A New Paradigm:
Constructivist Learning Systems

Oleh

Antonius P.G Manginsela

Program Studi Teknik Informatika/Komputer

Jurusan Teknik Elektro

Politeknik Negeri Manado

Mei 2010

A New Paradigm: Constructivist Learning Systems

Antonius P.G Manginsela [*)]
Prodi Teknik Informatika/Komputer,
Jurusan Teknik Elektro Politeknik Manado
Tel: (431)814393, Mobile: +6281244886896
Email: **antonpgm@gmail.com**,

Abstract

Di masa teknologi informasi saat ini, banyak lembaga atau institusi pendidikan dinegara maju, sedang berada ditengah perubahan filosofi dari paradigma "behaviorist" ke paradigma "constructivist". Apabila constructivism digunakan sebagai paradigma baru pendidikan diabad informasi ini, maka pengembangan-pengembangan program-program pendidikan harus lebih fokus pada peserta didik bukan pengajarnya.

1. *New Times Give New Challenges*

Advances in information technology are creating a new infrastructure for business, scientific research, social interaction, and education. Future workforce is required to effectively use information technology to remain competitive, employ creativity and critical thinking to solve problems, possess the ability to communicate and collaborate with others, and have the capacity to readily acquire new knowledge and skills.

With this trend, we must emphasize the learning environment that enables individuals to understand the changing world, create new knowledge and shape their own destinies. We must respond to new challenges by promoting learning in all aspects of life, through all institutions of society, in effect, creating environments in which living is learning.

Building an education enterprise suited to the new times requires developing new education strategies, designing new teaching and learning modes, and creating learning environments that enhance learners' proficiency in understanding, thinking, reasoning, and problem solving. The real promise of technology in education lies in its potential to enhance the learning experience for learners. Better learning will not come from finding better ways for teachers to instruct classes but from giving learners better environments to construct knowledge.

The increasing understanding of knowledge, learning process, and learning environments enables us to have a better perspective of how learning technology should be used to create "authentic" learning environment that correspond to the real world. During the past decade, constructivism has become an important intellectual movement in education as well as in many other fields.

The challenge is how to cast this new learning theory and vigorous information technology advances as an ***opportunity for creative and innovative learning paradigm*** that takes the whole learning environment into account.

2. Constructivism

Constructivism is a philosophical view about knowledge, understanding and learning. Constructivism holds that learning is a process of building up structures of experience. By contrast with the traditional view of education as a process involving the transmission of knowledge from teachers to students, a constructivist view believes that learning occurs through a process in which learners play active roles in constructing the set of conceptual structures that constitute their own knowledge base.

Constructivism focuses on the learner's control of learning processes. Learners are viewed as active constructors of knowledge.

They develop understanding through observation, reflection, experimentation, and interactions with the surrounding environment that continually confirm, challenge, or extend ongoing theories or beliefs. In summary, constructivism holds several general assumptions and beliefs about learning [1]:

- Knowledge is constructed, not transmitted.
- Knowledge construction is embedded in learner's interests and personally meaningful activities.
- Learners take active roles in developing their learning environment.
- Social interaction is an essential factor in the construction of knowledge.

Others view of constructivism is an epistemology, or a theory, used to explain how people know what they know. The basic idea is that problem solving is at the heart of learning, thinking, and development. As people solve problems and discover the consequences of their actions - through reflecting on past and immediate experiences - they construct their own understanding. Learning is thus an active process that requires a change in the learner. This is achieved through the activities the learner engages in, including the consequences of those activities, and through reflection. People only deeply understand what they have constructed.

A constructivist approach to learning and instruction has been proposed as an alternative to the objectivist model, which is implicit in all behaviorist and some cognitive approaches to education. Objectivism sees knowledge as a passive reflection of the external, objective reality. This implies a process of "instruction," ensuring that the learner gets correct information.

3. History of Constructivism

The psychological roots of constructivism began with the developmental work of Jean Piaget (1896 - 1980), who developed a theory (the theory of genetic epistemology) that analogized the development of the mind to evolutionary biological development and highlighted the adaptive function of cognition.

Piaget proposed four stages in human development: the sensor motor stage, the preoperational stage, the concrete operational stage, and the formal operational stage. For Piaget, the development of human intellect proceeds through adaptation and organization.

