An exploration of Constructivist Learning Theories & Systems of Instructional Theories:

Supporting Transfer of Learning in WBI courses

Abstract

This paper will present an exploration and analysis of the relationship between constructivist learning theories to the systems of instruction presented in Gagné's learning hierarchy and Reigeluth's elaborative theory. Further discussions and explanations justifying how these theories can support the transfer of learning in an example of the design of web-based instructional courses are included.

Constructivist Theories and Philosophy

Constructivism originated from one of the two sets of views or beliefs governing the nature of how human knowledge is developed. Its opponent, objectivism is based on a set of assumption that knowledge exist separately outside human perceptions and must be transmitted through directed instructional methods grounded on behavioral, cognitive-behavioral and information processing theories. Constructivism on the other hand believes that knowledge is generated by the learners through experienced-based activities rather than directed by instructors (Roblyer, 2006).

The paradigm for constructivism as noted by Lebow (1993) is still an ongoing development and proliferation phenomenon; hence, it is a challenge to consider whether it is a theory or a philosophy (as cited in Driscoll, 2000). As a theory, Driscoll asserts that it is immeasurable to instructional theories like Gagné's objectivist theories since they are on the opposite world of epistemologies. Conversely, as a philosophy, constructivism is not in competition with other learning theories; instead, it provides a set of values in many learning applications.

The learning paradigm of constructivist theories that began around 1980 had greatly influenced educators and instructional designers (Alessi & Trollip, 2001; Brandon, 2004). Constructivist theorists believe strongly in the following: (a) knowledge is not transmitted but constructed through hands-on activities or personal experience which generates knowledge; (b) learning occurs through student-centered activities rather than instructor-led; and (c) students must be allowed to exhibit what they have learned in different ways, not just in testing or examinations (Roblyer, 2006). In other words, learners, the active creators of knowledge can

learn by observing, manipulating and thus interpreting the world around them as they make sense of their learning experiences (Alessi & Trollip).

Methods of learning or instruction applying constructivist learning theories and beliefs are derived from a variety of concepts such as social activism or negotiation, scaffolding, and discovery learning. Prominent theorists include Dewey, Vygotsky, and Bruner (Roblyer, 2006).

In social activism, learning takes place in social environments where there are collaborative activities. Through these activities, learners communicate, interact and learn from each other, as a result constructing their own world of knowledge. Dewey, one of early founders of constructivism theory believes that collaborative learning should be related to the learner's interest, and it must be experienced-based as well as hands-on. This promotes meaningful learning. Both Vygotsky and Bruner, in their theory of social interaction also stated that learning is shaped and affected by the learner's background and cultural experiences (Driscoll, 2000; Roblyer, 2006). Social interactions are critical as knowledge is constructed during the process (Schunk, 2004).

Next, the application of scaffolding (levels of cognitive functioning) concept refers to the process of learning whereby guidance is provided from the basis of the student's experience; the process involves building on what they already know (Roblyer, 2006). Schunk (2004) further defines instructional scaffolding as a process while extending the learner's knowledge and task management, functions also as a supporting tool for learners. It should be used only when needed. That way the learners can be free and independent to construct their own learning.

A third constructivist component that can be applied during instruction is discovery learning concepts. Bruner supports the notion that learners construct knowledge concepts based on current or past experiences. The process of discovery learning involves active participation

where learners explore concepts, relate ideas and find alternative solutions to problems (Roblyer, 2006). In addition to discovery learning principles, Bruner proposed three systems of information processing also known as the three modes of cognitive representation by which human constructs their own world of understanding. They are: (a) enactive that is "representing one's understanding through motor responses" (using tactile instructional strategies to teach new concepts); (b) iconic representation where images are used to help represent concepts; and (c) symbolic representation where familiar symbols (learner has prior experience of subject material) (Driscoll, 2000, p. 224-225).

While the above discussions support the concept for constructivist teaching or instructional methods in a learning environment, there are however disagreements on such approaches. Critics state that in constructivist models of teaching, generating knowledge is slow and time consuming and inefficient, sometimes lacking pre-requisites to higher-level learning such as problem-solving situations; hence, not all teaching methodologies can rely on constructivist principles. This is where other approaches such as the instruction systems design theories can offer alternative strategies (Roblyer, 2006).

