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A Critical Review of Constructivist Theory and the Emergence of Constructionism

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Abstract: Perhaps one of the most powerful influences on students' success in the classroom is the teaching method implemented by the instructor. This paper discusses the constructivist approach, how it has been criticized, and the subsequent evolution of the constructionist approach. Constructivism is most closely associated with the Swiss psychologist Jean Piaget (1896-1980) whose epistemological theory is considered one of the most influential constructivist theories in education. In the wake of Piaget, his student Seymour Papert put forth the more developed concept of constructionism. This paper discusses how learners construct knowledge on schemas of prior knowledge through the lenses of both constructivism and constructionism, posits critiques that assess the constructivist approach, summarizes how proponents of constructivism respond to those critiques, and outlines key components of constructivism. Although both constructivism and constructionism have supporters and opponents, further research is needed on the effectiveness of constructivist and constructionist teaching methodologies to ensure which approach is most effective for educational learning environments.

Keywords: constructivism, constructionism, learning approaches, learning strategies.

INTRODUCTION

Educational theorists have long tried to understand how information is accumulated, transferred, and understood from one individual to the next. If educators could only understand this process fully, we could harness the power of knowledge transfer to enhance the learning outcomes of our students. One of the pioneers of education theory, John Dewey, asserted that knowledge was transmitted from one generation to the next by presentation of information by the learned and re-construction of this information by the learner, solidifying that person's understanding of this new information (1916). In other words, it is constructed by learners (Hmelo-Silver, Duncan, & Chinn, 2007) and built on prior experiences. Constructivism posits that learners must consciously think about deriving meaning when listening or watching the instructor who is facilitating their learning environments, and with this observation, learners construct their own knowledge. Divergent though their respective theories might be, Piaget, Brown, and Thomas all emphasize the principle idea that learning occurs through social interaction (Piaget & Inhelder, 2008; Thomas & Brown, 2011). This review of constructivism aims to highlight the social drivers behind the formation of knowledge structures in the minds of learners.

OVERVIEW

People learn and develop knowledge individually in social learning environments by constructing their own schema based on the information presented to them. For example, when students arrive on the first day of classes and they observe how the instructor is turning on the computer, the projector, and then pulling the screen all the way down to cover the blackboard, they learn what steps it takes for the instructor to prepare

the classroom. Constructivists assert that learners construct knowledge rather than acquire new knowledge; therefore, learning is an active process throughout the learners' experiences and the environment in which they are learning. Accepting constructivist learning theories means following the path of social learning pioneers such as Vygotsky and Leontiev as well as Brown, Collin, and Duguid. All of the aforementioned proponents of social learning argue that learning is an interactive, social process. Accepting constructivism also means that we must focus the majority of our attention on learners and on creating collaborative, interactive environments. Just prior to the advent of constructivism as it is known today, Vygotsky defined the Zone of Proximate Development (ZPD) which denotes the distance between what learners can achieve by themselves, their actual development, and what they can achieve with the help with others. This concept not only brought to light the social nature of learning, but to this day remains one of the most prevailing constructivist concepts within education (Vygotsky, 1978).

Swiss psychologist Jean Piaget's epistemological theory is considered one of the most influential constructivist theories (Jonassen, 1991). According to Piaget, the knowledge people interact with is added to schemas of prior knowledge wherein learners construct knowledge. This knowledge is formed by learners' own experiences, and hence this construction varies among learners(Hmelo-Silver et al., 2007; Jonassen, 1991; Mayer, 2004). In other words, learners conceptualize and perceive concepts differently based on their prior experiences (Jonassen, 1991). Constructivism indicates that knowledge is constructed based on the already existing knowledge in learners' minds (Hmelo-Silver et al., 2007).

CRITICISM OF CONSTRUCTIVISM

Though many educators have embraced constructivism, it is not without its critics. Several arguments have been developed to criticize constructivist approaches. Some of the researchers opposing constructivism, for example, the very vocalKirschner, Sweller, and Clark (2006), have posited the belief that constructivism promotes a teaching style with unguided or minimally guided instructions for students. Researchers such as Brown and Campione, 1994; Hardiman, Pollatsek, and Weil, 1986; Moreno, 2004; and Tuovinen and Sweller, 1999 indicate that when students learn with minimal instructions, they become "lost and frustrated" (Kirschner, Sweller,& Clark, 2006,p.6). The practice of designing minimally-guided instruction ignores the importance and structure of working memory during learning. Researchers such as Kirschner et al.(2006) indicate that minimally-guided approaches as practiced through constructivist approaches ignore empirical studies that have shown that unguided instructions are not effective in learning environments.

