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COMMON PRACTICES OF TEACHING AND LEARNING IN REQUIREMENT ENGINEERING SUBJECT

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ABSTRACT

Students learn ability in requirement engineering education is very important to make sure an effective teaching and learning process in education field. An effective student learn ability in requirement engineering education is crucial to make sure that the process of teaching and learning is a successful. A successful teaching and learning will produce a proactive, creative, and innovative student in the future. In term of requirement engineering education A successful teaching and learning will produce a proactive, creative and innovative fresh graduate and to be software engineer who worth working in the world wide industry market in the software engineering field. The problem and issues in the industry regarding the software engineering fresh graduates such as poor communication skills, leadership style, ego, gender issue, poor documentation skills, misinterpretation of requirements, incorrect requirements and etc. will no longer become a mess to us if we can apply the new approach in the learning and teaching in the requirement engineering field. This paper reports on a study that identify approach that can help in teaching and learning that focused on student engagement learning. The survey consists of a series of questions about the ability of understanding in requirement engineering activities. The answer to these questions helps to understand common practices, whether the research on pair work in requirement engineering activities and techniques.
Keywords: *Requirement Engineering, Teaching And Learning, RE Subject, RE Education*

1 INTRODUCTION

Requirements engineering (RE) is concerned with the field of software engineering (SE) and in particular with software development processes. Research in software development has revealed that the failures and deficiencies in software projects are often due to poorly conducted RE activities by software developers [1]. One possible reason of this is the lack of appropriate skills and knowledge of those engaged in RE activities. This education should be provided to students at the university level before they join the industry. Unfortunately, many universities do not include RE courses in the Computer Science or Software Engineering programs [2], and even if they do, these courses are often taught in a traditional lecture/lab. It would be unrealistic to expect students who have neither studied the RE course nor have experienced the lecture/lab format to appreciate the need for RE methods and to use them effectively in the industry. The challenge of RE educators is to educate students to be an up-to-date and expert requirement engineer as well as providing them with useful experience to be used after graduation [3].

The problem and issues in the industry regarding the software engineering fresh graduates such as poor communication skills, leadership style, ego, gender issue, poor documentation skills, misinterpretation of requirements, incorrect requirements and etc. [4]; [5]. In addition, they are also required to have experiences which cover all phases of software development process such as requirement elicitation and analysis, design, testing and implementation. However, it is identified that

requirement elicitation and analysis is the most crucial skill and experience that need to have as the process to get the requirements right is recognised as the most important and difficult in any software project [1]. Hence, these are the reasons why the student engagement in learning can improves accuracy and hence helps students perform better in developing software or analysing high quality requirements.

This paper reports on a study that identify approach that can help in teaching and learning that focused on student engagement learning. This paper is organized in six sections. After the introduction section, we present the purpose of the research for this study in Section 2. This is followed by the research methodology in Section 3. The results of this study are presented in Section 4 and the related works in Section 5. Finally, the summary and conclusion are presented in Section 6.

2 PURPOSE OF RESEARCH

The main purpose of the survey is to identify the approach that can help in teaching and learning that focused on student engagement learning. Focusing on the requirement engineering subject, this study aims to explore:

i. The ability of understanding in RE activities and techniques.
ii. Common approach in learning in RE activities and techniques.
iii. Pair work in RE activities and techniques.

3 RESEARCH METHOD

This study identified the approach that can help in teaching and learning that focused on student engagement learning. A survey had been conducted through questionnaire method to explore the common teaching and learning approach/practices in requirement engineering subject. For this survey, the subjects were 138 software engineering students from UTeM. This survey was conducted online where all participants were treated anonymously. In general, they had experience in studying Software Requirement and Design subject from FTMK. The sample of subjects participated in the experiments was on a voluntary basis and they agreed to participate in the survey. They were informed that: (i) the survey is not mandatory, (ii) they were not evaluated on their performance and (iii) data collected will be used only for research purposes.