Systems of Instructional Theories

Gagné's learning hierarchies and Reigeluth's elaborative theory of sequential learning support the notion that effective learning is best achieved from carefully designed systems of instruction (Roblyer, 2005, p.41). Learning theories underlying the systems of instruction states that, "learning is most efficient when supported by a well-designed system of instruction, and it is complete when the learning system contains well-structured and sequential lessons, objectives, learning activities and assessments" (Roblyer, 2006, p. 41). Proper learning consists of being able to apply consistent or systematic rules (Alessi & Trollip, 2001). Roblyer further affirms that

the system of instruction is grounded on objectivist epistemology where the development of human knowledge is based on behavioral, information-processing, and cognitive learning theories. Two prominent theorists who played important roles the systems of instruction paradigm are Gagné and Reigeluth.

Gagné's System of Instruction

Gagné, a cognitive-behaviorist theorist translated behaviorist and information processing principles into practical applications for instruction and training (Roblyer, 2006). As an objectivist, he firmly believes that in the system of instruction for intellectual skills must be developed structurally, linearly and in sequential steps. Higher-level skills cannot be achieved until the basic or foundational skills are first established. Learning task can be arranged in the following manner: "stimulus recognition, response generation, procedure following, application of terminology, discriminations, concept formation, rule application and problem solving" (Kearsley, n.d., para. 2). Learned behavior or learning outcomes identified by Gagné includes: (a) intellectual skills such as higher learning for problem solving skills, differentiating objects and understanding concept definition; (b) cognitive strategies; (c) verbal information or rote learning (memorizing facts); (d) motor skills; and (e) attitudes. A building block process of learning also known as intellectual skills, gave rise to the theory of learning hierarchies; the acquiring of lower skills prior higher levels of learning is important (Driscoll, 2000; Gagné, Wager, Golas & Keller, 2005; Roblyer, 2006). The planning of instruction with the application of learning hierarchies ensures that all components of intellectual skills are covered in a lesson. Next, it allows for the communication or required prerequisites (organization of learning). Finally, it offers the focus of learning essential components (Driscoll).

Gagné's instructional theory known as the nine events of instruction relating to the cognitive processes that shapes learning comprise of the following (a) gaining attention, (b) informing learners of the objective, (c) stimulating recall of prior learning, (d) presenting the stimulus, (e) providing learning guidance, (f) eliciting performance, (g) providing feedback, (h) assessing performance and, (i) enhancing retention and transfer. Educators may utilize these events as the basis for selecting media for instruction. The nine events of instruction and learning hierarchies applied in educational environment would require that the instructional activities provide events to support learning and learners must demonstrate prerequisite skills (Roblyer, 2006). Gagné and Driscoll (1988) stated that although there is a sequential order of events, the order for the events is not absolute. Implementation could vary depending upon the delivery system for instruction (as cited in Driscoll, 2000). The use for each event is variable depending on the lesson objective and learners. A combination of learning events can be supported by instructor, learner and/or instructional materials.

Reigeluth's Elaborative Theories

The purpose and development of the elaboration theory (ET) is to ensure that the learning process is motivational and meaningful. The learners have the option of making sequential decision during the learning process (Reigeluth, 1999). Courses must be created in the sequence from simplicity to complex order. This concept echoes Gagné's learning hierarchy theory where learners have to learn simpler concepts before complex knowledge (Beissner, Jonassen, & Yacci, 1993). Within the lesson structure, the sequencing order can be applied (Wilson & Cole, 1992). Beissner et al (1993) further states that the elaborative sequence is the most significant strategy as it communicates structural information to the learner. This is the most critical component in elaborative theory (Qureshi, 2004).

The seven strategy components of elaboration theory that can be applied to a lesson or a course consist of, (1) organization structure or elaborative sequence for content (order of lessons from simple to complex), (2) learning prerequisite sequence, (3) content summaries and reviews at the end of each lesson, (4) concept synthesis through the use of diagrams or presentation devices for meaningful learning, (5) analogies relating to learner's prior knowledge which can help build new knowledge, (6) cognitive strategies with the help of diagrams, pictures and mnemonics known as activators, and (7) learner control over content and instructional strategy (Beissner, Jonassen, & Yacci, 1993; Clark, 2000; Qureshi, 2004, Wilson & Cole, 1992).

