Challenges of a Project-Based Learning Approach Towards Requirement Engineering

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Abstract: - Higher Learning Education fails to deliver undergraduates with employability skills. The objective of this research is to identify challenges in the current practice of teaching Software Engineering at the undergraduate level in Requirement Engineering. As a conclusion, the steps of Project-Based Learning (PjBL) are produced as well as mechanism for educators in their delivery to assist students in enhancing their skill. The skills will be enhanced from the elicitation process until the management of requirement which students can easily apply in their employability skills. Future work will discuss on the analysis of the weaknesses in the current Requirement Engineering practices.

Key-Words: - Higher Learning Education, Software Engineering Education, Requirement Engineering, Project-Based Learning, Problem-Based Learning, Product-Based Learning, Employability skill

1 Introduction

In the Al-Quran, Surah Al-A'laq stated that Allah S.W.T teach human being through the writing which was transcended from the angel Jibrail to the Prophet Muhammad S.A.W at the Hira' in cave as the first sentence of Al-Quran. This first event showed us that as human being we need to learn, memorize and apply all the study. A sentence of Surah Al-Alaq states "Allah S.W.T teaches everything to the human that human does not know" [1]. From that moment onwards, Prophet Muhammad S.A.W was chosen by Allah S.W.T to inform and spread the taught to all mankind. It was difficult to teach them at first but through creative mechanism learning and good thinking habits, human being learned and accepted it easily until now. It is because the Al-Quran contains about everything including education, life, science and others. It can be closely related with Software Engineering education and Requirement Engineering education particularly which is using Project-Based Learning as a mechanism for educators in their delivery to assist the student in enhancing their skill.

2 Employability Skill

The sustainable world-class performance will not occur if there is a misalignment between a university programmes objectives and actual market requirements. In addition, effective faculty wide coordination in relation to market driven initiatives

is essential for ensuring the effective use of company resources [31]. Employers now focus on adaptation, cost reduction, increased productivity, new markets, products and services. Employees need to demonstrate teamwork, problem-solving and the capacity to deal with non-routine processes. They should also be able to make decisions, take responsibility and communicate effectively. Proficiency in the broad range of generic skills has become the main requirement for the modern worker. The skills required not only to gain employment, but also to progress within an enterprise so that it can achieve one's potential and contribute successfully to enterprise strategic directions. Employability skills are also sometimes referred to as generic skills, capabilities or key competencies [12] as shown in Table 1.

Seventy-seven per cent of employers want people to have fully developed team-working skills and seventy-one per cent want people to have fully developed problem-solving skills. However, employers then also expect these candidates to hold a more sophisticated and often work-specific set of skills. Eighty-six per cent of employers said that personal presentation should be fully developed, suggesting they want to employ people who appear to be professional [26].

Table 1. Common elements of various listings of generic skills [12].

Generic Skill	***Example***
Basic/fundamental skills	such as literacy, using numbers, using technology knowledge and skills
People-related skills	such as communication, interpersonal, teamwork, customer-service skills
Conceptual/thinking skills	such as collecting and organizing information, problem-solving, planning and organizing, learning-to-learn skills, thinking innovatively and creatively, systems thinking
Personal skills and attributes	such as being responsible, resourceful, flexible, able to manage own time, having self-esteem
Skills related to the business world	such as innovation skills, enterprise skills
Skills related to the community	such as civic or citizenship

2.1 The Importance of Fundamental Skills in Successful Project

In the summary of the NATO Science Committee report [27], the problems observed in 1968 are striking similar to problems we have today such as problems of achieving sufficient reliability in the data systems which are becoming increasingly integrated into the central activities of modern society, difficulties of meeting schedules and specifications on large software projects or education of software (or data systems) engineers.

Nowadays, society is increasingly dependent on software. Software failures can cause or contribute to serious accidents that result in death, injury, significant environmental damage, or major financial loss. Such accidents have already occurred and without intervention, the increasingly pervasive use of software - especially in arenas such as transportation, health care, and the broader infrastructure - may make them more frequent and more serious [22]. As observed by Hoare (2006): "The real value of tests is not that they detect bugs in the code but that they detect inadequacies in the methods, concentration, and skills of those who design and produce the code."

Thus, it is likely that the nature of products and processes would also evolve toward the complementarities of skills in such areas as culture-matching and localization [10]. Some key culture-matching dimensions are provided in [18]: power distance, individualism/collectivism, masculinity/femininity, uncertainty avoidance, and long-term time orientation. These often explain low software product and process adoption rates across cultures.

3 Requirement Engineering Education as a Kick-Start for Student in Developing Their Skill

Most literatures agree that skill is an important part for Software Engineering student if the student wants to be employed by the industry. The students' skill should be developed from the beginning of Software Engineering phase. It is because if they failed to understand from the early phase, so it will be hard for them to understand the next phase. Furthermore, the successful of end product depends on stakeholder's satisfaction. It can be seen from product that match and satisfy user requirement. Software Engineering has five major phases. It consists of software requirement, software design, software development, software testing and software maintenance.

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Requirement Engineering (RE) is an important part in software requirement [6, 9]. RE process involve elicitation, analysis, verification and validation, and management. RE differentiated by two that are software development and management [29] in CMMI (Capability Maturity Model Integration) to recognize work in matured organization. CMMI is a popular tool that can identify and certify organization who achieved a standard in their organization based on their matured process and services. If RE not captured a right problem or requirement from user, so the solution for software artifact will not be accurate.