A survey had been conducted through questionnaire method to explore the common teaching and learning approach/practices in requirement engineering subject. The main purpose of the survey is to identify the approach that can help in teaching and learning that focused on student engagement learning. The questionnaire consist of four part that is the background information, the ability of understanding, approach in learning requirement engineering and, using pair work to learn requirement engineering.

The questionnaires have been validated by two academic experts and one industry expert. They reviewed on the content validity of the questionnaires and gave opinion and idea on the contents related to elicitation security requirements and IoT.

4 FINDING AND DISCUSSION

A survey had been conducted through questionnaire method to explore the common teaching and learning approach/practices in requirement engineering subject. The main purpose of the survey is to identify the approach that can help in teaching and learning that focused on student engagement learning. The questionnaire consist of four part that is the background information, the ability of understanding, approach in learning requirement engineering and, using pair work to learn requirement engineering.

4.1 General and Background

The description of the demographic background of the respondents was shaped by four questions in the questionnaire which are questions related to gender, age, subject related to requirement engineering, faculty dan year of enrolment. The data have been collected from UTeM which consists of 72.5% female and 27.5% male from software engineering students. All of them were 18 – 29 years old and taken Software Requirement and Design subject from FTMK.

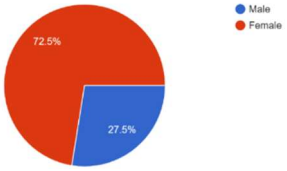

Figure 1: Gender

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4.2 The ability of understanding

For this section, respondents were questioned based on the ability of their understanding regarding requirement engineering activities and techniques. For requirement engineering activities, as general opinion, most of the respondents agreed that the level of difficulties of requirement engineering activities are in average level. Figure 2 shows that 19.6% respondents with level 4 of difficulties, 31.2% respondents agreed with level 3 of difficulties and 30.4% with level 2 of difficulties. While 18.9 % others with other levels of difficulties.

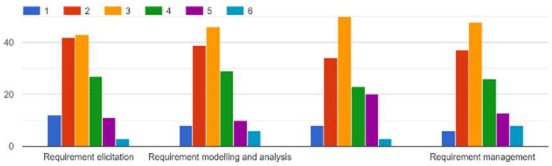

Figure 2: Level of difficulties that faced by students to understand each of the activities in requirements engineering.

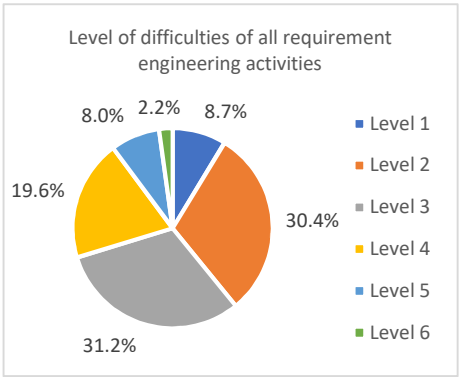

Figure 3: Level of difficulties that faced by students in all of the activities in requirements engineering.

Then, respondent being asked for the level of difficulties of each of the requirement engineering techniques. For requirement elicitation technique, that involved activities such as observation, interview, document analysis, case study, workshop, brainstorming, prototyping, throwaway prototyping and storyboarding. Based on the result, respondents agreed that the level of each activities are average. According to Figure 3, it shows that 28.3% respondents agreed with level 3 of difficulties and 38.4% with level 2 of difficulties. While 15.9% agreed with level 1of difficulties.

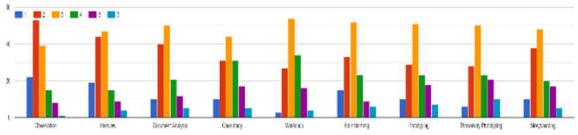

Figure 4: Level of difficulties that faced by students in each of requirement elicitation techniques.

