Karagiorgi, Y., & Symeou, L. (2005). Translating Constructivism into Instructional Design: Potential and Limitations. *Educational Technology & Society*, 8 (1), 17-27.

Translating Constructivism into Instructional Design: Potential and Limitations

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Abstract

Instructional designers are expected to be familiar with the epistemological underpinnings of several theories and their consequences on the process of instruction. Constructivism is the dominant theory of the last decade and supports construction of knowledge by the individual. This paper discusses the basic principles underlying constructivism, particularly active, collaborative and authentic learning. Application of these principles on the process - analysis, development, evaluation - of instructional design poses certain challenges with regards to issues such as pre-specification of knowledge, authentic evaluation and learner control. Most of the problems are attributed to the fact that constructivism is a learning theory and not an instructional-design theory. Therefore, instructional designers must attempt to translate constructivism into instructional design through a more pragmatic approach that focuses on the principles of moderate - rather than extreme - constructivism and makes use of emergent technology tools. This shift could facilitate the development of more situated, experiential, meaningful and cost-effective learning environments.

Keywords

Instructional design, Constructivism, Authentic learning, Active learning, Multiple perspectives, Collaborative learning

Introduction

The field of instructional design is in a state of rapid change. Instructional designers are expected to be familiar with the epistemological underpinnings of instructional design and the consequences on the process of instruction. Therefore, designers must develop reflexive awareness of the theoretical basis underlying the design and must continuously assess and review instructional theories, tools and resources. As Mergel (1998) stresses, designers must understand the strengths and weaknesses of each learning theory to optimise their use in appropriate instructional design strategies.

During the last decade, considerable interest has been paid to the design of constructivistic learning environments. Constructivist instructional design aims to provide generative mental construction "tool kits" (Jonassen, 1991) embedded in relevant learning environments that facilitate knowledge construction by learners. Compared to traditional instructional systems approaches of designing instruction, constructivism makes a different set of assumptions about learning and suggests new instructional principles. However, design practices do not merely accommodate constructivist perspectives. The implications of constructivism for instructional design are revolutionary as they replace rather than add to our current understanding of learning (Bednar et al., 1992). Instructional designers are thus challenged to translate the philosophy of constructivism into actual practice.

This article aims to throw more light into the area of instructional design in terms of the epistemology of constructivism. First, some of the basic principles of constructivism are presented. Second, the implications of constructivism for the design of instruction are discussed in terms of three dimensions: analysis, design and evaluation. Since application of constructivism on the process of instructional design poses certain challenges, some of the most problematic issues such as pre-specification of knowledge, authentic evaluation and learner control are further outlined. Although these issues are not resolved, they lay the foundation for further discussion between instructional designers and constructivists. This paper points to the need for instructional designers to translate constructivism into instructional design through a more pragmatic approach that focuses on the principles of moderate constructivism and makes use of emergent technology tools. Such an attempt could facilitate the emergence of more situated, experiential, meaningful and cost-effective learning environments.

Constructivism – An overview of the learning theory

Constructivism is the last decade's dominant theory that has roots in philosophy, psychology and cybernetics and attempts to describe how people know the world (von Glasersfeld, 1989). According to the constructivist theory, knowledge is being actively constructed by the individual and knowing is an adaptive process, which organises the individual's experiential world (Mayer, 1992; Hendry, 1996). Hence, the learner is not considered as a controlled respondent to stimuli as in the behaviourist rubric (Jonassen, 1990; Perkins, 1991a) but as "already a scientist" (Solomon, 1994, p. 16) who actively constructs knowing while striving to make sense of the world on the basis of personal filters: experiences, goals, curiosities and beliefs (Cole, 1992). Knowledge for constructivism cannot be imposed or transferred intact from the mind of one knower to the mind of another. Therefore, learning and teaching cannot be synonymous: we can teach, even well, without having students learn.