The elaboration theory also states that the structuring of ideas during the scaffolding and comprehension process can be divided into three presentations or components of course organization, (1) conceptual elaboration (what is), (2) theoretical elaboration (how and why it works) and (3) procedural or simplified conditions (how it works) (Beissner et al, 1993; Reigeluth, 1999; Roblyer, 2006). Conceptual elaboration deals with the relation of events or ideas in the construct of knowledge. Concepts can be broken down to other simpler or general forms. They can also be part of the scaffolding process of a broader cognitive perspective. From a theoretical point of view, it addresses rules or principle relationships in building domain expertise. Finally, the procedural method is a focus on step-by-step (simplified format) building of tasks applied to the context of complex cognitive tasking and/or cognitive understanding. In cognitive understanding, the elaboration sequences support the scaffolding processes of understanding complex information (Reigeluth, 1999).

Analysis of Constructivist Learning Theories in Relation to the Systems of Instructional Theories

Constructivist theories are philosophical and descriptive while Gagné and Reigeluth systems of instruction theories are design-oriented. The sequencing order of Gagné and

Reigeluth's theories reflects the very nature of objectivist approaches. Generally learning theories describes how learning occurs while design-oriented theories are guidelines prescribed to attain desired learning or instructional goals (Reigeluth, 1999).

The components and condition requirements, which form the elements of Gagne's theories and Reigeluth's elaboration theories discussed earlier, do reflect a systematic and linear guide and design approach and its definition for instruction. Conversely, constructivist theoretical concepts offer descriptive information about how meaningful learning can take place as by applying Dewey's hands-on or experiential approach, Bruner's discovery learning principles or Vygotsky's scaffolding theories.

Figure 2 represents an analysis of the structures for constructivist in relation to the systems of instruction learning theories. The arrows indicate possible relationships where the design within the teaching strategy may have to be altered to meet some of the theoretical implications depending on the learning context. What does the instructor want to present to the learners? How can the approach facilitate the transfer of learning? For example, in gaining attention (Gagné's event of learning) and Reigeluth's ET for presenting material, showing relationships, analogies and synthesizers may utilize Bruner's suggestion of using visuals (icons and symbols) for prior recall or introduce new concepts.