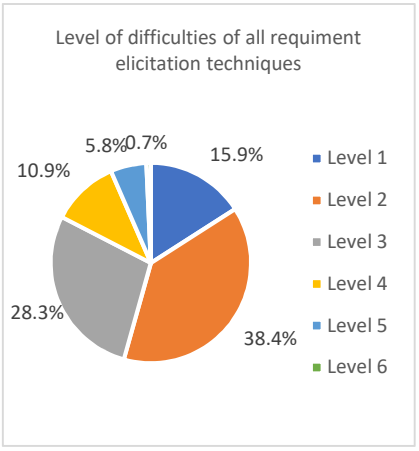

Figure 5: Level of difficulties that faced by students in all of the activities in requirements elicitation techniques.

Next, for requirement modelling and analysis activities that involves use case diagram, use case text, activity diagrams, swim lane diagram, analysis packages, crc models, collaboration diagram, state diagrams and sequence diagrams. Based on Figure 6 , the results shows that the level of difficulties when dealing with modelling requirements is average level. It also shows in Figure 3.7 with 29.7 %, 29% and 15.9% agreed that level of difficulties between level 2 – 4.

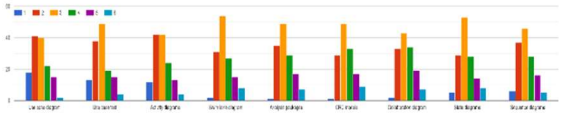

Figure 6: Level of difficulties that faced by students in each of requirements modelling and analysis techniques.

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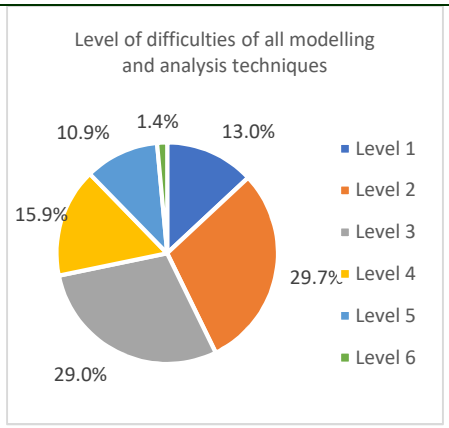

Figure 7: Level of difficulties that faced by students in all of the activities in requirement modelling and analysis techniques.

Figure 7 shows the level of difficulties of requirement validation and verification techniques that involved activities such as requirement concept specification, system specification, system design, detailed design, module and unit code and test, sub-system integration test, system integration test, acceptance test, sub-system integration test-plan, system integration test-plan and acceptance test-plan. Based on the results, it shows that the level of difficulties is average level. According to Figure 9, respondents agreed that the level of difficulties are between level 2 – 4 based on the result with 23.9%, 42.8% and 21%.

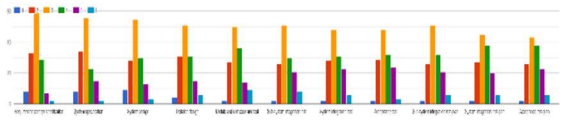

Figure 8: Level of difficulties that faced by students in each of requirement validation and verification.

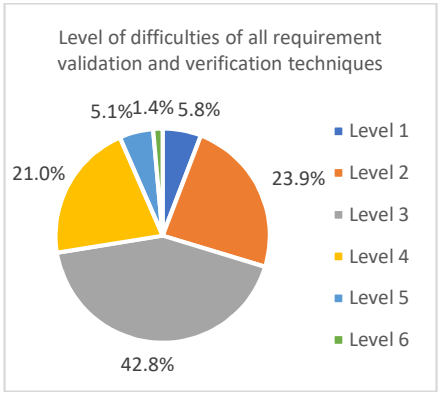

Figure 9: Level of difficulties that faced by students in all of the activities in requirement validation and verification techniques.

Respondents also being asked for level of difficulties that their facing when doing requirement management technique. The activities involves are Requirements identification, change management process plan, Traceability policies and CASE tool support. For these four activities in requirement management techniques, respondents also agreed that the level of difficulties are in average level. Based on Figure 11, respondents agreed that the level of difficulties are between level 2 – 4 based on the result with 25.4%, 37.7% and 20.3%.