Another concern held by critics of constructivism is that learners need to connect their knowledge to tangible objects in order to ensure that they have acquired the knowledge, and constructivist approaches do not support this learning-related need. According to these critics, cognitive learning is not enough for individuals; one must demonstrate knowledge by making artifacts (Papert & Harel, 1991). For example, a web design teacher may design a lesson plan with the objective that every student should be able to design a web page using Hypertext Markup Language (HTML) by the end of the semester. If the teacher were to embrace a constructivist approach, he or she might have the students discuss designing a web page in a group or complete problem-solving exercises without a large amount of teacher-provided instruction. According to the constructivist point of view, students will acquire knowledge through interacting with their peers. Conversely, a teacher who embraces a more structured approach might expect students to acquire knowledge through a lecture and to then demonstrate this newly acquired knowledge through the passage of a written exam.

In constructivist approaches, students have learned that they can negotiate designing a web page using HTML in a meaningful way through conversation or by a problem-based learning approach, not necessarily through the creation of the webpage itself. When learners have used the constructed knowledge through tangible

objects – in this case, a webpage–it is apparent that they have constructed the correct knowledge. Researchers who criticize constructivist methods believe that learners need to display their learning outcomes in a tangible manner so that these tangible learning outcomes continue to shape and sharpen students' thinking.

Other concerns include that the Piagetian concept of constructivism overlooks important contextual factors in learning environments such as available educational resources, the need to integrate media into learning environments, learners' preferences, and the affordance of individual student thinking (Ackermann, 2001). Critics argue that these aforementioned factors contribute to learning environments. This criticism suggests that constructivist approaches focus mainly on cognitive factors, ignoring other contributing environmental and technological factors.

A further critique of constructivist opponents claims that constructivism views learners as interpreting the world differently (Jon assen, 1991) and instructions are, therefore, not effective because critical concepts within the curriculum are not commonly constructed among learners. These critics argue that within constructivist-based pedagogies, giving learners adequate curricula is ineffective because curricula are centered towards all learners in the classroom while every individual has different thinking. Therefore, those who criticize constructivism argue that common curricula are ineffective and inefficient for learners (Carlson, Lundy, & Schneider, 1992).

Other critics of constructivist approaches argue that constructivism promotes group thinking and ignores the individuality of students even though learning should promote individual rights. Some psychologists criticize constructivism because dominant students control interactions in the classroom while average students might be ignored (Gupta, 2011). These critics contend that the dominant group drives the whole class towards their thinking while leaving other students behind. That is, these critics contend constructivist teaching overlooks the development of many students' skills because the activity is led by a few. Additionally, opponents of constructivism believe it to be unsound from an economic perspective, as it is costly to train instructors in how to teach in constructivist methods, especially with school budgets often in precarious circumstances.

ADVOCATES OF CONSTRUCTIVISM

Despite the colorful array of critiques, constructivism still remains a powerful force in the field of education thanks to its many supporters. Proponents of the theory contend that constructivist-minded teachers help students to construct knowledge and do not place the responsibility for learning solely on students. Constructivist approaches transform students from being passive recipients of information to active learners in educational environments (Ackermann, 2001). Constructivist proponents also argue this learning approach helps children to be guided by their curiosity when learning instead of being led by a large amount of instruction. Supporters of constructivism, such as Hmelo-Silver et al. (2007), argue in response to the constructivist opponents that some constructivist teaching approaches, such as problem-based learning and inquiry learning, do not represent minimally-guided instruction. Rather, the supporters of constructivist approaches use extensive scaffolding and guidance. Supporters of constructivism argue that their opponents, such as Kirschner et al. (2006), misunderstood how these approaches work. Constructivist supporters also indicate that students learn best by solving authentic problems and by acquiring experience in learning environments (Kirschner et al., 2006). Some opponents state that constructivist learners try to "reinvent the wheel," while proponents of constructivism respond that those students attempt to figure out and understand how those wheel works (Gupta, 2011). Constructivist classrooms purportedly value students' interests and build on what students already know by providing them with scaffolding instructions.