4.1 Requirement Engineering Challenges

Requirement Engineering (RE) issues [8] are still unresolved because of the rapid changes in technologies. Daily usage of system and software becomes significance for everyone in the world. Many issues that were not raised previously will arise in the future. It becomes a challenge [5] to RE community to improve the solution. It cannot be waited until it happen because "prevention is better rather than cure". The common problems with unsuccessful project are defined as late, over budget, and/or with less than the required features and functions. It also defined as cancelled (before it can be completed or delivered) and never used [11]. The challenges in RE now focus on system that relates with scale, cyber-physical system, self-adaptive system, security [23] and globalization [9].

So, the biggest responsibility is on the educator that needs to teach the student on how to manage and develop good software based on user expectation before they go to work in real environment. But educator faces the problem on how to simplify the process of learning process in RE to the student. The educator needs to make student understand as a whole about the significance of RE in real project that consist of soft and hard skill [2] on how they can successfully capture requirement from stakeholders, analyse and model. The data that been captured and verify and then validate the requirement. Additionally, the important part is deliverable. It used to control change management. It is because the changes (minor or major) will affect to overall project.

Another issue, the faculty needs to organize their infrastructure with minimal requirement that can support the learning environment in RE [33]. Higher Learning Education should conduct a survey of technology that will be adopted by the industry within five-year projections to avoid significant differences in technology used. The infrastructure is important because it can help students understand the concept, attract students to study and enhance their skills.

5. Project-Based Learning (PjBL)

The Project-Based Learning is a superset for Individual & Collaborative Problem Solving [14, 15, 17, 36] Problem-Based Learning [3, 13, 16, 19, 25, 34] and Product-Based Learning [24, 30]. In contrast, all of them are subset to Project-Based Learning and have an intersection with each others. All major generic skills schemes include conceptual 'thinking skills' and interpersonal 'teamwork' skills be a significance factors in PjBL [12].

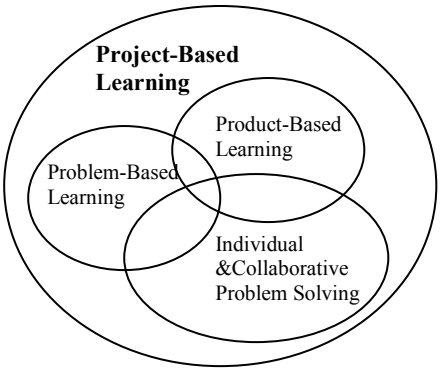

Figure 1: Problem-Based Learning, Individual & Collaborative Problem Solving and Product-Based Learning are a subset to Project-Based Learning [28].

If the PjBL want to be implemented successfully for undergraduate taking Software Engineering Courses, they need to identify suitable tools, the expertise people of PjBL need to come up with a guideline that refers on tertiary culture. By the time the need is identified, the courses developed, and the students trained, the new technology has changed. The education that succeeds will be the one that facilitates lifelong learning, equipping students with the skills they will need to adapt to change. The information of PjBL practices (such as productiveness, effectiveness in comparison to other methods and framework) is still lacking [35]. The educators face many difficulties in choosing the most suitable project type for each level of program (diploma, degree or master level). The educator should form a project team and identify their roles [4, 33].

In order to initiate the Project-Based Learning (PjBL) for educators and students, Problem-Based Learning (PBL) form the basic step for the student to start the project. The goals of PBL include

helping students develop flexible knowledge, effective problem-solving skills, Self-Directed Learning (SDL) skills, effective collaboration skills, and intrinsic motivation [20]. The number of technophobia is decreasing when PBL concept replace the traditional teaching process introduced in IT education. The PBL characteristics applied to the curriculum relied on the problems to drive the curriculum, the problems are authentically ill structured, students solve the problem, and students are only given guidelines on how to approach problems and authentic, performance-based assessment. The methods involved the participants, procedures, measurement, findings and discussion. The PBL motivate student to be an active learner and working with real problems to encourage their future career [32]. The outcome [7] shows that the added-value of PBL helps in improving the learning process of the students. The results that based on structure and outline of PBL activity indicated that students felt that a PBL approach helped to make the subject matter more interesting to them and they believe that they would retain knowledge for a longer period than if their learning had used traditional format.

As an extension to the Problem-Based Learning, the solution to an open-ended problem which requires the development of a real-world product introduces the Product-Based Learning. This approach provides further motivation by establishing the goal of satisfying a real user base. The students are not only responsible for their own learning and the success of the team, but they must also take the responsibility for a quality product to be used by end users. This allows the educator to be aware of student thinking, close connection with learning environment and development processes. Not only do the students benefit from more helpful and relevant guidance, but the educator benefits by experiencing the same interaction and motivation that drives the students [30].

5. Conclusion

It can be concluded that the human factor or attitude of educators and students is directly involved to ensure the process of Project-Based Learning (PjBL) is successful. Then only the student will see, understand and confident to apply the knowledge. It will benefit to student when they enter working environment after graduation. Higher Learning Education need to understand that a good educator will represent a good student which can have plenty of skill if the university think about the long-term benefit in terms of sending the educator for training to increase their knowledge in their teaching method and delivery mechanism. Educators and students act as a big role when implementing new learning method. Additionally, proper guideline is still lacking on how to implement the industry perspective into Software Engineering education. Besides, the significance of research that had been published and discuss about Software Engineering education in seminar, conference, proceedings and others should be included in structuring new curriculum or restructuring curriculum. The time consuming must be considered when implementing the learning method and reschedule the planning to review the existing curriculum at the faculty frequently. Future work will discuss on an analysis of the weaknesses in current Requirement Engineering practices.

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