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Thinking dimensions as a foundation of learning design

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Abstract

This work presents a position paper that describes a conceptual framework for 'learning design'-based e-learning systems focusing on the role of the development of learners' cognitive and critical thinking. Within this framework, teachers' active involvement is viewed as essential. To this end, an attempt has been also made to map basic dimensions of thinking to 'learning design' through the proposal of an innovative 'learning design' environment which includes various features.

1. Introduction

If the goal of education is not just to prepare learners to provide 'the right answers' to pass their exams but to create rational, mature thinkers who will be able to acquire and to appropriately use knowledge in analyzing problems, searching for meaning and make thoughtful decisions, then the centrality of teaching and learning within a framework that emphasize learners cognitive development needs no justification [1]. In a nutshell, thinking as a foundation of learning is essential.

'Learning design' based e-learning environments seem as promising contexts for the design of pedagogically sound e-learning events, unlike first generation of e-learning environments such as WebCT, and BlackBoard that seem to be strongly based around information transmission [2]. In fact, 'learning design' has been defined [3] as an application of a pedagogical model for a specific learning objective, target group, and knowledge domain. An important part of this definition is that pedagogy is abstract and not depended upon both; context and content. Specifically, best pedagogical practices can be reflected in the formation of 'design patterns' which could be shared and reused across instructional contexts and essentially assist online learning. The key principle in 'learning design' is that it represents the learning activities that have to be performed by learners and teachers in the context of a unit of learning.

The IMS Learning Design (LD) specification aims to represent the design of units of learning in a semantic, formal and machine interpretable way [4]. Despite the fact that, the IMS-LD specification brings many pedagogical benefits when compared with earlier open specifications for eLearning, it is not easy for teachers and non-technologically experts to understand and become actively involved with it [5]. Moreover, modern constructivist and social views of learning [6] emphasize that teaching is closely related with the design of both; appropriate activities as well as teacher monitoring and intervention. To this end, teaching can not become a pre-defined activity -performed by remote experts in learning design- but an online modeling, decision making, intervention and mediation process performed by the teacher as a basic actor in the design of the learning process. However, this kind of teaching is difficult for typical teachers to grasp, so they need appropriate education and supporting tools.

There are also well known integrated systems that support the idea of 'learning design' such as; LAMS [7] MOODLE [8] and COLLAGE [9]. Nevertheless, there is an absence of tools that could support teachers' attempts for 'learning design' by taking into account the development of learners' cognitive skills.

This paper is part of a wider work aiming at the design and the implementation of a system that would be appropriate for teachers so that they can encourage their students to develop their cognitive structures. In this paper, a coherent and integrated framework regarding thinking dimensions is presented. An attempt has been also made to map these dimensions within the 'learning design' context through the proposal of specific tools.

2. Mapping thinking dimensions within the 'learning design' context

The basic thinking dimensions presented in this section are based on the framework formed by [10] that

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has been reviewed by numerous researchers, experts, practitioners and scientific organizations. Five dimensions of thinking have been identified: Core thinking skills, thinking processes, critical and creative thinking, metacognition, and the relationship of content-area knowledge to thinking. Usually, learners use these dimensions simultaneously. Due to space limitations, a brief description of three of these dimensions is presented followed by proposals of how it is possible to treat them in terms of tools within the e-learning context.

a) Core thinking skills: These skills are used in metacognitive reflection as well as in thinking processes which are performed in the acquisition and performance of knowledge of each content area by the learners. Needless to say, these core skills are also implied in critical and creative thinking. Core thinking skills (TSi, i=1,...21) have been classified into eight categories (Ci, i=1,…8) and are briefly presented bellow:

C1. Focusing skills. Two skills are included: TS1) 'Defining problems', and TS2) 'Setting goals'. These skills can be used at any time during a task to clarify/ verify and also redefine one's efforts.

C2. Information gathering skills. Skills included: TS3) *'Observing'*, and TS4) '*Formulating questions'*.

C3. Remembering skills. Here, fall the skills of: TS5) 'Encoding', that is the process of linking pieces of information to be stored in long-term memory, and TS6) 'Recalling' that implies the use of effective strategies to store information for easy retrieval.

C4. Organizing skills. Here are included the skills of: TS7) 'Comparing', TS8) 'Classifying', TS9) 'Ordering', and TS10) 'Representing' that means put information in such diverse forms (visual, verbal, symbolic).

C5. Analyzing skills. Skills included in this category: TS11) 'Identifying attributes and components', TS12) 'Identifying relationships and patterns', TS13) 'Identifying main ideas', and TS14) 'Identifying errors'. These skills are crucial in critical thinking.

