Development Strategy using Cognitive Domain in e-Requirement Engineering Learning System

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Abstract

Current trend of e-learning promote continuous learning environment. Unfortunately, it fails to optimize the learning between student and learner. Some factors are discussed to encounter the current problem. It should have suitable contents representations that will be remembered and applied in practice by the students. The e-learning discussed in context of Requirement Engineering domain. Maximize the usage of e-Requirement Engineering Learning System, the cognitive domain is suggested to cooperate with the e-learning system. It will help Higher Learning Education (HLE) deliver students with employability skill with critical thinking strategy. In addition, it gives a big impact to software development project. Future work will be discussed on the quantitative analysis to measure the effectiveness of e-Requirement Engineering Learning System.

Keywords: *Requirement Engineering, cognitive Domain, Higher Learning Education, software development project, employability skill, problem-solving, bloom's taxonomy.*

1. Introduction

Developed country is boost with learning in virtual environment. Then, developing country with high effort make real a virtual learning in Higher Learning Education (HLE) to become a same level with developed country is undeniable fact [13, 24]. Most of the HLE [32] probably has the e-learning in their website. Unfortunately, the e-learning content different among others HLE in Malaysia. Sometimes, the e-learning website is not fully utilizing the needs for students learning [1, 2]. It make the e-learning is less effective. The improvement of e-learning should be growth fast [14] to deliver knowledgeable students with employability skill [35]. It should be concurrent with the industrial needs [22].

The concept of designing an e-learning [7, 25] should be similar with new car engine. The new engine is design with high performance to make a car move smoothly. At the same time, the car is very useful to the driver. To that reason, developing e-learning with cognitive domain is a way to improve the virtual learning between student and lecturer [3, 31].

2. Current Trend of e-Learning

Traditional learning promotes more on face-to-face environment [4, 26]. The constraint of face-to-face is based on limited of time and place for students to have guidance from the lecturer. They should come to the class as per schedule and only have the consultation hour by appointment. The learning is growing slowly. Especially, in Requirement Engineering subject, the technological tool is rapidly changes and the students unable to have continuously learning environment.

E-learning is taking place [15] to offer continuously learning environment with virtual medium. The internet is utilized by the students and lecturer to commit into e-learning environment. However, if e-learning does not have suitable contents and approaches, then e-learning will not enhance the learning entirely [17]. The success of e-learning depends on it being 'brain friendly' [8]. It defines that the students can totally optimize learning by e-learning contents representations that will be remembered and applied in practice [18].

3. Development of e-Requirement Engineering Learning System

Requirement Engineering [34] is a first step in controlling the whole software development project [20, 21] run successfully and meets stakeholder needs. Understanding the process and practice skill will help student to be a demanding employee. Somehow, the problems occur in traditional class which communication with the lecturer and stakeholder become a barrier to the student in finishing their task [33].

To that reason, some researchers have predicted that the traditional classroom will disappear [6, 9]. E-learning has entered the education [12] as well as the corporate world in a major way and it also complements the traditional delivery methods. It has facilitated the traditionally difficult educational paradigms such as adult learning or distance learning.

e-Requirement Engineering Learning System come across to provide a versatile learning environment, which many companies realize that educational institutions should be a kick start in deliver a student with employability skill [27, 38]. It is a combination of e-learning and Requirement Engineering. There are several factors are identified in implementing successful collaboration between cognitive domain [16] that cooperate with e-Requirement Engineering Learning system.

Development of web technology over the last two decades has led to a productive blooming of e-Learning methodology [18]. E-Learning materials and environments have several identifying characteristics [36, 37]: 1) availability – the learning materials are available on the net and students can easily download them; 2) multiple representations – the learning materials combine text, graphics, animation, sound and video; 3) multiple communication tools – several specially-developed social tools support e-Learning such as: discussion groups, e-mail, video conference, blogs and social networks. E-Learning instructors at the beginning of twenty-first century rely on this environment to implement various pedagogies.