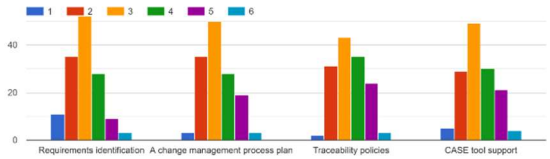

Figure 10: Level of difficulties that faced by students in each of requirement management techniques.

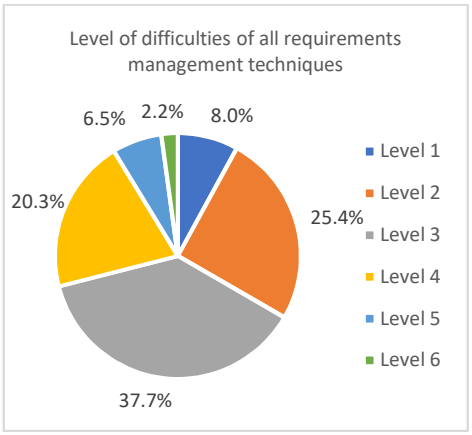

Figure 11: Level of difficulties that faced by students in all of the activities in requirement management techniques.

4.3 Approach in learning requirement engineering

The participants were ask to choose in the following technique related to requirement elicitation technique that is observation, interview, document analysis, case study, workshop, brainstorming, prototyping, throwaway prototyping and storyboarding. From the survey, Figure 12 shows their lecturer like to conduct each of the requirement elicitation techniques using pair work and group work while in Figure 14 shows that most students prefer using work group to be used in class in learning requirement elicitation.

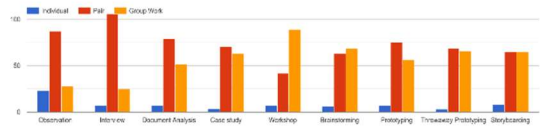

Figure 12: Requirement elicitation approach that practiced by lecturer

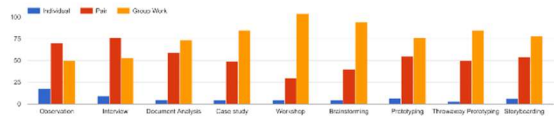

Figure 13: Requirement elicitation approach that preferred to be used by students

From Figure 14, we can see that lecture preferred to practice using pair work approach with 68% of respondents because of pair work can give better understanding in this requirement elicitation topic. While from student perspectives, 54.7% of the student believes that pair work can give them better understanding in requirement elicitation practice and 39.1% using group work. Both pair work and group work were preferred to be use in elicitation activities because most of the activities need to do together in group or pairing.

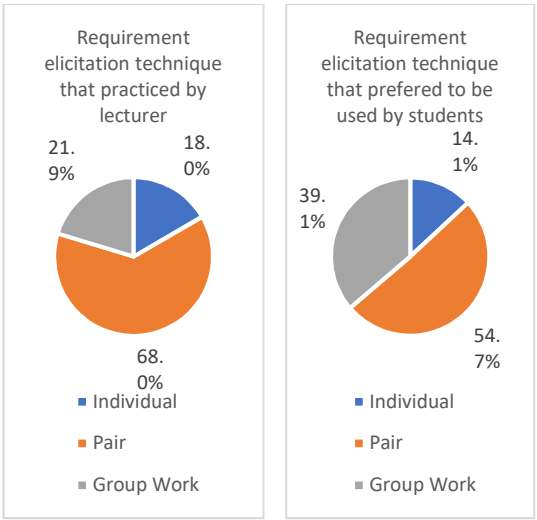

Figure 14: Requirement elicitation approach that practiced by lecture and preferred to be used by students

From Figure 15 and Figure 17 we can see approaches use by the lecturer while conducting the requirement modelling practice. From the figure can see that pair work approach is commonly use in mostly all activity in requirement modelling practices as stated there is 63% student claims that their lecturer always conducts their class using group work approach. While pair group with 27.5% and individual approach and 9.4% of individual approach. Meanwhile, according to Figure 15 and Figure 16 we can see that student have almost equal understanding when using the pair work approach and group work approach in this requirement engineering that is by 56.5% group work and 38.4% pair work which only different of 18.1%. In this requirement modelling technique their lecturer prefer to use the pair work approach for overall technique and from the survey we also can see that the group work approach help the student to learnt and understand the requirement elicitation technique.