Constructivist supporters advocate that constructivist approaches do not lack guidance, but rather they provide strong forms of scaffolding guidance during activities in learning environments. They argue that scaffolding

"reduce[s] cognitive load, provide[s] expert guidance, and help[s] students acquire disciplinary ways of thinking and acting" while still allowing room for the creative process (Hmelo-Silver et al. 2007, p. 2). Some advocates of constructivism such as Hmelo-Silver and Barrows (2006)illustrate that problem-based learning helps teachers in learning environments foster students to better explain their thinking and identify their limitations.

Constructivist advocates state that individuals of various ages know how to construct knowledge; therefore, it is not necessary to provide an individual with excessive guidance as minimal guidance is enough for them to construct their own knowledge building on previous knowledge (Kirschner et al., 2006). Providing support through scaffolding instructions while still allowing students to be driven by their curiosity, constructivists purport, is much more effective than spoon-feeding large amounts of information to be hurriedly digested by learners.

As the Table 1below illustrates, several proponents have supported the constructivist theories addressed in the literature. They indicate that advantages include engaging students in learning environments, supporting diversity (Cummings, 2004; Gibson & Gibbs, 2006; Shachaf, 2008), creating competitive environments, developing problem-solving skills, promoting social and communication skills (Hmelo-Silver et al., 2007), practicing tacit knowledge (Thomas& Brown, 2011), learning by doing (Dewey, 1916), learning to apply what they have learned, and building social relationships among learners (Thomas & Brown, 2011). Several constructivist schools in the literature support this notion, such as cognitive constructivism, radical constructivism, and social constructivism. Pioneers from constructivism schools include cognitive development (Piaget, 1964), the zone of proximate development (Vygotsky, 1978), social learning theory (Bandura, 1986), situated cognition (Brown, Collin, & Duguid, 1989), and online collaboration learning (Harasim, 2012).

Table 1. *The Building Blocks of Constructivism*

Principles Supporting Constructivist Approaches	Theoretical Architects
Learning is a human and social activity.	- Bandura, 1986; Dewey, 1916; Vygotsky, 1980
Knowledge is built upon, not passively received.	- Ackermann, 2001
Learners construct their own knowledge based on prior knowledge.	- Ackermann, 2001; Hmelo-Silver et al., 2007; Palincsar, 1998; Mayer, 2004;
Learning is an active and contextual process.	- Brown et al., 1989; Dewey, 1916
Learning is a cognitive process.	- Ormrod, 2012
- Language in a specific context is an essential component in the learning process.	Thomas & Brown, 2011; Vygotsky, 1978
- Social events generate activities that support learning.	Dunlap &Lowenthal, 2009; Hmelo-Silver et al., 2007; Lowenthal, 2012
- Learning is a mental activity.	Jonassen, 1991
- Language is important in the culture of learning.	Brown et al., 1989; Thomas & Brown, 2011
Learners need to have previous knowledge to build upon.	Ackermann, 2001; Mayer, 2014

The Emergence of Constructionism

Piaget's student, Seymour Paper (1928-2016), was a critic of his own teacher's approach to teaching. An educator himself as well as a mathematician and computer scientist, Papert, developed the theory of constructionism; a descendant of constructivism, constructionism is an educational method in which, according to Paper, tionism learners need to create physical artifacts to practice what they have learned and to experience the outcomes tangibly while the learners are engaged in the production of knowledge construction. Simply, constructionism can be considered as learning by making (Papert&Harel, 1991). Learning outcomes can be seen, critiqued, and used by others, and that knowledge is constructed by practicing skills physically, not just intangibly. Knowledge becomes constructed where complex problems and real issues arise in the learning environments and, specifically, where learners are engaged and involved. Constructionist activities integrate arts and design with the subjects being taught (Papert&Harel, 1991). To Papert, knowledge is an essential grounded element in the context of learning and is shaped by designing products.

