

E-Learning Technology for Problem-Based Learning Technique: An Introduction of Requirements Elicitation Model

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Abstract

Problem-Based Learning (PBL) is a learning technique that involves learners with problem-solving skills and it is known to motivate learners to collaborate among themselves to work together for the best solution. This technique requires effective social interaction in order to produce the best outcome from each discussion in the learning process. Social interaction issue becomes more interesting in reducing socio-technical gap in e-learning application since the interaction involves people virtually during the session regardless of time and place. The failure to reduce socio-technical gap in the implementation of e-learning can cause ambiguous features in the system due to different perception of requirements specification from stakeholders with various backgrounds. This paper portrays social elements in e-learning environment and how requirements components in requirements elicitation model can help in extracting social requirements in e-learning application.

Keywords: social aspect requirement; requirements; user; e-learning; elicitation; application

1. Introduction

E-learning plays tremendous phenomena in learning process around the globe. Many people are seeking for learning flexibility so that they can cater time and place constraints. Some of them prefer to study and work at the same time and by having flexibility in learning time and place, they do not have to worry on how to fix their time to learn as long as they keep track and use the modules given by the university. In other word, they can learn remotely from university and get connected with respected instructors and other members online. Recent updates and instructions can also be delivered easily through online learning. E-learning assists users to anticipate with group discussions, forums, problem solving activities and other categories that require collaboration and co-operation between members. Therefore, e-learning application should provide active learning platform to users since it is a medium for users to communicate actively via online. The impact from online learning process must be as effective as face to face learning process. Thus, there is one of the challenges in e-learning which is to promote active learning and in this case, social interaction must be taken into consideration in order to create effective and active communication via online.

The element of social interaction issue has been categorized as social aspect requirements in e-learning application. This requirement is a challenge to e-learning implementation since it is gathered from what users have experienced and how to make them comfortable while using e-learning as well as communicating with others members virtually whereby system analyst needs to transform the user's requirements to system requirement. The system analyst needs to carefully refine social aspect requirements that have been conveyed by users to accurately capture social features which can then be implemented in e-learning application. Clear social requirements elicitation by system analysts can help developer to design an application and hence reduce social-technical gap in e-learning. This paper is divided into seven sections which consist of; Section 1 as the Introduction, Section 2 and 3 illustrate how collaboration plays a part in supporting Problem-based Learning (PBL) technique via e-learning and overview of requirements engineering respectively. Section 4 gives some idea on requirements elicitation in RE. Section 5 is the results and discussions that comprised of approaches in requirements elicitation model. These approaches will be related with social aspect requirements for each case study that have been identified. Section 6 will cover how requirements

elicitation model relates with e-learning issue. Finally, this paper ends with Conclusion section.

2. Importance of Collaboration in Supporting PBL Technique

PBL empowers learners to have self-learning activity by having own research, collaborate and apply knowledge in resulting the best solution for defined problem (Savery, 2006). PBL technique is used in education for allowing students to hold the responsibility for resolving task given by their instructors. Usually, this technique is applied in groups of students and each of the individual in the groups has their own idea and role in order to come out with the best solution. PBL technique has shaped learning process in such a way that students need to cooperate and discuss the result and hence produce an agreement towards a particular issue that is to be solved. Instructor or lecturer for a particular course acts as an expert in their field to guide and share knowledge for that field with the students. There will be no right answer that is expected from them in PBL technique (Hmelo-Silver, 2004).

PBL technique permits learner to experience active learning environment in figuring out the solution. In order to stimulate discussion among members, e-learning must be designed to let users interact throughout learning process. Effective social interaction is generated by effective collaboration among members. Unlike face to face interaction, virtual communication needs to be developed based on how it will make users comfortable using the application in the future. Users tend to involve more frequently and feel motivated to use the application whenever they are secure with their group and hence social presence will increase in the environment due to a sense of trust and lively discussion as in the classroom environment (So and Brush, 2008).

Social presence can be defined as “the degree of awareness of another person in an interaction and the consequent appreciation of an interpersonal” (Walther, 1992). This theory of social presence helps to clarify another form of communication as the alternative of face to face interaction among individuals (Biocca and Harms, 2002). In online communication, the term social presence is used to describe the feeling of connectedness even though through user interface. The feeling of connectedness can be obtained from collaboration activities which involve information sharing among learners.