Currently, e-Learning had been implemented but not favorably used [18]. Haverila and Barkhi (2011) identified that more experienced students felt e-learning is less effective than the less experienced students in using e-learning. When the students lack the experience in e-learning, it is important that the procedures, software tools, and materials are well organized and expectations are explained in detail before the course starts.

3.1 Infrastructure Factor

Lack of infrastructure support will lead to e-learning failure. In organization, e-learning can help in employees development in term of consistency of message, flexibility of learning, availability of learning and monitoring of progress and performance. Technology in e-learning [28] known as web-based learning is another channel of learning, which provides 1) Real time communication (Synchronous technology) such as instant message, audio/video conferencing and 2) Anywhere and anytime (Asynchronous technology) to access the courses over the Internet or intranet [19, 29].

Table 1. The Influence of Experience, Ability and Interest on e-learning Effectiveness (Haverila, M. & Barkhi, R., 2011).

		Place	
		Same	Different
Time	Synchronous	Traditional Method	Distance Learning
	Asynchronous	Recorded	e-Learning

3.2 Students / Learner Factor

The other factors contribute in e-learning failure is individual perspective. It includes self-motivation among students. The e-learning level decrease if the student gets difficult to use e-learning if they don't have technological skill [22, 35].

Responsible (self-directed leaning) on finishing the task given by the lecturer is another crucial factor [14]. Better learner attitudes contribute to increase learner's control [17].

4. Element in Learning Environment

There are several arguments and similarity from three well-known researchers about the element in successful learning environment. According to Bloom's taxonomy (1956) of learning domains, there are three domains of educational activities 1) Cognitive Domain, which involves knowledge and the development of intellectual and mental skills, 2) The Affective Domain, which describes the way we face things emotionally and 3) The Psychomotor Domain, which involves physical movement, coordination, and use of the motor-skills.

In addition, Parnas (1999) encouraged Software Engineering curriculum to involve with five complementary elements in learning environment. It includes 1) principles (lasting concepts that underlie the whole field), 2) practices (problem-solving techniques which good professionals will apply consciously and regularly), 3) applications (areas of expertise where the principles and practices find their best expression), 4) tools (state-of-the-art products that facilitate the application of these principles and practices) and 5) mathematics (the formal basis that makes it possible to understand everything else).

Furthermore, Jazayeri (2004) states that learning environment should integrate with projects. This is often recognized as a very critical issue in Software Engineering education. Replaying the complexity of real-life projects in

an educational environment can be impossible. Thus we need to find innovative ways of integrating project [20, 21] work in curricula.

Table 2. Similarity element of successful learning.

Author	Year	Element (s)	Similarity on
Bloom's taxonomy	1956	1. Cognitive Domain 2. Affective Domain 3. Psychomotor Domain	• Cognitive Domain
Parnas	1999	1. Principles 2. Practices 3. Application 4. Tool 5. Mathematics	• Practices • Application • Tool
Jayazeri	2004	1. Project	• Project

5. Design e-Learning with Cognitive Domain Perspectives

Zamfir (2007) indicated that "cognitive domain, focused on learning about learning, both as individual and as organization, imply information technology and two effects of it: diversity and globalization".

Figure 1 shows that some factors influence in designing [7, 10, 11] the software towards cognitive domain. It is particularly based on 1) individual (refer to student, lecturer and stakeholder (who contribute in learning environment), 2) team (is among student's team members) and 3) project (refer to students team, lecturer (monitor student's project progress), and stakeholder (who will approve the requirement deliverables) factors.

