PEDAGOGICAL FRAMEWORK TO IMPROVE THE QUALITY OF LEARNING OBJECTS IN COLLABORATIVE E-LEARNING SYSTEMS

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Keywords: Collaborative e-learning systems, Learning objects, Self-regulated learning, Learning style.

Abstract: Learning objects are the building blocks of the learning resources in any e-learning system. In collaborative e-learning systems, the learning objects are produced and consumed by different learners. Finding high-quality learning objects that are related to a learner's profile is one of the major problems that may cause e-learning systems to fail. This is especially true as the number of learning objects in the learning environment increases. This paper presents a pedagogical framework to improve learners' interactions with learning objects in collaborative e-learning systems. The proposed framework is based on the theory of learning styles and the cyclical model of self-regulated learning. By incorporating the experiences and contributions of different learners with the available learning objects, the quality of the learning objects in the system can be increased. Learners' awareness of their preferred learning style can help them to find appropriate learning objects. This can be achieved by the help of the e-learning system that can generate a recommendation list of appropriate learning objects based on the learner's learning style.

1 INTRODUCTION

A collaborative e-learning system provides an environment where people who share common interests collaborate together by creating and sharing knowledge to provide the opportunities for everybody to learn (Wang et al., 2005).

The dominant education paradigm has shifted from the traditional teacher-centred to one where the student plays a more central role. This approach is based on the constructivism theory of education where the emphasis is placed on the learner to discover and construct knowledge through active participation (Glasersfeld, 2009). Social Constructivism (Pritchard and Woollard, 2010) is an extension of constructivism theory where the focus is placed on the role the environment plays in helping the learner construct knowledge. According to this theory, learning is a social process and, rather than only being passively received or constructed by each individual learner, knowledge is also the result of engaging in social activities. This view of learning is also related to some contemporary theories of education such as Social Cognitive Theory (SCT) (Bandura, 2001). SCT views human behaviour as being influenced continuously by the social and physical environment.

Learner-centred education paradigm places more responsibilities on learners to control and regulate their personal learning process in a collaborative social environment. In this new education paradigm, our vision of the learning resources should be changed, so that more emphasis is placed on learner-generated resources, and in this case the learner is no longer a passive consumer of knowledge but active as a consumer and producer of knowledge and learning resources (McLoughlin and Lee, 2010).

In e-learning systems, the building blocks of learning resources are referred to as learning objects. A learning object can be defined as any digital resource that has a pedagogical objective and is intended to be used and reused in different learning contexts (Sosteric and Hesemeier, 2002). Images, animations and simulations are all examples of learning objects. However, a learning object can also be an entire web page that combines text, images, and other resources to deliver a complete unit of learning.

In collaborative e-learning systems, learning objects are created to be shared and reused in different contexts (Koohang, 2004). Having low-quality learning objects is one of the major problems that cause

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e-learning systems to fail (Han et al., 2003). Another problem is that it can be difficult to find learning objects related to a learner's profile (Shishehchi et al., 2010). This is especially true as the number of learning objects in the learning environment increases.

This paper presents a pedagogical framework to improve learners' interactions with learning objects in collaborative e-learning systems. The proposed framework is based on the theory of learning styles and the cyclical model of self-regulated learning. By incorporating the experiences and contributions of different learners with the available learning objects, the quality of the learning objects in the system can be increased. Learners' awareness of their preferred learning style can help them to find appropriate learning objects. This can be achieved by the help of the e-learning system that can generate a recommendation list of appropriate learning objects based on the learner's learning style.

A learner can then use different learning strategies which can contribute to increase the quality of learning objects by providing different notes, comments, summaries, examples, ratings or reflections associated with the same learning object.

This paper is organized as follows. Section 2 presents the theoretical background of this paper by defining and discussing the concepts of self-regulated learning and learning styles. Section 3 presents the proposed pedagogical framework for improving the learning process in the collaborative e-learning systems based on the self-regulated learning and the learning styles. Section 4 discusses some implications of the proposed pedagogical framework on searching and recommending of learning objects that are related to different learning styles. Finally, section 5 presents conclusions and proposals for future work.

2 THEORETICAL BACKGROUND

2.1 Self-Regulated Learning

Self-regulated learning (SRL), an educational approach influenced by the constructivism and social views of learning, is an important area of research in education and psychology. Self-regulated learning can be defined as " self-generated thoughts, feelings and actions that are planned and cyclically adapted to the attainment of personal goals" (Zimmerman, 2000).