Adaptation is a process of assimilation and accommodation, where external events are assimilated into existing understanding, but unfamiliar events, which don't fit with existing knowledge, are accommodated into the mind, thereby changing its organization.

Countless studies have demonstrated - or tried to discredit - Piaget's developmental stages. For example, it has become clear that most adults use formal operations in only a few domains where they have expertise. Nonetheless, Piaget's hypothesis that learning is a transformative rather than a cumulative process is still central. Children do not learn a bit at a time about some issue until it finally comes together as understanding. Instead, they make sense of whatever they know from the very beginning. This understanding is progressively reformed as new knowledge is acquired, especially new knowledge that is incompatible with their previous understanding. This transformative view of learning has been greatly extended by neo-Piagetian research.

For the American philosopher and educator John Dewey (1859 - 1952), education depended on action - knowledge and ideas emerge only from a situation in which learners have to draw out experiences that have meaning and importance to them. Dewey argued that human thought is practical problem solving, which proceeds by testing rival hypotheses. These problem-solving experiences occur in a social context, such as a classroom, where students join together in manipulating materials and observing outcomes. Dewey invented the method of progressive education in North America. The Fostering Communities of Learners (FCL) program, devised by Ann Lesley Brown and Joseph Campione, is a current attempt to put Dewey's progressive education theory to work in the classroom.

In summary, Piaget contributed the idea of transformation in learning and development; and Dewey contributed the idea that schools had to bring real world problems into the school curriculum.

4. Constructivist Processes and Education

There is a number of competing constructivist views in education. Constructivists tend to celebrate complexity and multiple perspectives, although they do share at least a few educational prescriptions.

- **Prior knowledge.** Constructivists believe that prior knowledge impacts the learning process. In trying to solve novel problems, perceptual or conceptual similarities between existing knowledge and a new problem can remind people of what they already know. This is often one's first approach towards solving novel problems. Information not connected with a learner's prior experiences will be quickly forgotten. In short, the learner must actively construct new information into his or her existing mental framework for meaningful learning to occur.

- **Real and authentic problems.** Constructivist learning is based on the active participation of learners in problem-solving and critical thinking - given real and authentic problems.

- **Constructivist curriculum.** A constructively oriented curriculum presents an emerging agenda based on what children know, what they are puzzled by, and the teachers' learning goals. Thus, an important part of a constructivist-oriented curriculum should be the negotiation of meaning. Maggie Lampert, a mathematics teacher, guides students to make sense of mathematics by comparing and resolving discrepancies between what they know and what seems to be implied by new experience.

  In constructivist classrooms, curriculum is generally a process of digging deeper and deeper into big ideas, rather than presenting a breadth of coverage. For example, in the Fostering Communities of Learners project where students learn how to learn, in knowledge-building classrooms where students seek to create new knowledge, or in Howard Gardner's classrooms where the focus is on learning for deep understanding, students might study endangered species, island biogeography, or the principles of gravity over several months. As students pursue questions, they derive new and more complex questions to be investigated. Building useful knowledge structures requires effortful and purposeful activity over an extended period.

- **Cognitive conflict and social context.** According to Dewey, "Reflection arises because of the appearance of incompatible factors within an empirical situation. Then opposed responses are provoked which cannot be taken simultaneously in overt action" (p.326). To say this in another way, cognitive conflict or puzzlement is the stimulus for learning, and it determines the organization and nature of what is being learned. Negotiation can also occur between individuals in a classroom.

  This process involves discussion and attentive listening, making sense of the points of views of others, and comparing personal meanings to the theories of peers. Justifying one position over another and selecting theories that are more viable leads to a better theory.

- **Constructivist assessment.** Assessment of student learning is of two types: formative and summative. Formative assessment occurs during learning and provides feedback to the student. It includes evaluations of ongoing portfolios, and demonstrations of work in progress. Student collaboration also provides a form of formative assessment. In FCL, for example, students report to each other periodically on their research. In knowledge-building classrooms, students can read and comment on each other's work with the Knowledge Forum software. Formative assessment rarely occurs in classrooms.