A core notion of constructivism is that individuals live in the world of their own personal and subjective experiences. It is the individual who imposes meaning on the world, rather than meaning being imposed on the individual. Even though there might be an external absolute reality, "cognising beings can never know what that reality is actually like" (Tobin & Tippings, 1993, p. 4). The notions of 'truth' and 'certainty' are replaced by the term 'viability'; any knowledge to be constructed has to be viable for its agent under the particular conditions of the case. As Savery and Duffy (1996) point out, "what we understand is a function of the content, the context, the activity of the learner and, perhaps more importantly, the goals of the learner" (p. 136). Correspondingly, learners do not just take in and store up given information, but they make and test tentative interpretations of new experiences until a satisfactory structure emerges (Perkins, 1991a). Therefore, individuals build a personal view of reality by trying to find order in the chaos of signals that impinge on their senses.

Constructivism proposes the existence of many levels of abstractions for knowledge construction. The first level is abstraction from sensory-motor experiences or using Piaget's term, from a perceptual experience (von Glasersfeld, 1993). If we reliably repeat such an experience we can conclude that, under the particular circumstances, it is a viable construct. Once such an abstraction has taken place, its result can immediately be taken as material for a further abstraction, and so on. Thus, more abstract concepts are a result of the operations we carry out.

At this point, it is important to understand that there are various types of constructivism such as radical, social, physical, evolutionary, post-modern and information-processing. Hence, Ernest (1995) stresses "there are as many varieties of constructivism as there are researchers" (p. 459). In general, two loosely associated groups are identified: first, radical constructivists who insist that every reality is unique to the individual and second, non-radical or social or moderate constructivists who believe that shared reality grows out of social constraints placed on the constructive process of the individual. For the social constructivists, knowledge is viable not only personally, but also in social contexts (Tobin & Tippings, 1993) while reality is viewed as a constructive process embedded in socio-cultural practices (Duffy & Cunningham, 1996). Culture provides different types of tools to help us construct meaning. For example, language, the most frequent of these tools, is characterised by a dynamic process of interchange during which meanings are chosen. Our construction of meaning is grounded in the groups to which we belong through social interactions (von Glasersfeld, 1995; Willis, 1998). Correspondingly, learning that focuses exclusively on individual construction of knowledge is inadequate; our experiential world appeals as a negotiation between individual and social knowledge, whose contributions have a dialectical relationship and cannot be meaningfully separated.

Implications of the constructivist paradigm for the design process

A number of theorists have discussed the ways in which constructivist values influence instructional design and have proposed several principles of the 'constructivist instructional design model' (see Lebow, 1993; Jonassen, 1994; Willis, 1995). For the purposes of this article, reference is made to the implications of constructivism in terms of the three major phases of instructional design: analysis, development, and evaluation. These three dimensions are used here as poles for further discussion.

Analysis

In the traditional approach, the instructional designer analyses the conditions - such as the content, the learner, and the instructional setting - which bear on the instructional system, in preparation for the specification of intended learning outcomes. In the constructivist approach, the instructional content cannot be pre-specified. Constructivist designers avoid the breaking down of context into component parts as traditional instructional designers do, but are in favour of environments in which knowledge, skills, and complexity exist naturally. Since objects and events have no absolute meaning, the design task is one of providing a rich context within which meaning can be negotiated, and ways of understanding can emerge (Hannafin et al., 1997). Therefore, designers develop procedures for situations in which the instructional context plays a dominant part, and the instructional goals evolve as learning progresses (Tam, 2000). Thus, constructivists do not adopt learning and performance objectives that are internal to the content domain. Instead, they “search for authentic tasks and let the specific objectives emerge and be realised as they are appropriate to the individual learner in solving the real-world task” (Bednar et al., 1992, p. 25). The goal, for instance, is not to teach a particular version of history, but to teach someone how to think like a historian.