Basically, self-regulated learning refers to the ability of the learners to understand and control their learning process and environment. To achieve this, learners have to specify their goals, select and use appropriate strategies, and monitor their learning progress towards achieving their goals (Schunk, 1996). Students with the ability to self-regulate their learning can have high academic achievement with less effort (Pintrich, 2000).

Despite the fact that there are a variety of self-regulated learning models, these models are all similar to Zimmerman's Cyclical Model of Self-Regulated Learning. Zimmerman (Zimmerman, 2000) developed a model that represents self-regulated learning as a process of three cyclical phases (Figure 1): (1) forethought, (2) performance, and (3) self-reflection.

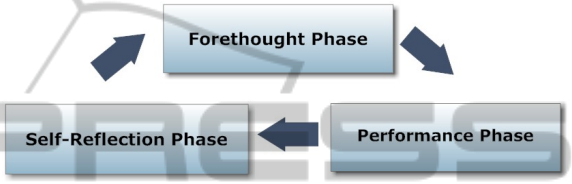

Figure 1: SRL Cyclical Model.

Forethought phase involves processes that occur before learning including goal settings, previous knowledge activation and strategic planning. Goal setting is the process of determining the outcomes of the learning task. Strategic planning involves the selection of strategies and resources required for performing the task and time planning.

Performance phase involves processes that occur during learning. This includes cognitive learning strategies students use to deal with the learning material. Rehearsal, elaboration, organizational and critical thinking strategies are examples of cognitive strategies that have been reported to have positive impact on the academic performance of students (Pintrich and De Groot, 1990). Rehearsal strategies are the basic methods used by the learner to keep the information in the working memory, and involve strategies such as note taking and repeating the learning material. Elaboration strategies are methods used by the learner to keep the information in the long-term memory, and involve methods such as summarizing, paraphrasing, relating new information to the existing knowledge of the learner and using examples and analogies. Organizational strategies are methods used by learners to link the important ideas of the learning materials such as creating concept maps. Rehearsal strategies are example of surface level processing strategies which focus on memorizing of facts and information retrieval, while elaboration and organizational strategies are deep level processing strategies which focus on understanding the relationship between learning material (Zusho et al., 2003).

The performance phase involves also metacognitive strategies the learners may use to monitor their progress such as self-recording and self-questioning. Self-recording is a technique used by learners to record each learning activity and its results. Self-questioning or testing is a strategy used by the learners to assess their understanding of the learning material by performing a test to evaluate performance against a predefined goal or standard. During this phase, the learner can use resource management strategies such as searching for suitable learning resources and seek help from other learners in the learning environment.

The phase of self-reflection involves processes that follow the learning task including the learners' perceptions of their performance and experience with the learning material.

The self-regulated learning phases are cyclical; feedback from previous phase is used to adjust the next phase (Zimmerman, 2000).

2.2 Learning Style

Learning is a process whereby individuals acquire new knowledge. Research indicated that students tend to gather and process information in different ways. These differences are known as learning styles. Many definitions can be found in the literature for the term learning style. The learning style can be defined as "a particular way in which an individual learns" (Pritchard, 2009). Shaw and Marlow (Shaw and Marlow, 1999) describe the learning style as "a distinctive and habitual manner of acquiring knowledge, skills or attitudes through study or experience". One of the most comprehensive definition of the learning style is the one provided by Keefe (Keefe, 1988) who defined learning style as " the characteristic cognitive, affective and psychological behaviors that serve as relativity stable indicators of how learners perceive, interact with and respond to the learning environment".

Learning styles can be identified using different learning style models. Felder and Silverman (Felder and Silverman, 1988; Felder and Spurlin, 2005) developed a model to identify students' learning styles especially in science and engineering education. This model consists of four dimensions:

2.2.1 Sensing/Intuitive

This dimension describes the type of information an individual preferentially perceives. Sensing learners prefer concrete contents and facts and oriented toward the details whereas intuitive learners prefer abstract concept, theories and mathematical formulas and dislike details. Sensing learners tend to solve problems using well-established methods and dislike complications. Intuitive learners like innovations, new ideas of solving problems and dislike repetition.

2.2.2 Visual/Verbal

This dimension describes the channel through which the learner most effectively perceives information. Visual learners prefer learning through visual medium such as pictures, charts and diagrams whereas verbal learners prefer spoken or written materials and explanations.