  Summative assessment occurs through tests and essays at the end of a unit of study. Summative assessments provide little specific feedback. From a constructivist perspective, formative assessments are more valuable to the learner, but with the recent emphasis in North America on standards, and due to the poor alignment of constructivist approaches and standards, it is very difficult to harmonize formative and summative assessments.

- **Technology and constructivism.** Cognitive research has uncovered successful patterns in tutorial, mentoring, and group discussion interactions.

However, typical Internet chat and bulletin-board systems do not support a constructivist approach to learning and instruction. During the 1990s, researchers created tools such as Knowledge Forum, the Knowledge Integration Environment, and Co Vis to more fully address constructivist principles. Each of these tools invites collaboration by structuring the kinds of contributions learners can make, supporting meaningful relationships among those contributions, and guiding students' inquiries. Teachers who use information and communication technologies in their classrooms are more likely to have a constructivist perspective towards learning and instruction. Additionally, sophisticated information and technology communications tools can capture the cognitive processes learners engage in when solving problems. This affords teacher reflection and coaching to aid deeper learning. It also affords teachers the chance to learn from each other.

- **The teacher's role.** The teacher's role in a constructivist classroom isn't so much to lecture at students but to act as an expert learner who can guide students into adopting cognitive strategies such as self testing, articulating understanding, asking probing questions, and reflection. The role of the teacher in constructivist classrooms is to organize information around big ideas that engage the students' interest, to assist students in developing new insights, and to connect them with their previous learning. The activities are student-centered, and students are encouraged to ask their own questions, carry out their own experiments, make their own analogies, and come to their own conclusions. Becoming a constructivist teacher may prove a difficult transformation, however, since most instructors have been prepared for teaching in the traditional, objectivist manner.

   It "requires a paradigm shift," as well as "the willing abandonment of familiar perspectives and practices and the adoption of new ones".

A constructivist approach to education is widely accepted by most researchers, though not by all. Carl Bereiter argues that constructivism in schools is usually reduced to project based learning, and John Anderson, Lynn Reder, and Herbert Simon claim that constructivism advocates very inefficient learning and assessment procedures. In any event, the reality is that constructivism is rarely practiced in schools.

5. Constructivist Learning Environment

Constructivism provides both theoretical foundation and practical opportunity to move towards building constructivist learning environments. A constructivist learning environment (CLE) is a technology-rich, open place where a learner can use a variety of tools and information resources in his pursuit of learning goals and problem-solving activities. Wherein the learner can draw upon information resources and tools to actively construct knowledge, generate a diverse array of ideas, develop *multiple modes of representation, engage in social* interaction, and solve authentic problems.
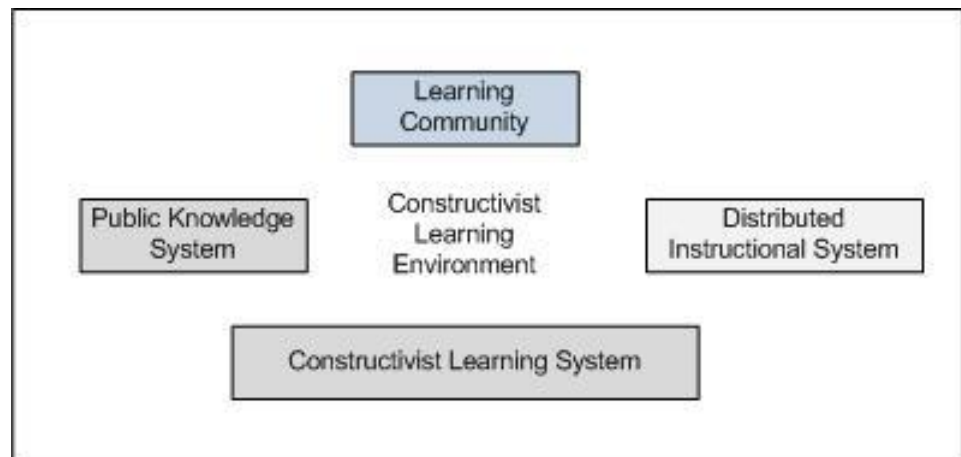
Figure 1 Elements of constructivist learning environment

Four major elements are bound together by their roles in the establishment of a CLE (Figure 1):

- **Public knowledge system**: It consists of all kinds of knowledge management systems that facilitate the creation, capture, storage, manipulation, and dissemination of public knowledge.
- **Distributed instructional system**: It offers educational programs, produces instructional materials, and is entitled to give out legally recognized certificates.
- **Learning community**: It is a group of individuals who are interested in a common topic or area and engage in knowledge-related transactions as well as transformations within it.
- **Constructivist learning system**: Constructivist learning system is a tool with which learners combine the most appropriate learning information and tools for a certain kind of learning situation. This system emphasizes the active and purposeful role of learners in configuring learning environments to resonate with their own needs, echoing the notions of learning with technology through mindful engagement [2].