Constructivist designers assume that every learner has a unique perspective, so the concept of the global ‘average’ learner is rejected (Bednar et al., 1992). Empowering students to make choices about how and what they will learn results to a shift from having all learners learning the same things to allowing different learners learn different things. In the opposite case, without a level of persistence and mindfulness in the cognitive process, any benefits of the process become questionable (Greening, 1998). Constructivists are also interested in the learner’s prior knowledge in terms of cognitive processes and self-reflective skills (Vrasidas, 2000). Both students’ prior ‘correct’ concepts and ‘errors’ or ‘unanticipated’ responses - often labelled as ‘misconceptions’ or ‘misunderstandings’ - are important. Perkins (1991b) points out that, when the prior knowledge is a ‘naive’ construction, a conflict is caused and the learner can follow three different paths: ignore the conflict (‘conflict buried’), construct a better model of prior understandings (‘conflict faced’) or ‘bracket’ the intuitive models for a while and learn a new way of thinking about the phenomenon in exploration (‘conflict deferred’). The two latter paths lead learners via reflection to realise that a specific approach used by the experts in the particular knowledge-domain is a product of rational thought. Subsequently, the knowledge leads to reorganisation and accommodation of activities at increasingly sophisticated levels to make problem solving possible. Thereby, instructional designers must confront students with information and experiences that threaten their ‘misconceptions’ and offer support to this reflective process. Since learning occurs as an act of cognitive restructuring, students’ metacognitive capabilities are augmented (Greening, 1998). Correspondingly, designers are interested in the learners’ skills of reflexivity and not on remembering (Bednar et al., 1992).

Development

In traditional instruction, this phase involves the design of a sequence to achieve specified performance objectives (Skaalid, n.d.). Draper (1997) states that the instructional design of the Gagne school takes instructional objectives and subdivides them, ending up with a set of small items, for each of which a separate instructional action is taken. As already mentioned, pre-specified content and objectives are not congruent with the constructivist view. Constructivists point to the creation of instructional environments that are student-centred, student-directed, collaborative, supported with teacher scaffolding and authentic tasks and based on ideas of situated cognition, cognitive apprenticeship, anchored instruction and cooperative learning. Such learning environments involve an abundance of tools to enhance communication and access to real-world examples, reflective thinking, multiple perspectives, modelling or problem solving by experts in a context domain and mentoring relationships to guide learning.

Active Learning

According to constructivism, the centre of instruction is the learner. Meaningful understanding occurs when students develop effective ways to resolve problematic situations. Such situations foster motivation, because students have an opportunity to experience the pleasure and satisfaction inherent in problem solving. Constructivists recommend that designers provide problems which may be solved in different ways and leave students struggle with problems of their own choice (von Glasersfeld, 1993). Such problems are regarded by learners as obstacles in their progress towards a goal. Perkins (1991a) points to the need for discovery learning through two approaches of constructing knowledge: ‘Without the Information Given’ (WIG) and ‘Beyond the Information Given’ (BIG).

Except from problem solving approaches, technology tools must also bring about learners' active learning (Spiro et al., 1991b). The technology, as a knowledge construction tool, should confront the learner "with a 'phenomenarium' (an artificially limited arena where phenomena to investigate occur, such as an aquarium or a computerised Newtonian 'microworld') or with a 'construction kit' (a set of modular parts with which to make things, as in Tinker Toys with its physical parts or Logo with its computer-command parts)" (Perkins, 1991b).

Several cognitive tools can establish a partnership with the learner on the basis of Vygotsky's theory of the 'zone of proximal development'. During the partnership the tools provide strategies that experts use to solve problems as well as opportunities for higher level thinking and metacognitive guidance. Such tools can also provide scaffolding, relevant to the learner's ability level (Mercer & Fisher, 1992; Murphy, 1997). Scaffolding is the process of guiding the learner from what is presently known to what is to be known. Therefore, the learner engages in cognitive processes, appropriate for the learner's zone of proximal development: unfamiliar to the learner and of higher order than the ones the learner would display without the partnership.