2.2.3 Active/Reflective

This dimension describes how the learner processes information. Active learners prefer learning in groups and they tend to try things out whereas reflective learners prefer working alone and think about how things work before try them.

2.2.4 Sequential/Global

This dimension describes how the learner progresses towards understanding the information. Sequential learners prefer following a logical, step by step linear approach whereas global learners prefer absorbing the learning materials randomly in big jumps without following step by step approach until grasping the full picture.

3 PROPOSED PEDAGOGICAL FRAMEWORK FOR COLLABORATIVE E-LEARNING SYSTEMS

The framework proposed in this paper is to enhance the educational effectiveness of the collaborative learning environment based on the cyclical model of self-regulated learning and learning style that are well-grounded in the educational theories. The self-regulated learning cyclical model (section 2.1) is applied to provide an alternative and effective design for collaborative learning environment. The new pedagogical framework takes into consideration the learning styles of learners before involving in any learning activity within the learning environment. The proposed framework consists of the following components (Figure 2):

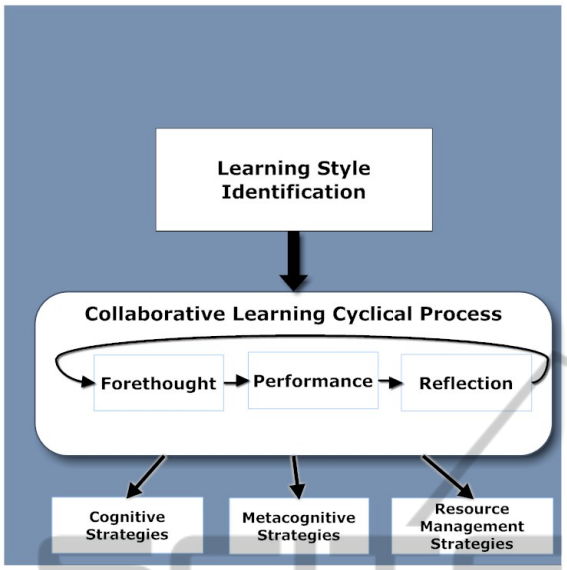

Figure 2: Pedagogical Framework for Collaborative e-Learning Systems.

3.1 Learning Styles Identification

This component is responsible for identifying learners' learning styles based on Felder-Silverman learning style model. An instrument known as Index of Learning Style (ILS) (Felder and Spurlin, 2005) can be used to achieve that. Felder-Silverman model describes the learner's preferences based on four dimensions: Sensing-Intuitive, Visual-Verbal, Active-Reflective and Sequential-Global. Based on the result, a learner's profile will be created to contain information about his/her learning styles. This module is responsible for increasing learners' awareness of their learning styles by providing guidelines to help them to better utilize the strengths of their learning styles. Also, this can help the collaborative e-learning system to recommend suitable learning objects for the learners based on their learning styles. The following are sample of the guidelines that can be given to the learners based on their learning styles:

1. Sensing Learners:
   - Find real world examples to link the content of the learning object with the real word.
   - Focus on the learning objects that contain facts and procedures.
   - Find learning objects that contain experiments results.
2. Intuitive Learners:
   - Read the summaries written by other learners.
   - Find learning objects that contain innovative ideas of applying the concepts.
   - Find learning objects that use theories and mathematical formulas.
3. Visual Learners:
   - Focus on learning objects that use visualization (e.g., pictures, diagrams, animations, etc.).
   - Draw concept maps to link key points in the learning objects.
4. Verbal Learners:
   - Find descriptions for diagrams and other visual learning material.
   - Focus on learning objects that contains audio learning resources.
   - Write summary for the learning object in your own words.
5. Active Learners:
   - Find learning objects that contain simulations.
   - Discuss the content of the leaning object with other learners.
6. Reflective Learners:
   - Read the comments and reflections written by other learners about their experience using the learning object.
   - Think of possible questions or applications of the content of the learning object.
7. Sequential Learners:
   - Look at the outline of the content of the learning object.
   - Use concept map to see how the key points in the learning object linked to each others.
8. Global Learners:
   - Take overview of the learning object before going into the details.
   - Link the content of the learning object with something you already know.