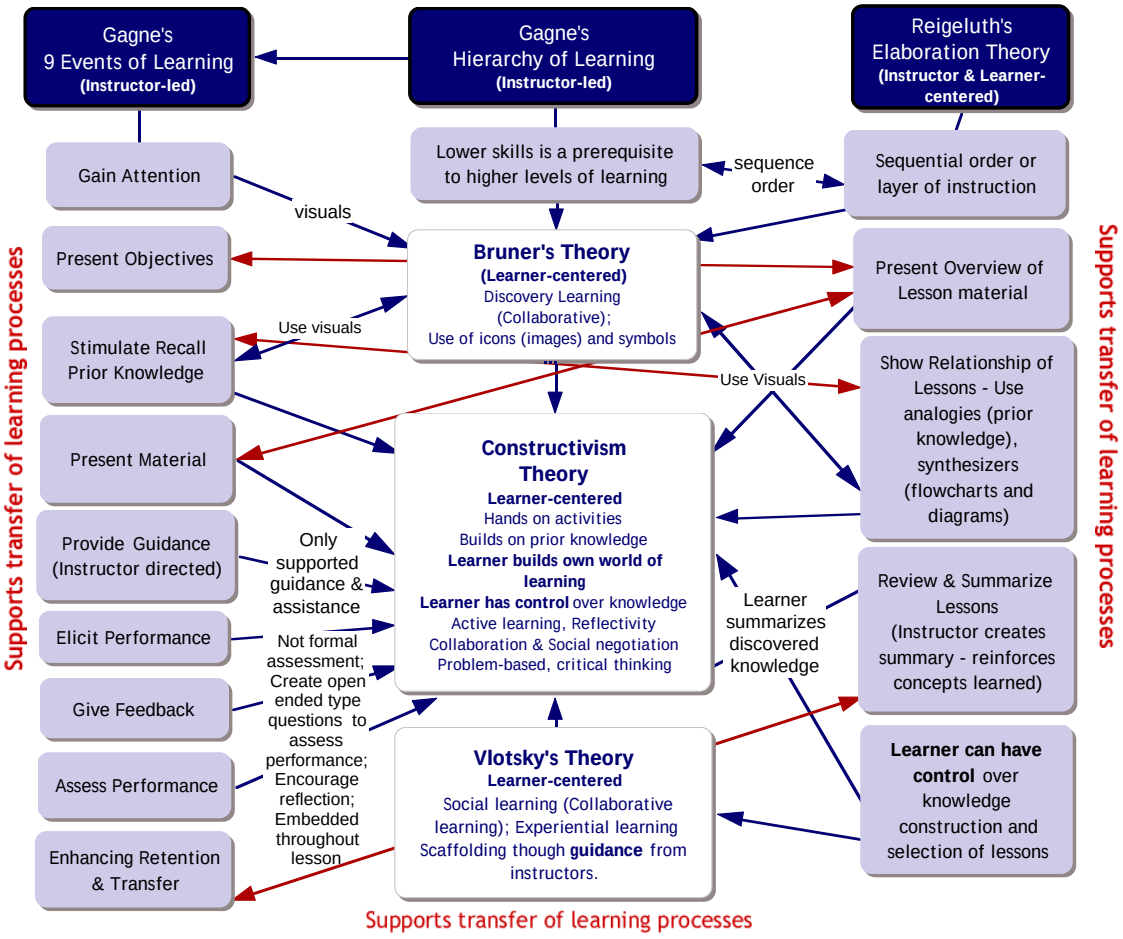

Figure 2. Diagram showing the possible relationships of constructivist learning theories to the systems of instruction presented by Gagné and Reigeluth.

Increase uses of constructivism have caused many researchers to examine if Gagné's instructional theories are compatible with its goals and assumptions. For example, Gagné's conditions for learning states that learning goals must be categorized to the type of learning outcome. The constructivist goals of learning focuses on learning activities such as problem solving, critical thinking, active and reflective application of knowledge (Driscoll, 2000). Gagné's theories are linear and structured in approach where the instructional processes control external events (instructor design lessons based on goals and objectives); but it also integrates internal events (learners can control their learning process). The constructivist approach focuses

strongly in internal events where learners are the focus instead of the content (Richey, 2000). Richey pointed out an important issue relating to the content design based on Gagné's theories. While content in the systems design world is an emphasis, it also tends to highlight learner behavior that must be related to the content development. For instance, prerequisite skills, background experiences and interest related to lesson focus and/or leaner's cognitive strategies is required to master content forms important aspects to the transfer of learning. Designers today are evolving with new design procedures while considering learner characteristics as well. This is clearly an example representing how constructive concepts and values appear to be consistent with Gagne's system of instruction. This is also present in Reigeluth's ET where learner is allowed to construct knowledge from the freedom of content selection and instructional strategy.

Constructivist learning theories from the world of constructivism as mentioned earlier is in opposition with objectivist views of instruction such as Gagne and Reigeluth's system of instruction. One can actually employ the best of strategies offered by both worlds. Jonassen (1999) states that these design tools applied in different contexts can complement each another; and in fact, confirmed that the combination of these methods has been used effectively in some of the best learning environments. Discussions on how these theoretical implications can be applied to support and benefit the transfer of learning, for example in web-based instruction courses will be presented in the following section.

Designing Web-based Instruction Courses

Web-based instruction (WBI), sometimes also known as "online courses" is a form of instruction delivered via the use of computers over the World Wide Web. Delivery of lecture material and online communication takes place via the course module. Web-based training (WBT) is a system that utilizes multimedia elements within the constructs of lecture material

(Oregon Network for Education, n.d.). A web-based design instructional course following a system design approach (see Figure 3), generally consist of the following components: (a) the delivery of goals and objectives often times embedded and distributed in a syllabus format and lesson plans; (b) lesson content or lecture material incorporating teaching strategies for the course; (c) course assignments and projects (including discussion activities and group projects) which is an extension from the lecture application; and (d) evaluation and assessments for learning competencies.