The more learners design, think, and rethink products, the more they learn and sharpen their thinking and strengthen their knowledge, which is a process of development in Papert's view (Ackermann, 2001). Researchers such as Ackermann (2001) state that Papert's approach to learning helps us understand how ideas are formed as a result of cognitive learning. Therefore, Papert's approach to constructionism is to design and produce products of learning, and that is where learning authentically occurs. That is to say, within constructionism, learning that develops in learners' minds is situated within products; learning is not only exclusively situated within the learning process itself. Papert's approach indicates that learning must occur physically and tangibly, not only cognitively, as constructivists believe. Constructionism is different from constructivism in that making tangible products allows for learning to occur, whereas in constructivism, learning is a cognitive occurrence. Constructionism also focuses more on technology (Papert&Harel, 1991). Constructionism states that to construct knowledge, learners need to construct a tangible product and make them visible entities which is often expressed with the phrase called "object-to-think-with" (Papert & Harel, 1991). The term was not explicitly utilized by Papert and Harel but the pragmatism of this approach is implied (Ackermann, 2001).

An Object-to-think-with

The expression "object-to-think-with" indicates cognitive links that connect abstract knowledge to visual artifacts. The idea was first articulated by Papert and Harel (1991) and can also be interpreted as a framework that connects visual artifacts to abstract knowledge. Ackermann (2001) states that while within the constructivist framework, the focus of learning centers upon the universe of schemas, whereas within the constructionist paradigm, design artifacts becomes the focus of learning. An object-to-think-with is a term used to indicate how constructionism presents the idea that learning occurs when there are projects as products for learning outcomes that indicate abstract knowledge. This term also indicates the idea that learners have conversations with objects when designing them as outcomes, so that knowledge is not only built on previous knowledge in learners' minds, but rather has to tangibly exist as proof of learning.

Constructivism versus Constructionism

In constructivism, learning is a mental process and people learn from previously-built knowledge by building on that knowledge in collaborative environments. Constructivism places the vast majority of the learning process on learners while constructionism puts much of the work's focus on teachers and instruction. In constructivism, learners are provided with minimal instruction are required to figure out the essential information to be acquired. Opponents of constructivism state that providing learners with large amounts of information enhances students' abilities to learn accurately, while constructivists posit that

providing students with minimal instruction to build their own knowledge through the scaffolding process is sufficient (Kirschner et al., 2006). Constructivism focuses more on the learning process, while constructionism focuses more on the teaching process. Constructivists state that that knowledge is not independent or external from knowers.

Using a statistical metaphor, within the framework of constructivism, student outcomes can be compared to a dependent variable and teacher proficiency can be compared to an independent variable. In other words, according to constructivism, student learning is directly associated with the quality of teachers and the role of teachers is to be that of facilitators and negotiators, not a "sage on the stage" as compared to their constructionist counter parts. However, constructivism and constructionism are similar to each other in terms of knowledge construction.

In constructivist approaches, learning occurs essentially by interacting with peers. In constructivist approaches, students learn how to learn, so they are given minimal instructions. On the other hand, within constructionism, learners need more instructions to learn and design tangible products so that their learning outcomes become authentic (Kirschneret al., 2006). Personal understanding is another important factor in constructivist approaches because it is affected by prior experience. In constructivist environments, learners need to be involved and active within a democratic classroom atmosphere, while collaboration is mainly a contributing element in the learning process as well as a student-centered approach. Class discussions, blogs, and wikis are examples of constructivist teaching methods. With in this approach, learning environments need to be flexible for learners (Jonassen, 1999).

From a constructionist perspective, students are like blank slates for whom teachers need to design common instruction to guide them in how to learn and perform. In constructivist approaches, instructors are facilitators and not explicitly teachers. In a clearly-defined way of teaching, knowledge is not taught explicitly; rather, it is delivered as an accompaniment to learners' experiences (Piaget & Inhelder, 2008).Constructivism focuses on learners' cognitive process, whereas constructionism focuses more on tangible production: "Knowledge can best be learned or only learned through experience that is based primarily on the procedures of the discipline" (Kir schner et al., 2006, p. 5).Consequently, classroom methodologies and more statistical analysis are needed in order to further study the constructionist approach.

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