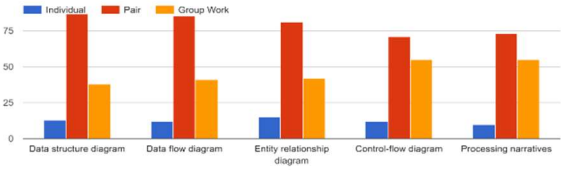

Figure 15: Requirement modelling approach that practiced by lecturer

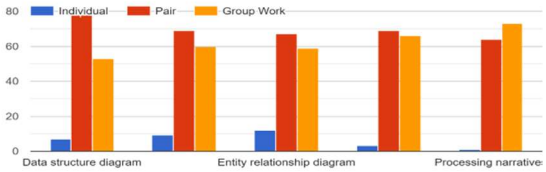

Figure 16: Requirement modelling approach that preferred to be used by students

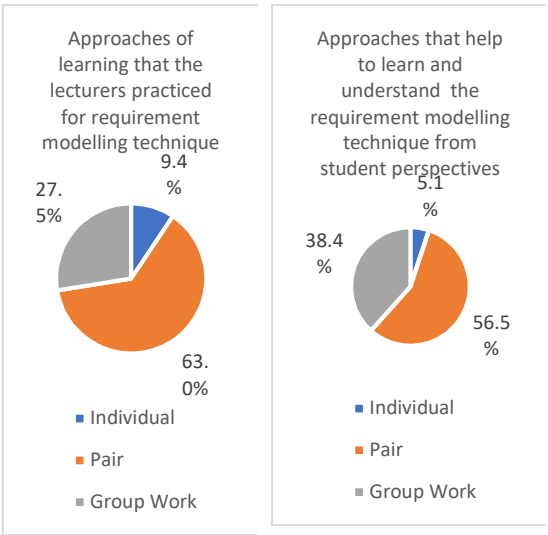

Figure 17: Requirement modelling approach that practiced by lecture and preferred to be used by students

For requirement validation and verification, from Figure 18 and Figure 20, participants agreed that the approaches use by the lecturer while conducting the requirement validation and

verification practice are pair work. From the Figure 17 and 18 can see that both group work and pair work approach is commonly use in all activity in requirement verification and validation practices as stated there is 52.9% and 28.3% student claims that their lecturer always conducts their class using group work and pair work approach. While individual approach only rate 18.8% for this validation and verification activities. Meanwhile, from Figure 18 and Figure 19, it shows that student get better understanding by pair group approach by 45.7% of them agree with that this is might be due to the approach conduct by the lecturer in the classroom. Other are preferred in group work with 28.3% and 26.1% prefer group work and individual task in this validation and verification practice.

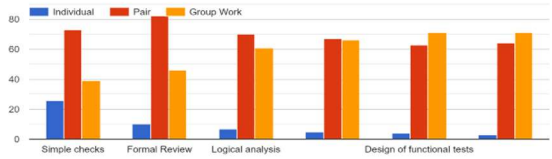

Figure 18: Requirement validation and verification approach that practiced by lecturer

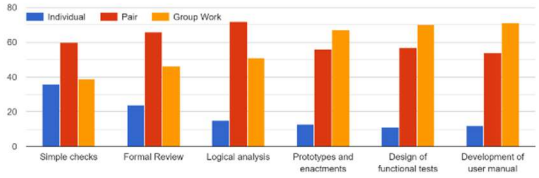

Figure 19: Requirement validation and verification approach that preferred to be used by students

