Constructivism. Learning Theory, Instructional Design

Model or Information Technology Agent?

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Introduction

The development of an Instructional Design (ID) model, the Learning = CM² Model (Chaulk & Clement, 2007), based upon constructivism, created confusion about the role and the effectiveness of constructivism. This paper attempts to clarify whether constructivism is a learning theory, an ID model, or an agent for Information Technology (IT).

Learning Theory

Fosnot states “Constructivism is not a theory about teaching. It’s a theory about knowledge and learning” (Brooks & Brooks, 1993, as cited by Boethel and Dimock 1999). Cognitive constructivism emphasises exploration and discovery by the learner and social constructivism emphasises collaborative efforts of groups of learners (Wilhelmsen, Åsmul & Meistad, 1998). Boethel and Dimock (1999) state that constructivist learning theory emphasizes: learning as an adaptive activity; learning as situated in the context where it occurs; knowledge as constructed by the learner; the role of experience and prior understanding; resistance to change; and the role of social interaction in learning.

“From a cognitive perspective, learning is flawed. The message that is received may not be the one sent. The student thinks they are right until they apply it and it does not work. Even then, they are confused. To ensure comprehension, the concept is applied in increasingly complex problems to ensure understanding. You make them practise it. Even then, understanding may not be complete.” (C. Chaulk, personal communication, September 26, 2007). Knowledge cannot be transferred, but must be constructed by each individual learner and it is only by articulating that knowledge will errors and misconceptions be identified.

So constructivism attempts to create a learning environment that allows each learner to construct meaning. Learning is flawed, so we increase the complexity of the learning
environment. This seems wrong because the increased complexity will confuse learners and they have no reference to know when they are right or if they have arrived. It is like learning to tell time on an analog clock without an expert or a digital clock. Even if another learner agrees with you, the learner is not confident their answer is right without an external reference.

A constructivist learning environment uses open-ended questions to promote extensive dialogue among learners (Rovai, 2004). Specifically, learners use cognitive constructivism as they generate their initial answers and use social constructivism as they discuss answers in an attempt to find consensus. This process should allow all learners to arrive at the same understanding, but this is not always the case, especially if learners just answer the questions and do not engage in discussion. “Constructivism looks at the learning process of how knowledge is constructed by each learner. So the meaning of knowledge is not absolute, but is relative and constructed by the each individual learner.... If knowledge is constructed by individuals, errors will be made in that construction” (C. Chaulk, personal communication, September 24, 2007).

To illustrate this, the course question ‘What kinds of learning theories are being used in this course now? Are you constructing yet?’ generated many different answers. S. Lowes (personal communication, September 24, 2007) and R. Synk (personal communication, October 3, 2007) answered correctly; J. Boutilier (personal communication, September 27, 2007) sees constructivism and cognitive flexibility; M. Landry (personal communication, September 28, 2007), T. Grandy (personal communication, September 29, 2007) and D. Graham (personal communication, September 29, 2007) see direct instruction and constructivism; R. Gallant (personal communication, October 2, 2007) sees direct instruction, constructivism and cognitive flexibility; E. Murray (personal communication, September 23, 2007) sees cognitive flexibility; and P. Butler (personal communication, September 26, 2007) and J. Hiebert (personal
Conceptual change occurs when learners are confronted with information that contradicts their conceptualizations (Jonassen, 2006). Jonassen feels that low domain knowledge learners will not notice the contradictions, low interest learners are unlikely to engage in conceptual change, and experts are unwilling to change because they feel they are correct. It is not known the effect social constructivism had on EDU533 learners, but it is difficult to see all learners answering the question correctly by the end of the course. This is a very insignificant example, but it illustrates the misconceptions that can sneak into learner’s understanding when using constructivism.

“But all of us will experience the same activities and be at different realities at the end” (C. Chaulk, personal communication, September 24, 2007). B. Winsor (personal communication, September 29, 2007) feels that “In the end, we will have all become more knowledgeable with regards to Integration of Instructional Design and Information Technology”. This is the true weakness of the constructivist learning theory. Learning is not guaranteed or absolute, but the learners become ‘more knowledgeable’!

Social constructivism (online discussions) is meant to help all learners seek consensus and understanding, but success depends upon the quality of discussions and learner participation. “If a student does not actively participate in the online discussion, he does not exist” (Black, 2005). Klemm (2000, as cited in Black, 2005) believes learners may not realize the purpose or importance of online discussion or what constitutes as good input. Black (2005) feels an important part of online discussion is a summary or wrap up of the discussion by the instructor or students.
If a student does not exist if they do not participate, does an instructor who just reads the discussions exist? Heuer and King (2004) feel the roles and responsibilities of the online instructor are: facilitator; model; planner; coach; and communicator. The participation of the instructor would help to broaden and deepen the quality of the discussions to ensure all learners are closer to the desired outcomes. Timely input from an expert would enhance social constructivism.