3.2 Collaborative Learning Cyclical Process

This is the main component of the pedagogical framework in which the learners participate in the learning process by interacting with learning objects. To increase the educational effectiveness of the learning process, this paper applies the cyclical model of self-regulated learning. The model consists of three phases: forethought, performance and self-reflection as described in section 2.1.

3.2.1 Forethought (Planning and Activation)

Before engaging in learning activity, learner has to set goals and plan for their time using tools that should be provided by the e-learning environment. Choosing suitable learning objects is very important task that need to be done in this phase. This can be achieved by the help of the information gathered from the interaction of other learners with learning objects. Also, the e-learning system can recommend suitable learning objects based on the result of the learning style identification in the previous phase. After that, the learner should assess their previous knowledge required to understand the content of the learning object. To achieve that, learning objects have to be associated with extra information on the prerequisite knowledge required before using the learning objects.

3.2.2 Performance (Action)

In this phase, the learner starts the learning task by using different cognitive and metacognitive learning strategies as discussed in section 2.1. The learner can perform a number of actions on the learning object:

- Note taking and commenting.
- Paraphrasing and summarizing.
- Providing real world examples of applying the concept.
- Outlining and creating concepts maps for the content of the learning object.
- Rating and tagging the learning object.

In this phase, learners also use metacognitive strategies such as self-testing to check their understanding of the concepts covered by the learning object. This can be achieved by providing assessment questions associated with the learning object.

3.2.3 Reflection Phase

This phase involves the processes that occur after completing the learning task. In the proposed framework, the e-learning system should allow learners to write reflections on their experience in using the learning objects and whether the learning goals have been achieved or not. Learners' reflections on their experience of using the learning object will be associated with the learning object and can help other learners to choose suitable learning objects and plan for their learning process.

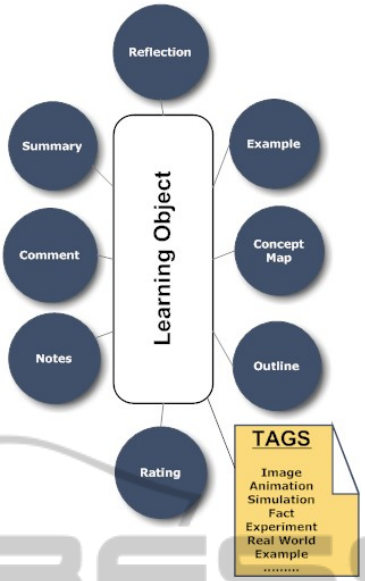

Figure 3: Extension of the Learning Object.

4 IMPLICATIONS OF THE PROPOSED FRAMEWORK: SEARCHING AND RECOMMENDING OF SUITABLE LEARNING OBJECTS

In the proposed framework, learners follow cyclical model to consume the knowledge provided by the learning objects in the collaborative e-learning system. According to this, learners with different learning styles interact with the learning objects by following a number of strategies which will result in providing different notes, comments, summaries, examples, ratings and reflections associated with the same learning object and generated by learners with different learning styles (Figure 3). In this case, the learner is not only a consumer of the knowledge but also a producer. This can increase the quality of the learning objects to be compatible with different learning styles.

Searching and recommending of learning objects can be improved as a result of applying the proposed framework. The experience of a learner in using specific learning objects can help other learners to find suitable learning objects for them based on the collaborative comments, ratings and reflections provided by learners with different learning styles. Also, appropriate tags can be used to index the learning objects to match different learning styles. For examples, for

sensing learners, appropriate tags can be *fact, experiment, real world example*, while for intuitive learners, the tags can be *innovative idea*, *mathematical formula* and *theory*. For Visual learners, the appropriate tags can be *image, diagram*, and *simulation* while for verbal learners, *explanation* and *audio*. For sequential learners, appropriate tags such as *outline* can be used while for global learner, *overview* is one of the suggested tags that can be used. Recommendation systems can be integrated to the collaborative e-learning environment to provide learners with suitable learning objects based on their learning styles and the interaction of other learners with learning objects.

5 CONCLUSIONS AND FUTURE WORK

This paper presented a pedagogical framework based on the learning styles and the self-regulated learning to improve the quality of the learning objects in collaborative e-learning systems.The proposed framework can also help learners to find suitable learning objects compatible with their learning styles. This work will continue by conducting empirical studies involving students using a collaborative e-learning system based on the proposed pedagogical framework. These empirical studies will help to evaluate the educational effectiveness of the proposed framework.

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