6. Constructivist Learning System

The fundamental principle of the constructivist theory is that learning is a constructive activity that the learners themselves have to carry out. The insights gained from constructivist perspective can be instrumental in forming our views about the nature of learning system and the purpose of learning technology. A constructivist learning system (CLS) is a technology-based knowledge-construction tool with which a learner develops his CLE and constructs his knowledge base. Since CLEs are constructed from the perspective of learners, sensitive to their learning needs, styles, paces, local cultures, interests, and aspirations, learning system developers provide learners with only scaffoldings that contain tools, strategies, and guides, which enable learners to interact with construction tools in ways that best enable them to build the learning systems at different levels of knowledge structure and technological sophistication.

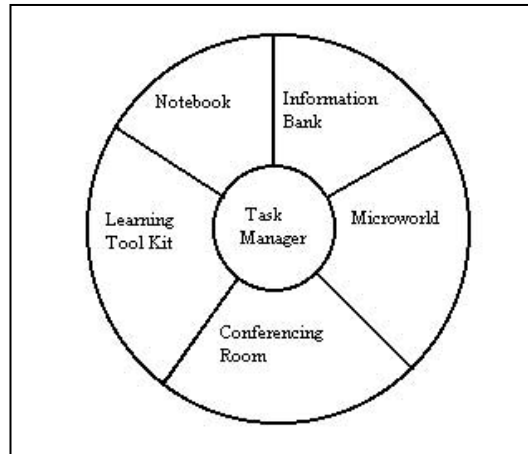As shown in Figure 2, in general, a CLS contains six components [1, 2]:

Figure 2 The components of a constructivist learning system

- **Information bank:** It serves as a source of explicit information about topics through which a learner can access databases of information, including textbooks, dictionaries, encyclopaedias, journals, digital library, music, films, and other electronic documents.
- **Notebook**: It is a highly organized set of note-taking tools for a learner to construct his own artefacts in the form of presentations, written documents, reports, models, pictures, etc.
- **Learning tool kit**: It provides a learner with access to the tools to understand and solve a problem. Learning tools include visualization tools, modelling tools, simulation tools, remote instrumentation, remote engineering tools, remote workstations, etc.
- **Micro world**: It presents scientific and social phenomena and makes them accessible to scrutiny and manipulation. It may contain virtual realities, scientific simulations and emulations, virtual laboratories, virtual museums, online field trips, online special events, and other miniature scientific and social world.
- **Conferencing Room**: It provides conversation and collaboration tools, using a variety of computer mediated communication methods, to facilitate communication among communities of learners and with teachers and experts.
- **Task manager**: It provides a learner with self-service and self-administrative mechanism that enables the leaner to plan his study, create learning maps, manage and track learning process, update records, register for courses and event, and schedule activities.

References

[1] D. H. Jonassen, K. Peck, & B. G. Wilson, *Learning with Technology: A Constructivist Perspective*, Columbus, OH: Prentice-Hall, 1999 (e-Book).

[2] D. N. Perkins, "Technology Meets Constructivism: Do They Make Marriage?" *Educational Technology*, vol. 31, no. 5, 1991 (e-Book)

[3] D.J. Bransford, et.al, *How People Learn: Brain, Mind, Experience, and School.* Washington, DC: National Academy Press,. 1999 (e-Book)

Internet Resources:

[4] Unknown, "Learning Theory: Constructivist Approach", www.answers.com, accessed on May 18, 2010 at 22.00 PM.

[5] Dewey, John. 1916. *Democracy and Education: An Introduction to the Philosophy of Education.* New York: Free Press. www.ilt.columbia.edu/publications/dewey.html

.