Authentic Learning

Learners are more likely to view a problem from an ownership perspective when the situations represent authenticity. According to Cey (2001), authentic learning occurs when instruction is designed to facilitate, simulate and recreate real-life complexities and occurrences. Ordinary practices and tools used by professionals of the field under study are the most authentic situations as students are helped to implement knowledge in genuine ways and become aware of the relevancy and meaningfulness of their learning. Therefore, students should be placed in such situations in which they will not be artificially constrained. The complexity of authentic contexts must be maintained; any simplification of the knowledge base, which is the way traditional instruction deals with ill-structured knowledge, facilitates memorisation but denies the development of associations between concepts and reflective metacognitive processes (Greening, 1998). Squires (1999) refers to "cognitive authenticity" through the articulation of ideas, experimentation and engagement in complex environments as well as 'contextual authenticity' through the relation of tasks to the real world.

Thus, constructive instructional designers must situate cognition in real-world contexts. Situated cognition suggests that knowledge and the conditions of its use are inextricably linked (Brown et al., 1989). Learning occurs most effectively in context, which becomes an important part of the knowledge base (Jonassen, 1991). The context facilitates the application and transfer of knowledge in both heavily ill-structured domains, such as medicine, history, literacy interpretation, and well-structured domains at advanced levels of study, such as mathematics (Spiro et al., 1991a). A related approach to situated cognition is anchored instruction, which emphasises skills and knowledge in holistic and realistic contexts (Cognition and Technology Group at Vanderbilt, 1991a). This approach aims to help students develop useful knowledge rather than inert knowledge. Anchored contexts support complex and ill-structured problems wherein learners generate new knowledge and problems as they determine how and when knowledge is used.

Cognitive apprenticeship is an instructional strategy that provides authentic 'indexed' and 'situated' or 'anchoring' experiences for extended exploration. This method aims primarily at teaching the processes that experts use to handle complex tasks (Hannafin et al., 1997; Conway, 1997). Apprenticeship models promote scaffolding and coaching of knowledge, heuristics, and strategies, while students carry out authentic tasks. Such settings present learners with the phenomena they are learning about and help them understand the problems that experts in various areas encounter and the knowledge that these experts use. As Jonassen (1990) notes:

In order to be a physicist, learners must think like physicists, but thinking like a physicist is different than thinking like an artist. Not only are the knowledge domains different, but the ways of thinking about them also differ (p. 34).

Multiple Perspectives

Another important strategy is the presentation of multiple and alternative views to learners. A rich learning environment encourages multiple learning styles and multiple representations of knowledge from different conceptual and case perspectives (Kafai & Resnik, 1996). Any specific concept must be approached via a wide range of learning contexts to aim transfer of the knowledge in a broader range of domains. On the contrary, when the learning of a concept occurs as separate topics, the learning remains inert and superficial, bringing about boredom, negative effects on motivation, and incapability of transfer to meaningful real-world situations

(Cognition and Technology Group at Vanderbilt, 1991b). Spiro and his colleagues (Spiro & Jehng, 1990; Spiro et al., 1991a) refer to the need for 'cognitive flexibility' that stresses conceptual interrelatedness, provides multiple representations of the content and emphasises case-based instruction that provides multiple themes. This plurality of content, strategies and perspectives typifies post-modern approaches to instruction.

Collaborative Learning

A central strategy for constructivism is to create a collaborative learning environment. Collaborative learning does not just entail sharing a workload or coming to a consensus, but allows learners to develop, compare, and understand multiple perspectives on an issue. The goal is the rigorous process of developing and evaluating the arguments (Bednar et al., 1992). Learners should be able to explain and justify their thinking and "openly negotiate their interpretations of and solutions to instructional tasks" (Cobb, 1994, p. 1051), leading towards the establishment of consensual meanings. The learning environment should make it possible for students to build their theories and articulate these theories to one another. By continually negotiating the meaning of observations, data, hypotheses, and so forth, the learners construct systems that are largely consistent with one another (Cognition and Technology Group at Vanderbilt, 1991a). Knowledge, then, becomes explicit, available, generalised and promotes insight into alternative perspectives. Mayer (1999) points out that although social contexts of learning provide opportunities for constructivist learning, not all social contexts promote constructivist learning and more importantly, not all constructivist learning depends on social contexts.