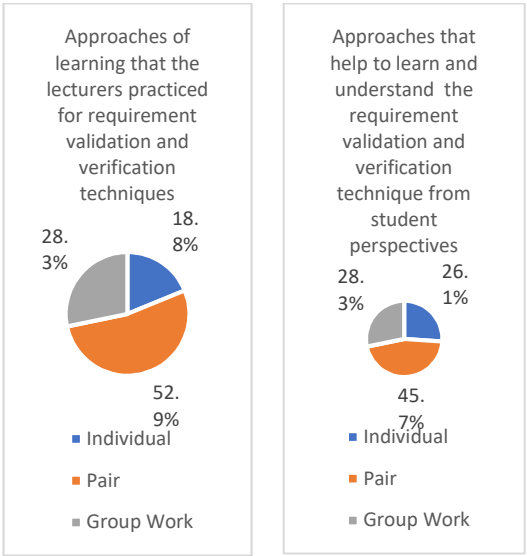

Figure 20: Requirement validation and verification approach that practiced by lecture and preferred to be used by students

For requirement management technique in requirement engineering activities, based on Figure 21, Figure 22and Figure 23, shows that participants agreed that the approaches use by the lecturer are pair work while conducting the requirement management practice. From the figure can see that both group work and pair work approach is commonly use in all activity in requirement management practices as stated there is 55.8% and 36.2% student claims that their lecturer always conducts their class using group work and pair work approach. While individual approach only rate 8% for this management activities. Meanwhile, from Figure 22 and Figure 23, it shows that student also get better understanding by using group work and pair group approach by 52.2% and 42.8% of them agree with that this is might be due to the approach conduct by the lecturer in the classroom. Only 26.1% prefer individual task in this validation and verification practice.

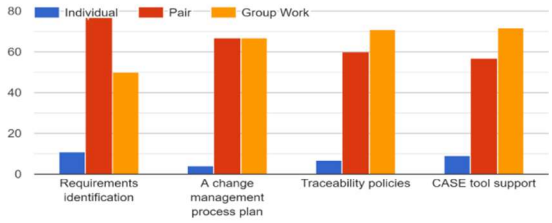

Figure 21: Requirement management approach that practiced by lecturer

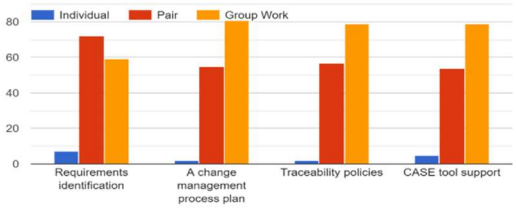

Figure 22: Requirement management approach that preferred to be used by students

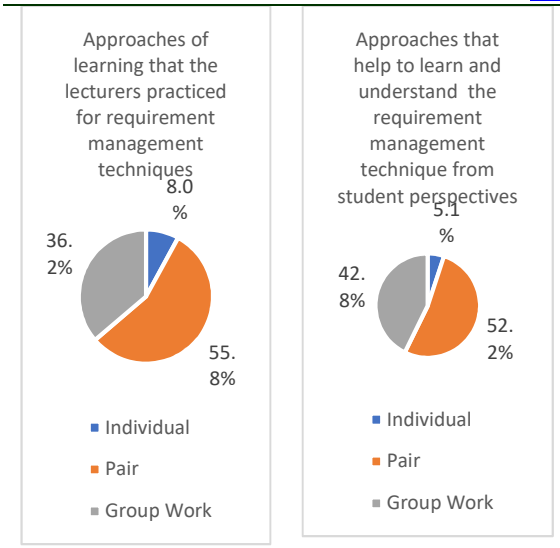

Figure 23: Requirement management approach that practiced by lecture and preferred to be used by students

4.4 Pair work approach in learn requirements engineering

For this section, participant were ask to rate the frequently their using pair work in requirement engineering activities that involved requirement elicitation, requirement modelling, requirement verification and validation and requirement management. Form Figure 24 and 25, it shows that 54.3 % student often use pair work in requirement elicitation process. Which mean that most of them are actually using pair work in completing the requirement elicitation activities.

