceptual understandings that may prove to be more or less viable. This being the case, a student's understanding and adaptability is increased when he or she is able to examine an experience from multiple perspectives. These perspectives provide the student with a greater opportunity to develop a more viable model of their experiences and social interactions.

Constructivism Online

It needs to be re-emphasized that constructivism is a theory of knowledge acquisition, not a theory of pedagogy; thus, the nexus of constructivism and online education is tentative, at best. Constructivism posits that knowledge acquisition occurs amid four assumptions:

1. Learning involves active cognitive processing.
2. Learning is adaptive.
3. Learning is subjective, not objective.

4. Learning involves both social/cultural and individual processes.

These four assumptions have led, indirectly, to eight primary pedagogical recommendations:

1. Learning should take place in authentic and real-world environments.
2. Learning should involve social negotiation and mediation.
3. Content and skills should be made relevant to the learner.
4. Content and skills should be understood within the framework of the learner's prior knowledge.
5. Students should be assessed formatively, serving to inform future learning experiences.
6. Students should be encouraged to become self-regulatory, self-mediated, and self-aware.
7. Teachers serve primarily as guides and facilitators of learning, not instructors.
8. Teachers should provide for and encourage multiple perspectives and representations of content.

The question then arises, can an online medium support this pedagogy that is based on the constructivist assumptions. Below, each of the eight pedagogical statements is briefly addressed based on this question and a "grade" is given to reflect online education's ability to meet or implement these statements.

1. **Learning should take place in authentic and real-world environments.** If authenticity were examined as an either/or proposition, then online education would fail miserably; however, authenticity is more a matter of degree than constitution. From this perspective, online education is potentially quite effective in providing virtual environments in which one can simulate real-world events. In order for online education to adequately satisfy this pedagogical statement the online environment must provide complex, culturally relevant, ill-structured domains within which the user can operate and "live." The use of virtual reality, simulators, and microworlds has focused on this concept. (Grade: A)
2. **Learning should involve social negotiation and mediation.** Online education provides a unique opportunity for students to engage in social negotiation and mediation; unfortunately, until recently, social negotiation and mediation were constrained in the online medium. The use of both asynchronous (e.g., email, threaded discussions, listservs) and synchronous (e.g., MOOs, MUDs, IRCs, video teleconferencing) online communications allows for social negotiation and mediation to occur across both time and distance. (Grade: A)
3. **Content and skills should be made relevant to the learner.** Online education is capable of making vast amounts of very diverse information, knowledge, and skills available to the learner. In this sense, online education is quite capable of providing relevance as long as the

learner is able to self-select a relevant topic, process, or skill. Where online education may have difficulty is in spontaneously adapting instruction to a change in student perspective. In a face-to-face meeting, when a student asks a question such as “How does this concept relate to my interest?” the teacher is able to adjusting the next response to the clearly fit the student’s query; however, most online education interfaces are not flexible enough to handle this type of tailoring. This type of immediate tailoring is more available through synchronous than asynchronous environments. (Grade: B)

4. **Content and skills should be understood within the framework of the learner’s prior knowledge.** This pedagogical statement is perhaps the most difficult for online education to handle. To address this statement requires a transaction to occur between the user and the online educational environment. In a synchronous environment mediated by an instructor, student’s prior knowledge may be probed at the beginning of instruction and instruction may then be adjusted based on the feedback from the student; however, in an asynchronous environment, this type of probing and responding is less fluid and flexible. (Grade: C)
5. **Students should be assessed formatively, serving to inform future learning experiences.** While online environments are capable of frequently assessing students during instruction, difficulty arises in using this formative assessment to guide further instruction. The reason for assessing students formatively is to make adjustments to instruction that take into account the student’s currently level of understanding. Instructors will often provide students with “self-check” quizzes that assess students during various parts of instruction; however, the use of these quizzes is usually marginal, providing feedback to students so that students have a better understanding of their learning. Rarely is this knowledge used to alter subsequent instruction. (Grade: C)
6. **Students should be encouraged to become self-regulatory, self-mediated, and self-aware.** In most online education environments, self-regulation, self-mediation, and self-awareness are requirements for successfully engaging in that environment. Online education typically requires students to be more involved and more persistent relative to the educational environment. One aspect of online education that is currently lacking is educating the student in the processes necessary to successfully engage in online education. Students often begin an online educational experience with no instruction concerning how online education differs from tradition classroom education. This pedagogical statement is attainable, but is currently not being addressed adequately. (Grade: C).
7. **Teachers serve primarily as guides and facilitators of learning, not instructors.** While it is still possible for instructors to lecture and to use direct instruction during an online educational experience, it is not nearly as easy as it is when one is teaching in a classroom.

As a result, one is likely to find less “instructing” and more guiding and facilitating in online education. In addition, online education can be effectively constructed to emphasize a facilitating role for instructors while students engage in simulations, web-based data collection, and ill-structured problem solving. The self-regulatory and self-mediated nature of online education promotes the instructor taking the role of guide or coach. (Grade: A)

8. **Teachers should provide for and encourage multiple perspectives and representations of content.** Online education, especially with a diverse group of students, is ripe for the presentation and experience of multiple perspectives. Online education has easy access to international and culturally diverse resources, including diverse populations. With the passing of time, a greater amount of diverse articles (published and pre-published) and presentations are accessible online, providing students with the resources for multiple perspectives. (Grade: A)

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