Although students are anxious for feedback on their work and curious about the instructor's position on a topic, it is important to let discussion end before the instructor expresses an opinion (Bonk & Cummings, 1998, as cited by Chaulk & Clement, 2007). The role of the instructor in discussion is as the “guide on the side” guiding discussions as opposed to the “sage on the stage” teaching (Heuer & King, 2004).

**Instructional Design**

Savery and Duffy (1996, as cited by Knowles, Holton III, & Swanson, 2005, p193) state constructivist instructional principles are:

- anchor all learning activities to a larger task or problem.
- support the learner in developing ownership for the overall problem or task.
- design an authentic task.
- design the task and the learning environment to reflect the complexity of the environment in which learners should be able to function at the end of learning.
- give the learner ownership of the process used to develop a situation.
- design the learning environment to support and challenge the learner’s thinking.
- encourage testing ideas against alternate views and alternative contexts.
- provide opportunity for and support reflection on both content learned and the learning process.

Bonk and Cummings (1998, as cited by Chaulk & Clement, 2007) feel that finding a balance between interesting real-world projects and not overwhelming learners is a complex
challenge for instructors. To meet the principles of Savery and Duffy, and find a task that would be interesting and do-able, it may be essential for learners to be involved in task selection.

Karagiorgi and Symeou (2005) feel that constructivism is a learning theory and not an instructional-design theory. For Jonassen (1994, as cited by Karagiorgi & Symeou, 2005), constructivist instruction is an oxymoron. This problem was found when developing the Learning = CM² Model (Chaulk & Clement, 2007). It is an ID model with no instruction, just a set of tasks for the learner, using the ‘learner as designer’. Ultimately, the model may be flawed because the learner has to take on too much responsibility.

Kirschner, Sweller, and Clark (2006) state that research shows minimal, constructivist-based instruction: is less effective than direct instruction for novice and intermediate learners and only equally effective for expert learners; and may have negative results as learners make errors constructing knowledge. They feel that expert learners do better because they use cognitive processes in their long-term memories for guidance.

C. Wheeler (personal communication, October 8, 2007) feels “constructivism is about relating new content to something that students can already relate to”. This explains why expert learners can use constructivism effectively and novice/intermediate learners struggle.

“Working memory is severely limited in capacity when dealing with novel information sourced from the external environment but largely unlimited when dealing with familiar, organized information sourced from long-term memory” (p116, Kirschner, Sweller & Clark, 2007). They feel the search for answers forces novice learners to overload their working memory, with little transfer to long-term memory. They feel that weak guidance causes cognitive overload for learners as they form weak problem-solving strategies. They suggest that worked examples and process worksheets are good examples of guided instruction to allow novice
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learners to reduce working memory loads and learn the process to solve problems and change long-term memory.

Kirschner et al (2006) feel the two main assumptions of minimal guidance are: learners constructing their own solutions to authentic problems; and knowledge is best acquired by experience. They feel it applies to: discovery learning; problem-based learning; inquiry learning; experiential learning; and constructivist learning. According to Spiro, Feltovich, Jacobson and Coulson (1995), “An instructional approach should be no more complicated than it needs to be. However, instruction must be as complicated as is necessary to achieve the established goals of learning”. When designing instruction, it is essential to keep in mind learners can be easily distracted and discouraged. Even if the goal is to teach learners how to solve problems, it may be best if a number of worked examples are provided so that the learner can step through the process. By reducing instruction, to a set of tasks the learner must complete, constructivism increases the complexity of learning. It may be more meaningful, but the essential learning may be missed as the learner is distracted by completing other components of the task.

Spiro et al (1995) feel that learning can be based on simplification of concepts in structured knowledge domains, but oversimplification of concepts in complex and ill-structured domains can cause misconceptions for learners. They feel oversimplification occurs from looking at knowledge from just one perspective, which causes important aspects of conceptual understanding to be missed and they propose a form of constructivism called the cognitive flexibility theory, which promotes the flexible use of pre-existing knowledge. Learner’s construct new meaning from prior knowledge and construct the prior knowledge from different long-term memories. For example, to solve an applied math problem, a learner may have to interpret a word problem, use various math theories (eg. vector addition, trigonometry, etc.), and
“So how do you teach something that has multiple correct solutions with a flawed learning system? ... The solution is simple. Look at the task from a number of different perspectives. As the student experiences each different perspective, it increases their understanding of the task. The process is flawed, so we make it redundant.” (C. Chaulk, personal communication, September 26, 2007). “... topics that fall into the ‘ill-structured domains’ must be taught and taught again through multiple means. This will help ensure that mastery of the topic has been achieved. Failure to do so according to Spiro et al (1995), will have students tackling future problems ill-prepared, since they may carry misconceptions with them from previous learning experiences.” (G. Winsor, personal communication, October 9, 2007). Spiro et al (1995) feel:

Errors of oversimplification can compound each other, building larger scale networks of durable and consequential misconception. The tendency towards oversimplification applies to all elements of the learning process, including cognitive strategies of learning and mental representation, and instructional approaches.