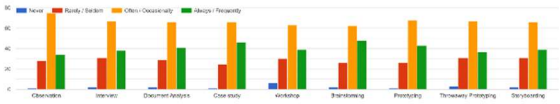

Figure 24: Frequently of students using pair work for each of the requirement elicitation technique

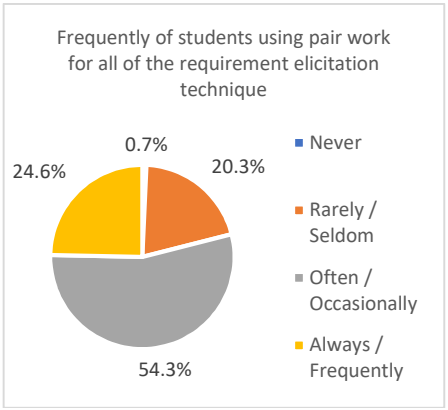

Figure 25: Frequently of students using pair work for all of the requirement elicitation technique

Based on Figure 26 and 27 the students occasionally apply the pair work approach when doing their assignment regarding the modelling requirement analysis. Where 53.6% of them said they use pair work occasionally and 29.7% state that they always use pair wok in requirement modelling process.

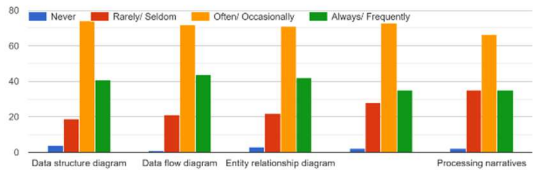

Figure 26: Frequently of students using pair work for each of the requirement modelling technique

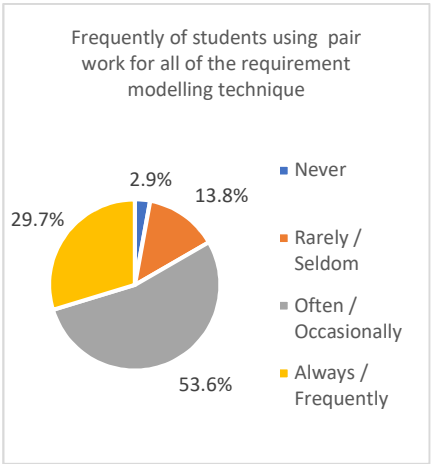

Figure 27: Frequently of students using pair work for all of the requirement modelling technique

From Figure 28 and 29, 52.9% of student claim they often use pair work and 23.2% other said they always use pair work. This still means that they are using pair work mostly in their learning activities in requirement verification and validation. The students prefer to work in pair for validation and verification process. For this topic it seems that pair work approach help the student to learnt and understand the requirement validation and verification. In addition, the students occasionally apply the pair work approach when doing their assignment regarding the requirement validation and verification topic.

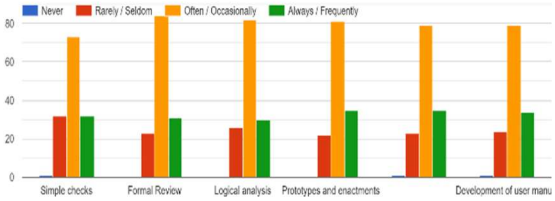

Figure 28: Frequently of students using pair work for each of the requirement validation and verification process

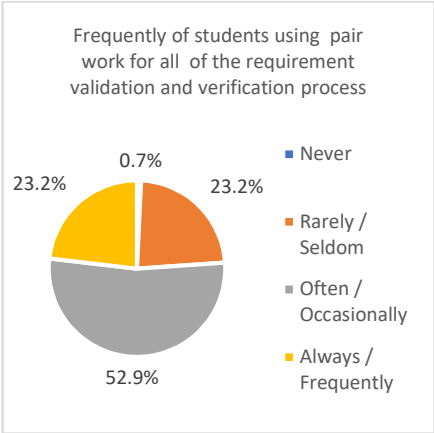

Figure 29: Frequently of students using pair work for all of the requirement validation and verification process

For management process in requirement engineering activities, 56.5% claim that their occasionally using pair work. Also, 27.5% of other are claim frequently using pair work. From the survey, it show that most of the students still frequently use the pair technique in completing their assignment in this subject especially in completing requirement engineering activities.