Collaboration enable learners to learn mutually and participate actively to do tasks (Alonso et al., 2005). Alonso stated activities in collaboration, participants and instructor are the components of collaboration and the collaboration activities are related with learning

objectives, identification of group backgrounds and assignments creation via interactions.

In order to ensure social presence in using e-learning system, organization like university particularly, should plan and design effective e-learning for users. This objective can be achieved by looking at the software development by improving requirements elicitation process for e-learning system. Therefore, social aspect requirements like social presence, comfort, emotions and so forth can be clearly identified. This paper provides Section 3 to give some idea of what is requirements elicitation in software development process.

3. Definition of Requirements Engineering

Requirements Engineering (RE) is a broad topic under the area of Software Engineering (SE). SE can be depicted as the process of developing and maintaining software throughout software development process. “Software engineering is an engineering discipline that is concerned with all aspects of software production from the early stages of system specification to maintaining the system after it has gone into use” (Sommerville, 2007). To relate, RE is an activity that exists in SE process. Requirements Engineering concentrates on ‘designing the right thing’ (Sutcliffe, 2002). RE consists of a few processes like requirements elicitation or requirements discovery, requirements analysis and reconciliation, requirements representation or requirements modeling, requirements verification and validation and requirements management (Laplante, 2009).

RE is said to be intricate since it covers a lot of area related with software development. RE may relate from technical issue to business issue as well as social issue of the software development. Different stakeholders from various areas have their own expectations about system’s output (van Lamsweerde, 2000). For instance, Technical people might see it from tangible output like functional requirements and non-functional requirements. whereas, business people find the system sufficient from intangible benefits such as less tense in using the system, more motivation in doing work which create productivity and also more organized business process by the existence of new system. The challenge arises in meeting all sorts of expectations in developing desired software. Problem may also arise if software developer tends to think like a developer not like a user. In the end, the system fails to meet user’s needs although it gives good functionalities.

Van Lamsweerde also stated that there is conflict in aligning proposed software so that it can be understood by all users with different skills and background. This leads to different viewpoints from users and that

information might be too long and acquire much times in requirements negotiation. Users may not technical aspect only but they are more focus in using user-friendly system.

4. Requirements Elicitation in RE

This paper will focus on requirements elicitation or requirements discovery since there is an issue in capturing social aspect requirements from users in e-learning. According to Laplante, requirements elicitation or requirements discovery is the first process happened in RE. Customer's needs are discovered in order to get requirements for purposed system. This process also involved the identification of other stakeholders related to the system. The concept of requirements elicitation can be expressed by some processes that accomplished certain techniques related with RE. Example of techniques involve in requirements elicitation are interviews, questionnaires, task analysis, domain analysis, introspection, repertory grids, card sorting, laddering, group work, brainstorming, Joint Application Development (JAD), requirements workshops, ethnography, observation, protocol analysis, apprenticing, prototyping, goal based approaches, scenarios and viewpoints (Zowghi and Coulin, 2005).

Based on these techniques available in requirement elicitation, system analyst has the option to identify an achievable way in order to extract social aspect requirements from users and thus process the information gathered so that it can be seen as some features available in e-learning application. The system analyst tends to think of technical requirement of the application rather than the pedagogy of learning process for online learning. The stakeholders who are responsible for giving social aspect information can be from learner and instructor point of view since they are using e-learning system throughout the learning session. Administrators of the application can also be considered in this case since they are the one who developed and designed the course activities in the e-learning. As been mentioned by Alonso in his paper, the components that are considered in collaboration are collaboration activities, learner and instructor. Therefore, it is necessary to identify the real stakeholders that can give information in terms of e-learning usage. The information given by learner and instructor can therefore be used in designing the system which can eventually reduce social-technical gap in e-learning.