C6. Generating skills. Here, fall skills such as: TS15) 'Inferring' implying the ability to identify what maybe true based on learners' previous knowledge and reasoning, TS16) 'Predicting', and TS17) 'Elaborating' that is adding relevant information and explanations.

C7. Integrating skills. Two skills included in this category: TS18) 'Summarizing', and TS19) 'Restructuring'.

C8. Evaluating skills. Here as well, fall the skills of*:* TS20) 'Establishing criteria' for judging about the value or logic of statements from both; philosophical and psychological points of view, and TS21) 'Verifying' a statement by using the evaluation criteria established using the previously mentioned skill.

Mapping core thinking skills to 'learning design'. Considering the core skills mentioned in this section, our framework proposes a specific vocabulary for critical thinking consisting of a number of appropriate key-words. These key-words can be used as labels in the construction of structured forums and chat rooms, in the formation of relative questions, and in design patterns of learning tasks. Examples of the use of this vocabulary in designing good communication as well as appropriate questions and examples could be also provided.

b) Thinking processes

Concept formation. A concept consists of several information about one or more entities – objects, events, ideas or processes- organized by a person so that s/he is able to discriminate the particular entity or class of entities and also to relate to other entities and classes of entities ([11], p. 276). Various concept formation levels have been proposed such as; concrete and identity level, beginning classificatory level, and mature classificatory and formal level.

Principle formation. Principles are generalizations describing relationships between or among concepts in a discipline. Principles have been classified as: cause and effect, correlational, probability and axiomatic [11].

Comprehension. Comprehension is the subjective process of extracting new information from various sources, interpreting and integrating it with what is already known to generate new meaning. Such sources would be; observing a phenomenon, reading, listening something, looking at a sign, participating in an activity etc. Various strategies have been proposed to achieve comprehension.

Problem solving. The ability to solve problems is essential in human development. In fact any goal directed behavior can be classified as problem solving [1]. Problems could fall in two broad categories: well defined and ill-defined. Despite the fact that, some general problem solving processes are lists of unordered strategies, various heuristics and specific strategies have been proposed to treat problem solving [12].

Decision making. This process is closely related to problem solving and it is also an activity that we all engage in, many times each day. In fact, the decision maker has to invent or choose the best among alternatives, taking into account essential criteria [13]. To this end, a 12-step decision making process has been proposed involving four operations: state the goal, generate ideas, prepare a plan and take action.

Scientific inquiry. This is a major thinking process that includes problem solving and decision making but its purposes emphasize explaining and predicting. Different views of scientific inquiry share common characteristics such as; describing phenomena, formulating and testing

hypotheses. General models for the process of scientific inquiry have been also reported [10].
Composition. This is a process towards the development of a product. Composition models have been proposed emphasizing: planning, translating and monitoring [14].
Oral discourse. This process is central in the process of meaning making. Basic abilities for effective discourse have been reported and a number of tools are also available to the teacher to supervise conversation.

Mapping thinking processes to 'learning design'. By exploiting the various constructs proposed for the development of thinking processes, our framework proposes diverse design patterns for specific learning activities. Specifically, design patterns can be formed by taking into account the proposed: a) levels of concept formation, b) the classification of principles, c) strategies to achieve comprehension, d) problem solving processes, e) decision making processes, f) models of scientific inquiry, g) composition models and h) tools for oral discourse. Since these general patterns of skills are characteristic descriptions of most thinking processes, it could be helpful to design units of learning emphasizing the use of these skills.

c) The relationship of content-area knowledge to thinking

Thinking skills cannot and should not be taught apart from content because content is inseparably linked with cognition [10]. However, each content area represents a particular way of mapping out the world and has specific approaches to investigation and analysis resulting in a body of ideas that are the discipline's conceptual core. Four main perspectives on content area were reported that could be used in teaching and learning: a) content-area learning as schema-dependent, b) content areas as models and metaphors, c) content areas as changing bodies of knowledge and d) content areas as special approaches to investigation.

Mapping main perspectives on content-area to 'learning design'. Taking into account the previously mentioned perspectives, design-patterns representing essential learning techniques for schema developing, modeling and investigation as well as tools for the study/generation of metaphoric representations.

3. Summary

This paper proposes a sound conceptual framework for critical thinking and the mapping of basic dimensions of thinking onto curriculum and instruction within e-learning through the design of appropriate features (basically, design patterns and tools). This framework can be used for the design of curriculum, instruction and assessment within a 'learning design' based e-learning context.

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