Evaluation

Not any interpretation or opinion is as good as any other and the learners are not free to construct any knowledge. The concepts, ideas, theories and models constructed are both built and tested. They will only survive in terms of viability (not in terms of 'truth') and 'usefulness' in a pragmatic or instrumental sense in the context they arise, and in terms of whether they either do or do not do what they claim to do (Spiro et al., 1991b). In other words, even though the learner is free to build a personal interpretation of the world, this interpretation has to be coherent with the general 'Zeitgeist' (Cognition and Technology Group at Vanderbilt, 1991a).

Evaluation in the constructivist perspective examines the thinking process. As there are more than one ways of solving a problem, each student's approach is more important than a particular solution (Cole, 1992). The students' ability to explain and defend decisions is an important element of evaluation and is related to the development of metacognitive skills and self-reflexive processes. Therefore, by looking at the learning activity itself and at the child's ability to reflect upon or discuss that activity, assessment emerges from task performance (Duffy & Jonassen, 1991). This 'understanding performances' principle (Perkins, 1991a), also implies that evaluation calls for measures of transfer of learning and emphasis on student responsibility and autonomy. Learners have an active and critical role in assessing their own learning by articulating what they have learned and how they have made the connections to their previous experiences (Lambert et al., 1995).

It is thus argued that multiple evaluators are needed to deal with both goal-driven as well as goal-free evaluation in order to triangulate the learners' theories (Cole, 1992). Multiple evaluation methods are also employed to document the learners' growth. A contextualised learning environment in which "learners can explore and set their own goals, and be assessed via an examination of portfolios and other idiosyncratic accomplishments" is recommended (Dick, 1996, as cited in Willis, 1998, p. 14). In general, evaluation methods are context-driven as they assess knowledge construction in real-world contexts that are as rich as those used during the instruction (Jonassen, 1992).

Towards pragmatic constructivism

The application of constructivism to instructional design has certain advantages such as more meaningful learning outcomes, more independent problem-solving capability and more flexibility in both design and instruction activities. However, the translation of constructivism into practice constitutes an important challenge for instructional designers. Most designers do not unconditionally embrace this new epistemology as there are many areas of conflict.

The challenges

A major issue of debate deals with the pre-specification of knowledge. Instructional designers complain about the constructivist view that learning is a personal interpretation of the world. Therefore, they show little concern for the learners' entry level skills, for efficiency and for certifying individual students' competency level (Dick, 1992; Tobias, 1992). Additionally, as stressed before, constructivists contest that learning objectives are not possible and that all understanding is negotiated. The conundrum that constructivism poses for instructional designers is that if each individual is responsible for knowledge construction, then designers can not determine and ensure a common set of outcomes for learning (Jonassen, 1994). Besides, the instructional designer's access to individual learners' cognitions is extremely indirect and limited (Wilson, 1997). The evident autonomy of learners in knowledge construction makes it difficult, if not impossible, to predict how learners will learn or how to plan instructional activities. Hence, constructivist instruction is from a theoretical perspective at least, an oxymoron (Jonassen, 1994). The instructional design approach is very much top-down while the 'pure' constructivist approach is totally bottom-up (Hart, 1997, as cited in Draper, 1997).

At the same time, evaluation - the other 'end' of the instructional process - has also produced differences between constructivists and designers. For constructivists, evaluation emerges naturally from authentic tasks and measures learning gain but not mastery of a pre-determined set of skills. However, when learning outcomes are individually constructed - as constructivism suggests - it is extremely difficult to set standards to assess the meaningfulness of the learning. Prawat and Floden (1994) point to the inability of the constructivist approach to evaluate learning. Jonassen (1992) describes evaluation as the thorniest issue yet to be resolved regarding the implications of constructivism for learning and points to the need for evaluation methodologies that possess the cognitive sophistication implied by constructivism. As evaluation becomes demanding, Cey (2001) suggests that peer-assessment and self-assessment must be incorporated.