5. Results and discussion

A few requirements elicitation model has been studied in order to see whether those models consider social aspect requirements while in requirements capturing process. Model that is going to be used in software development, especially in e-learning issue, particularly, must be designed in a way that social aspect requirements can be captured and refined for system development purpose. This paper will discuss a few concepts that might be helpful to assist requirements elicitation activity. The concepts that may concern with requirements elicitation are as follow; activity theory, collaborative approach in requirements elicitation model, collaborative ethnography and affective requirements and goal-driven approach

5.1 Requirements Elicitation Model with Activity Theory

One study has used Activity Theory (AT) in requirements elicitation model to develop Multiagent System (MAS) in Agent-Oriented Software Engineering (AOSE) (Davey and Cope, 2008). Requirements analysis process become clearer with the adoption of AT, Activity Checklist (AC) tool and also with the help of Unified Modeling Language (UML) software to visualize requirements gathered. Another study also supported the usage of AT during collaboration for learning purpose (Uden, 2007). See Fig. 1 for Activity Theory Model. Students get to talk, share ideas and materials with friends through discussions, forums, chat room which indirectly gets them connected even though there is no face to face connection. With the use of AT, activities involved in e-learning are analyzed to allow developers upgrading e-learning version which can motivate users using the application. There are components available in AT that requires developer to answer tools that can be used in the system. For instance, psychological tools and physical tools are which can help to encourage effective collaboration. This paper however, did not mentioned feedback of learning process psychologically.

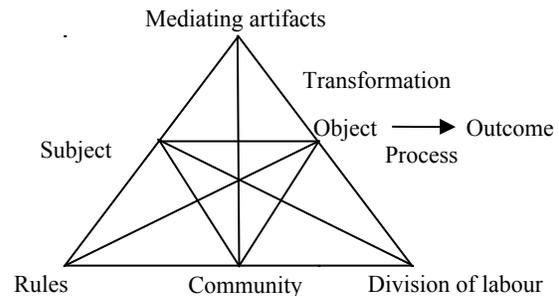


Fig. 1 Activity Theory Model (Uden, 2007).

5.2 Requirements Elicitation Model with Collaborative Approach

Collaborative approach is one of the approaches that are used to elicit requirements. This method is used to promote knowledge exchange and negotiation among stakeholders (Laport et al., 2009). This method has used storytelling approach in order to discover information from stakeholders and therefore convert the story to scenario. The scenario is then will be converted to use cases which are related to the state story. The strength with this approach is it replaced interview and questionnaire by capturing story and also helps to decrease vague views given by the stakeholders.

The weakness of this approach is it tends to be more time consuming since analysts need to gather information in the form of story which they need to spare a lot of times if it involves many stakeholders. This paper did not focus on the types of requirements gathered after refining the story. The approach might be repeatable if the information gathered is not sufficient to the analyst. There is also a tendency of same stakeholders giving different versions of the same stories to the analysts who might cause complexity and requirements conflicts in requirements elicitation process.

5.3 Requirements Elicitation Model with Collaborative Ethnography

Unlike collaborative approach, collaborative ethnography executed observation technique rather than getting stories from stakeholders. The purpose of having this approach is clearer unlike collaborative approach since this approach tries to gain cognitive requirement from human to system relations, human to organization relations, human to technology relations and human to human relations (Silva et al., 2009). This approach might reduce elicitation time besides resulting specific information needed that is in terms of cognitive requirements from stakeholders.

5.4 Requirements Elicitation Model with Affective Requirements

Affective requirements are extension concepts of usability and user experience. It consists of user satisfaction, efficiency and effectiveness of the system (Bentley et al., 2002). See Fig. 2 to visualize affective factors as user experience. Based on the case study, a set of affective requirements helps to establish computer game that is enjoyable to users. This paper has clearly defined specific requirements that are related to emotional expression which must be obtained from users. Analyst interviewed computer game users and has specifically asked their opinion in satisfaction, efficiency and effectiveness. The use of affective requirements explained that it is important to clearly identified activities involved in the system

because clear definition of problem domain will lead to best fit solution for that particular system implementation. In producing game application for computer game users, affective requirements help developer to identify emotion that is to be put into game application. Users might not know how to interpret the emotion requirements to developer. Therefore, it is important for developer to clearly understand the right method to elicit social requirements like emotions and refine it as system requirements for game application.