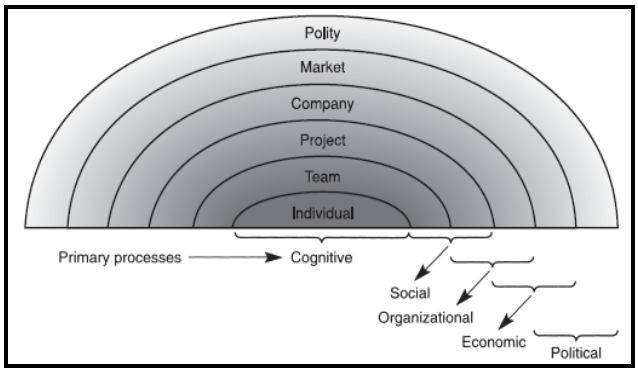

Figure 1. Factors influencing the software design process (Curtis *et al.*, 1988)

Cognitive Strategy used as an internal process by which the student [37] controls their own ways of thinking and learning. Example: Engaging in self-testing to decide how much study is needed; knowing what sorts of questions to ask to best define a domain of knowledge; ability to form a mental model of the problem [10]. Problem solving is combining lower level rules to solve problems in a situation never encountered by the person solving the problem. It may involve generating new rules which receive trial and error use until the one that solves the problem is found. Bloom (1956) described six sub-categories in the cognitive domain, which are measured by degrees and levels of difficulties so that an individual cannot master one of these levels if the student has not first mastered the preceding sub-category.

6. Conclusion

As a conclusion, the e-Requirement Engineering Learning System should integrate with Cognitive Domain to increase problem-solving skill among student. The students should have a responsibility in order to finish their task according to the milestone given by the lecturer.

Table 3 discussed the suggestion of assessment method regarding the Cognitive Domain (Blooms, 1956) and Bloom's Revised Taxanomy (Pohl's, 2000). Several top universities such as Harvard [40] and Cambridge [41] University were used quiz as a medium for students to memorize learned information.

Other assessment [23] methods (case study, small group assignment and project) have collaboration between students, lecturer and stakeholder [20]. It should be an important element in an interactive and process-oriented course. It will facilitate a collaborative learning context to improve critical thinking skills. Otherwise, projects [21] are used to tailor with the needs of employability skill [33]. The skill of presentation can be improved by using peer-to-peer assessment of assignments and conferencing in a team environment.

In addition, the expectations should be clear with proper milestones and set it in specific time frames. Students should be informed that the deadlines and schedules should be taken seriously [18]. Ada (2009) highlight a positive correlation between the quality of the group's engagement in a collaborative process and the quality of cognitive skills fostered. Future work will be discussed on the challenges in developing e-Requirement Engineering Learning System.

Table 3: Suggestion of e-Requirement Engineering Learning System based on Cognitive Domain (Blooms, 1956) and Bloom's Revised Taxanomy (Pohl's, 2000).

Cognitive Domain	Bloom's Revised Taxonomy	Suggestion assessment method e-Requirement Engineering Learning System	Participant
Knowledge: Recall data or information	**Remembering**: Recall previous learned information.	**Quiz / Exercise / Short Essay**	**Student**
Comprehension: Understand the meaning, translation, interpolation, and interpretation of instructions and problems. State a problem in one's own words	**Understanding**: Comprehending the meaning, translation, interpolation, and interpretation of instructions and problems. State a problem in one's own words.	**Exercise / Case Study**	**Student / Lecturer**
Application: Use a concept in a new situation or unprompted use of an abstraction. Applies what was learned in the classroom into novel situations in the work place.	**Applying**: Use a concept in a new situation or unprompted use of an abstraction. Applies what was learned in the classroom into novel situations in the work place.	**Case Study / Assignment**	**Student / Lecturer / Industry**
Analysis: Separates material or concepts into component parts so that its organizational structure may be understood. Distinguishes between facts and inferences.	**Analyzing**: Separates material or concepts into component parts so that its organizational structure may be understood. Distinguishes between facts and inferences.	**Small Groups Assignment / Project**	**Student / Lecturer / Industry**
Synthesis: Builds a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure.	**Evaluating**: Make judgments about the value of ideas or materials.	**Project / Presentation**	**Student / Lecturer / Industry**
Evaluation: Make judgments about the value of ideas or materials.	**Creating**: Builds a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure.	**Project / Presentation**	**Student / Lecturer / Industry**

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