Additionally, there are other areas in which there are either unanswered questions or differences with the typical instructional design approach, such as that of learner control. The key to developing constructivist models is to provide the learners a measure of control over the construction of content (Savery & Duffy, 1995). Constructivists offer the learner almost unlimited discretion to select what is studied, from among available resources and how it is studied. However, this creates problems of accountability that students will learn. Learners might construct the wrong knowledge, skills and abilities since some students just want to be told what they need to learn (Perkins, 1999). Merrill (as cited in Draper, 1997) points out that appropriate learner guidance will make learning far more effective than 'sink or swim' exploration. He further continues that allowing students to structure their own learning in 'ill structured' environments is "not a great virtue but abdication of our responsibility as teachers and instructors…students do not know or understand their own learning mechanisms" (p. 6). Perkins (1991b) suggests that the learner may find the constructivist learning experience dauntingly complex, "a tortuous path towards an end that looks as though it might be more directly addressed" (p. 164). Therefore, not all learners benefit from having almost unlimited control over their own learning (O' Donnell, 2000).

Most of the problematic issues described above, stem from the fact that constructivism is an underlying philosophy and not a strategy (Wilson et al, 1995). While constructivism is a well-documented theory of knowing, it is not yet a well-documented theory of teaching (Fosnot, 1992). Further to this, one can also conclude that constructivism is not an instructional-design theory but a learning theory. In contrast to instructional-design theories that describe specific events outside of the learner that facilitate learning, learning theories describe what goes on inside a learner's head when learning occurs and are, therefore, less directly applied to educational problems (Reigeluth, 1999). The literature proposes several principles - discussed in the previous sections of the paper - that can be applied to design, but fails to refer to practical model building. In the light of this, constructivists and instructional designers are often on opposite camps. Constructivists are not 'system builders' as they support a philosophy, not a systems approach, that a designer can implement (Petraglia, 1998). Those involved in instructional design, on the other hand, need examples and real-world case tudies of how theory can be applied in practice (Corich, 2004). Snelbecker (1999) refers to instructional designers and instructors as knowledge users who have divergent interests, expectations about and reactions to instructional theories compared to knowledge producers such as theorists and researchers.

Constructing the theory: Moderate constructivism

In order to develop 'pragmatic' constructivism, there is a need to draw links between constructivist theory and instructional design practices. Therefore, a dialogue between learning theorists and instructional developers should be established to clearly define the theoretical basis of constructivism.

In drawing links from theory to practice, it is important to understand that, as mentioned before, constructivism embraces a range of different viewpoints and perspectives, since scholars do not share only one single set of beliefs. Hence, a distinction needs to be drawn between extreme and moderate approaches to constructivism (Merrill, 1991). Extreme constructivism seems to merely have a narrower point of view and be limited to certain kinds of outcomes. On the contrary, principles of moderate approaches can be more easily incorporated into instructional designers' repertoire. These modest principles should be generic in order to be relevant to the wide variety of situations encountered (Wilson, 1997). As Merrill (1992) points out, some of the assumptions and prescriptions of a more moderate constructivism are consistent with instructional design theory. Therefore, the needed next step is for designers to consider principles of constructivism that are aligned with non-radical views.

An example of application of moderate constructivism on instructional design is Merill's 'second generation instructional design theory'. This assumes that mental models are constructed by the learner as a result of experience; that the content of each individuals' mental models may be different, but the structure is the same; that knowledge can be pre-specified and represented in a knowledge base that applies to different domains; that teaching authentic tasks in context is desirable, but there is also a need to teach abstractions that are decontextualized; that the instructional strategy and subject matter are somewhat independent; that there are fundamental instructional transactions that can be adapted to a wide variety of situations and used with different subject matter contents; that there are classes of strategies which are appropriate for all learners; that learning should be active, but not always collaborative, since sometimes individual learning is more effective; that testing could be integrated and consistent with the learning objectives, but separate assessment of achievement is also possible.