Education and learning are ill-structured and education theories are oversimplifications. Constructivism is a learning theory that is being used as an ID model. “A theory explains learning from the perspective (or constructivist reality) of the theorist. Another theorist can explain the same learning event from a completely different perspective. Both are right within the perspective of each theorist and each theorist tries to explain or carve out as much of the learning experience as possible. But at some point, all theories break down.” (C. Chaulk, personal communication, October 10, 2007).

Cognitive Flexibility (Spiro et al, 1995) differs from constructivism in that the learner must construct meaning from knowledge that is specified. This may be a way around the
cognitive overload concerns of Kirschner et al about constructivism.

**Information Technology**

Reeves and Jonassen (1996) state that designers of instruction learned the most (designers as learners) because “the process of instructional design forced them to reflect upon their knowledge in a new and meaningful way”. Glasser (n.d., as cited by Brogan, 1999) states that we learn: 10% of what we read; 20% of what we hear; 30% of what we see; 50% of what we see and hear; 70% of what we discuss with others; 80% of what we experience; and 95% of what we teach someone else. So the highest level of learning occurs when teaching other learners.

Reeves and Jonassen (1996) feel education benefits when learners use computers as cognitive tools to try to represent what they know (learners as designers). They feel “students learn and retain the most from thinking in meaningful (mindful) ways. Some of the best thinking results when students try to represent what they know”. They feel learners use cognitive tools or mindtools to organize, restructure, and represent their knowledge. When learners use computers, the workload is divided into areas each partner is good at: computers calculate, store, and retrieve information; and learners recognize and judge patterns of information and organize information (Jonassen, Carr, & Yueh, 1998).

Jonassen, Peck and Wilson (1999, as cited by Jonassen, 2000) feel the learning is meaningful when it is: active; constructive; intentional; authentic; and cooperative. Jonassen (2000) feels learners learn with computers when they support: knowledge construction; explorations; learning by doing; learning by conversing; and learning by reflecting. “Mindtools require students to draw on a deeper knowledge and pull together different aspects of prior knowledge in the same way as cognitive flexibility” (P. Butler, personal communication, September 26, 2007).
A mindtool is essentially any computer program the learner uses to engage and facilitate critical thinking and higher order learning (Jonassen, 2000). Jonassen list them as: databases; semantic networks (concept maps); spreadsheets; expert systems; system modelling tools; microworlds; search engines; visualization tools; multimedia publishing tools; live conversation environments; and computer conferences. This list can also include the Web 2.0 tools: blogs; wikis; social bookmarking; podcasts; and RSS feeds.

Mindtools are a constructivist use of technology (Jonassen, Carr, & Yueh, 1998) that helps learners construct models of their understanding. By representing learner’s understanding, constructivism functions as an agent for incorporating IT into education. The old adage, a picture is worth a 1000 words was demonstrated as each group in EDU533, used mindtools to present their ID model. The best usage for constructivism may be to represent the learner’s understanding.

The additional cognitive load of using mindtools, forces instructors to balance curriculum requirements vs meaningful learning experiences (Jonassen, 2006). The instructor must “balance deeper understanding vs. time consumed” (C. Chaulk, personal communication, October 8, 2007) when using mindtools.
Conclusion

In many ways this paper feels like a personal reflection paper as the discussion was mined for appropriate content. EDU533 has been an interesting first course in the M.Ed. IT degree.

Cognitive flexibility theory states that in ill-structured domains such as learning, deeper understanding comes from revisiting the information in different ways. This paper examined the role of constructivism, so it’s main benefit is an increased understanding of constructivism.

The best use for constructivism is as an agent for the integration of IT into education. As for whether constructivism is a learning theory and/or ID model, no real conclusion can be reached, but it is being used as both. Constructivism can produce weak learning as a learning theory, and weak problem-solving skills due to cognitive overload as a ID model.

Maybe the best usage of constructivism is as portion of a blended course with objectivism to expose learners to real-world (authentic) tasks for meaningful learning. This way the instructor can set up the task so that the workload is manageable for learners.

The premise of this paper would require considerable time and research to prove, which is beyond the expectations and capabilities of this course. But the concerns and argument are legitimate when based upon a learner’s reality. As C. Chaulk (personal communication, September 16, 2007) says “using the constructivist style, all answers are correct because they come from your individual reality at the time. A false can become a true as your reality changes”.
References