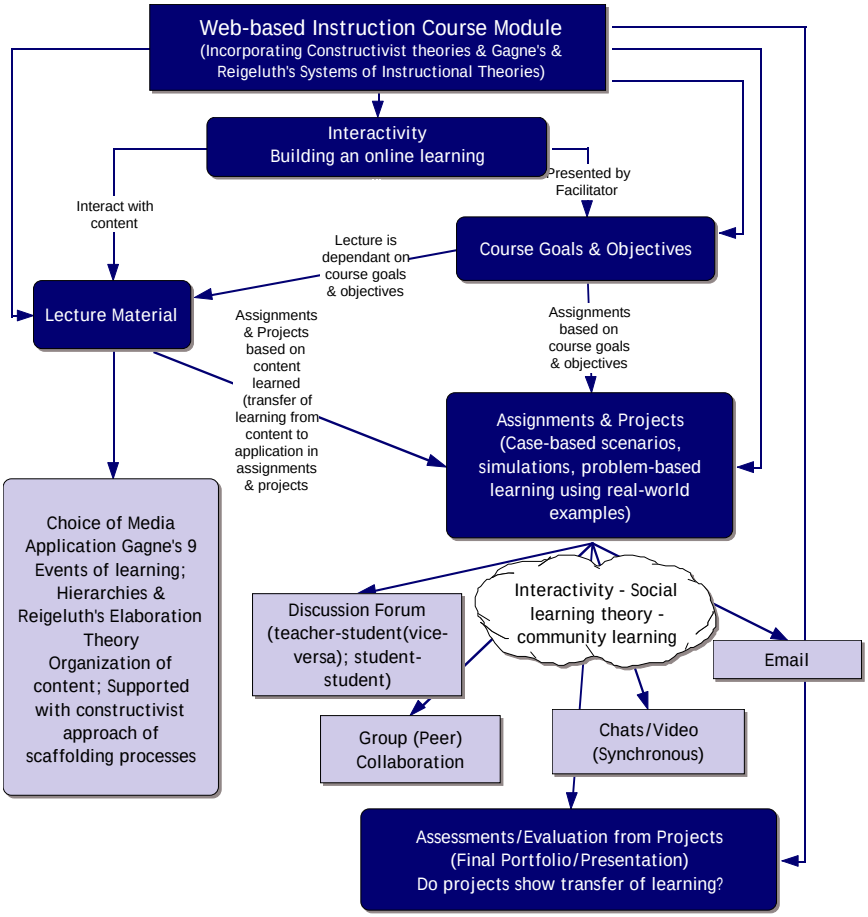

Figure 3. Diagram showing the relationships of how constructivist theories and instructional system theories can support the transfer of learning in the design of WBI courses.

During the course of instruction, the process of transfer of learning takes place when knowledge or procedures learned are transferred from one context to another (NSF, 2002;

Perkins & Salomon, 1992). For example, transfer of learning in WBI can take place when knowledge learned from lecture material or discussions is applied to assignments and projects.

Clark and Voogel (1985) proposed two different types of transfer processes known as near-transfer and far-transfer (as cited in Alessi & Trollip, 2000). Near-transfer is the repeated application and practice of the same tasks. It is procedural and has similar application that does not require higher or complex cognitive processes. Courses that utilizes near transfer must focus on organized lesson structures that meets students' learning styles as well as targeted with the right skills (Clark, 2003). This application is present in Gagne's ninth level of learning. Far transfer skills, on the other hand requires a higher cognitive processing is needed, the elements of instruction and task procedures must be similar to the application environment, example case-based learning or simulation in a real job situation (Alessi & Trollip, 2001). To prevent stagnating in learning or negative transfer, the learners must be able to comprehend or understand what is being taught to a point so that further application of knowledge transfer can take place. Far transfer task also involves problem solving through the application of knowledge and skills that may vary in different context or situations (Clark). This can be fostered through constructivist instructional approaches.

The delivery of web-based courses is similar to the delivery of any type of learning or training. The design of web-based courses is dependant on the institution or organization needs for their learners. Focusing on the learner's needs and the development process is crucial. Rapid growth and evolvement of technology has opened doors to a plethora of ways where WBI courses can be delivered to enhance constructive learning. In order to support the notion of transfer of learning to be successful from the educational environment to the performance site, institutions must plan, strategize and design the courses carefully (Dick, Carey & Carey, 2001).

Both constructivist and instructional theories are very important elements in the support for transfer of learning processes in the design of web based courses. Many educators feel that web-based training is an ideal environment for constructivist teaching approach. Learners are able to construct knowledge through "self-directed inquiry, guided activity and group collaboration" (Wonacott, 2000, p.1). Greenberg (1999) and Wonacott (2000) further states that in a constructive environment, the instructor's role is to facilitate, guide, and coach during learning activities. The application and understanding of constructivist descriptive theories can help instructional designers and faculty members understand the implication of its benefits while instructional theories can help offer guidance to the design, structure and delivery of a WBI course that can enhance the learning process, thus promoting transfer of learning.

Goals and Objectives

Before the preparation for lecture material, project assignments and assessments, instructors must first identify and communicate goals and objectives for the course as well as each lesson component to the learners (Hanna, Glowacki-Dudka & Conceicao-Runlee, 2000). Learning objectives are outlined steps that serve as a guide to building course content. Knowing what the learning outcome for a course is an effective way to help decide what type of content should be covered in a course (Palloff & Pratt, 2001). Gagné's second event of instructional theory, "inform learners of objectives" addresses the crucial need for informing the learner of course objectives so that the learners know what to expect during the course. Self-expectancy can be an ongoing motivational tool to draw the learner into the course (Driscoll, 2000). Designing learning objectives is important to meeting the final goal of competency-based learning in a WBI course.