Additionally, it is important to remember that the instructional designer's toolbox contains an increasing number of theoretical applications and physical possibilities. Constructivism is one learning theory that supports successful practice, but not the only one. Instructional design does not exclude constructivist strategies, but may also choose alternative strategies when they are appropriate. Other theories such as behaviorism and cognitivism also have their strengths. In Jonassen's words, "to impose a single belief or perspective is decidedly nonconstructivist" (Jonassen, 1999), since there are complementary design tools to be applied in different contexts. Therefore, instructional designers can be eclectic and apply such theories of instructional design in the proper setting and context. Some learning problems require highly prescriptive solutions, whereas others are more suited to learner control of the environment. For example, pre-determined, constrained, sequential, criterion-referenced instructional design is most suitable for introductory learning while constructivist approaches are more appropriate for advanced knowledge acquisition (Mergel, 1998).

Moving onto practice: Technology tools

The development of a more pragmatic stance on constructivism and instructional design could provide a more cost-effective approach to instructional development and thus, enable the emergence of effective, situated and experiential environments. Technology built on the assumptions of "pure", extreme constructivism is extremely hard to conceive (Merrill, 1992); it is certainly not cost viable to proceed to design that is unique in each case. In general, it is considered easier, less time consuming and less expensive to design within the 'closed system' of the classical instructional design techniques rather than the 'open' constructivist design (Mergel, 1998). Merrill (1991) describes constructivist interventions as labor intensive and Dick (1992) concludes that since such interventions are costly to develop, require technology to implement and are difficult to evaluate, they will probably not be accepted in public schools. However, non-radical constructivism could provide the theoretical rationale for the development of learning environments available to all learners.

As technology-related learning ventures represent growing opportunities for applying instructional theories, advancements in technology could make constructivist approaches to learning more possible. Hypermedia environments that allow for non-linear learning and increased learner control are frequently mentioned in the literature, as particularly useful for the constructivist designer (Mergel, 1998). Multimedia and the Internet are also alternatives to the linear structure and facilitate data gathering techniques, supportive of constructivist learning principles. As an experiential learning tool, virtual reality is also considered an enactive knowledge-creation environment. In general, the emergence of environments - such as toolkits and phenomenaria, multimedia, socratic dialogues, coaching and scaffolding, role-playing games, simulations, storytelling structures, case studies, holistic psychotechnologies - could promote instructional strategies that facilitate more active construction of meaning (Wilson, 1997). Moreover, microworlds and virtual reality simulations could stimulate authentic learning while the World Wide Web in general and Web Quests as innovative teaching strategies in particular could offer multiple representations of reality (Cey, 2001).

An example of how tools can promote further development of pragmatic constructivism is provided in Jonassen's (1999) model for designing constructivist learning environments. This model is a generic context in which students, in groups as well as alone, can be aided in interpreting and solving various kinds of problems. There is usually a problem or question, the understanding of which is supported by related information resources. Cognitive tools help learners interpret and manipulate the aspects of the problem by engaging specific kinds of cognitive processing. Such are problem/task representation tools (visualisation tools), static and dynamic knowledge modelling tools, performance support tools and information-gathering tools. In addition, conversation and collaboration tools enable communities of learners to negotiate and co-construct meaning of the problem. Such are computer conferences that support discourse communities, as well as other shared knowledge-building tools.

Synopsis – Conclusion

It is approximately 100 years since John Dewey began arguing for the kind of change that would move schools away from authoritarian classrooms with abstract notions to environments in which learning is achieved through experimentation, practice and exposure to the real world. Today, learning is approached as a constructive, self-regulated, situated, cooperative, and individually different process. In a world of instant information, constructivism can become a guiding theoretical foundation and provide a theory of cognitive growth and learning that can be applied to several learning goals.

This article has described how instructional design functions within the constructivist framework. The platform has also been set in terms of the challenges that constructivism holds for instructional designers. In spite of all the problematic areas, the future of constructivism can be optimistic in this field. To enable the transition from theory to practice, there are two important points for consideration. First, that pragmatic constructivism could be built on moderate theoretical assumptions that are more compatible with instructional design practices and second, that the emergence of rich constructivistic environments can be facilitated by the emergence of powerful technology tools. Practical model building along with the eclectic application of learning strategies and technology can help designers accommodate the constructivist perspective so as to respond to the learning requirements of the 21st century.

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