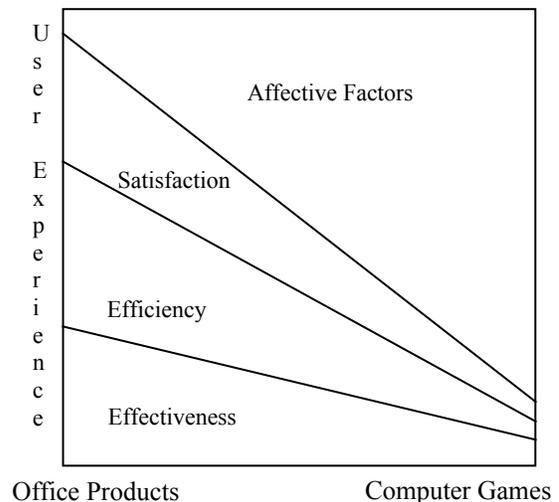


Fig. 2 The model of user experience, with notional divisions for affective factors (Bentley et al., 2002)

5.5 Requirements Elicitation Model with Goal-Driven Approach

Goal-driven approach helps organization to elicit requirements during RE activities by identifying business goals, plans, processes and system that is more structured in eliciting requirements because this approach needs the developer to understand business process, recognize stakeholders in order to avoid conflicting goal and this requirement elicitation is more structured in gaining categories of information from stakeholders.

Therefore, this approach has structured some information required such as nature of requirements which lead to goals from stakeholders, what are the things that can be achieved from dedicated goal and how to implement and transform those goals so that it is tangible to the system and can be used by the user.

6. Requirements Elicitation Model in E-Learning

In producing E-learning system, developers need to plan and design what information needed for the environment. RE plays important role in assisting

developer to seek for sufficient information so that E-learning is successfully used by users. According to Section 5, there are five requirements elicitation models that have been listed down in Table 1 and each section has been identified whether it might help to elicit social aspect in reducing social-technical gap in e-learning. Five factors that motivate e-learning success have been generated based on three case studies (Fetaji and Fetaji, 2007, Lanzilotti et al., 2006, Sun et al., 2008). These papers stated that factors that can help in motivating e-learning success are interaction, content, user, services and technology.

Five models can elicit social aspect requirements from users since they can capture the requirements through collaboration, observation, extracting from component and from structured information. However, there is an opportunity to explore how these models can help to contribute in social aspect requirements for e-learning using PBL technique. Table 1 summarizes those models in terms of its implementation, social aspect and approach used during the requirement elicitation.

Model	Implementation	Social Aspect	Approach
5.1	Multi-agent System (MAS)	Collaboration between stakeholders	Activity Theory
5.2	System Development in general	Interaction from storytelling	Collaborative-group storytelling: Athena
5.3	Complex systems	Cognitive requirements	Collaborative Ethnography-observation
5.4	Computer Games	Affective factors	Goal Analysis
5.5	Development of system in organization specifically	Not mentioned specifically since it is based on stakeholder-analyst interaction about business process in the organization and how to achieve goals	Goal-Driven

Table 1: Types of requirements elicitation model (based on Section 5)

Based on Table 1, the author can further investigate how possible it is to adopt or extend those models in PBL-based e-learning by investigating how the model has been implemented, social aspect that can be extracted from the requirement elicitation process and approach used in the model. The scenarios related with those five models might differ with e-learning scenario. Therefore, the author may further examine motivating factor in e-learning and identify which elements in requirements elicitation model can assist in improving e-learning success based on criteria defined

for e-learning. Those scenarios produce various business processes and hence, process flow in the requirements elicitation model must be flexible accordingly.

7. Conclusion

Social aspect requirements can help in decreasing social-technical gap of a particular system. In motivating students to use e-learning, social aspect requirements and technical requirements must be analyzed to create an environment that can be understood by all stakeholders and thus harmonize social-technical gap. It is also important due to the fact that developers tend to develop system technically and it is difficult to think like user. Hence, requirement elicitation model can be an option for developer to further understand social aspect requirements as well as technical requirements simultaneously. The author may continue with the investigation of model's flexibility in e-learning scenario to ensure best-fit model can be produced for gathering social aspect requirements in e-learning success. The challenge might arise in identifying what are requirements for social aspects among the users of e-learning.

As the conclusion, in reducing social-technical gap for e-learning implementation, developer and other stakeholders have to collaboratively discussed requirements that needs to be implemented in order to encourage active learning and allow users to participate in tasks that have been given to them.

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