Course Content (Lecture Material, Project Assignments, and Assessments)

There are many factors involving the selection and design of content for WBI courses. Transfer of learning utilizing constructivist theories would require that the instructor select material where learners can interact constructively with the material. Content should be also available in different media and sequence format to accommodate different cognitive learning styles, modality and multiple intelligences. The very nature of the web, an environment rich with information can function as additional resources for learners (Wonacott, 2000). Reigeluth's theory of allowing the learner control over course material supports the notion of that the learner can have learning decisions over the choice of learning materials. For example, in the selection for reading materials based on a constructivist approach, Mayer (1999) states that constructivist learning can take place during the passive task of reading. During the reading process, the learner gets to engage in three cognitive processes by (a) selecting relevant information, (b) organizing information mentally coherently and (c) integrating information with current knowledge. Learners in WBI environments have the advantage of learning at their pace which lands itself as an important element of constructivism where learning is self-directed.

In WBI learning modules requiring the approach of sequential order of lessons or unit, Gagné's learning hierarchies and Reigeluth's sequential lesson planning is able to offer practical guidance to the design of lessons. Transfer of learning can occur when lessons are arranged and delivered incrementally from simple to complex levels. In addition, the inclusive of a summary unit as suggested by Reigeluth can reinforce learning concepts.

Designing content to ensure that the application of something previously learned applies to a new context (transfer of learning) can be challenging. In WBI courses, instructors can assist encoding or transfer processes by incorporating instructional media presented in text, graphics,

audio or video (Driscoll, 2000). For example, sharing a situation or the use of review material in the form of text, visuals (images, flowcharts or diagrams) or audio can help the learner recall a previously learned experience or knowledge. The learner through interacting with the WBI environment can now add the prior knowledge activated into new context, hence constructing new meaning to learning content (Wonacott, 2000). Gagné's simulation recall of prior learning from the nine events of instruction, Reigeluth's analogies and use of synthesizers in his theory of instruction and Bruner's symbolic mode for instruction echoes the principle of prior knowledge activation important to the context sustaining transfer of learning (see Figure 2).

Clark & Mayer (as cited by Toth, 2004) states that effective learning (retrieval of knowledge and skills) takes place when: (a) the exercise can simulate the job environment and desired thinking processes not just pure memorization; (b) learners have the opportunity to design their own questions and thoughts; and (c) additional exercises (not necessarily "end of module quiz") is placed throughout the lessons. In constructivist learning models, learning focuses on problem solving, research and exploration of possible answers or solutions and developing projects as well as presentations. There is emphasis on group collaboration rather than individual work. Learning and assessment methods comprise of open-ended questions and scenarios, creating portfolios and descriptive narratives (Roblyer, 2006). Vygotsky's scaffolding techniques can be applied in open-ended questions and feedbacks. The guidance and support can help facilitate learning processes. These constructivist approaches and techniques can be implemented into the discussion activities assignments, projects as well as assessment components for WBI.

Active interaction is crucial to the success of online classes. Instructors must encourage learners to interact by making them part of the learning system thereby achieving learning

effectiveness (Belanger & Jordan, 2000). For example, increase interactions can be achieved though careful thought in question & response preparations to students via discussion threads. Instructors can also motivate students into the discussion through supportive feedbacks to their postings. Palloff & Pratt (2001) used the example of how a learner through reflective exercises can apply course material learned to actual work experiences. This is one of the effective ways how to implement "transformative learning" online that can support constructive learning. Assessment for learning can also be monitored from the discussion activities.

As shown from the various examples above, both constructivist and systems of instructional theory applications seem to complement each other very well from the design of instruction to the activities and assessment within the course. Instructional systems can help with the design guide while constructivist approach can help drive learning. The application utilizing the different approaches is dependant on the purpose of the course as well as learner needs.

Conclusion

This exploration paper began with the definitions and implications of constructivism theories, Gagne and Reigeluth's systems of instructional theories helpful to the examination and analysis of how constructivist theories relate to Gagne and Reigeluth's systems of instruction. Analysis and evaluation of the theories during the exploration process offered a variety of practical insights and justification on how these theories, while complementing each other can support the transfer of learning in the design of web-based instructional courses.

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