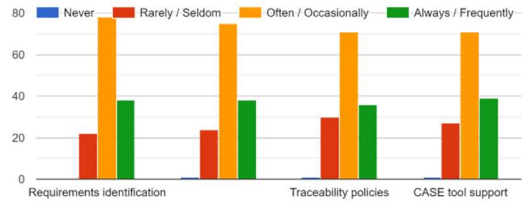

Figure 30: Frequently of students using use pair work for each of the requirement management technique

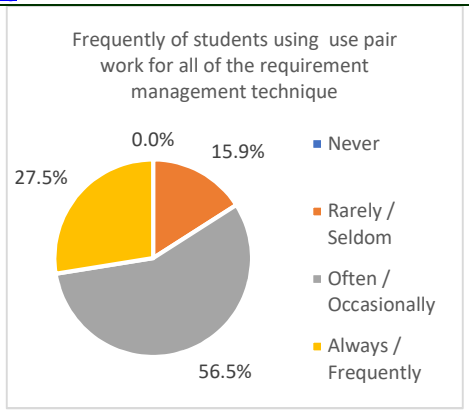

Figure 31: Frequently of students using use pair work for all of the requirement management technique

5 RELATED WORKS

There are many researchers that are concern about pair work in education but they are not done yet the research in the requirement engineering (RE) education for the pairing approach. Canfora et al. [6] explore to what extent pair designing can produce the same benefits, in terms of quality and effort, as that of pair programming, within an industrial setting. They also compare the results obtained from this empirical study, which involved professionals, with the results of a previous exploratory experiment, carried out in a University, which involved students, we found that the outcomes exhibit very similar trends.

Albakry et al. [7] implemented pair-analysis by adapting pair programming to the requirements analysis process in an academic setting. They conducted a preliminary study to compare the outcomes of pair and single participants by evaluating the performance and correctness of the answers as well as the students' satisfaction and confidence. Their findings were positive but require more experiments with larger groups of participants for further confirmation. Additionally, a better way to pair the students for analysis work by considering the differences of course background and culture is needed.

Bellini et al. [8] also conducted an experiment and its replica in both Italian and Spanish academic settings to understand the capability of pair-designing in diffusing and enforcing design knowledge when a system design is evolved. They used formalised system design documentation in UML including textual system requirements specification, use cases and class diagram. They found that pair-designing helps to increase the diffusion of the knowledge among the project team

as well as providing a good level of predictability on the enforcement of knowledge compared to the traditional designing setting. However, a similar experiment in industry and application of this approach to more complex systems is needed.

Silliti et el. [9] investigated the effects of pair- programming on developers' attention and productivity by looking at the influences of pair programming on their code writing style and their interaction with the development machine. They found that pair-programming allows the developers to stay more focused and spend a longer time on task and switch less often between tools. However, more data is needed to support these preliminary findings.

Kamalrudin et al. [10] introduces Pair-Oriented Requirements Engineering (PORE) that uses an Essential Use Case (EUC) model to capture and analyze multi-lingual requirements. This approach is intended to assist practitioners in developing correct and consistent requirements as well as developing teamwork skills. Two quasi-experiment studies involving 80 participants in the first study and 38 participants in a subsequent study were conducted to evaluate the effectiveness of this approach with respect to correctness and time spent in capturing multi-lingual requirements. It was found that PORE improves accuracy and hence helps users perform better in developing high quality requirements models.

In addition, the current evidence relative to the effectiveness of pair programming (PP) as a pedagogical tool in higher education CS/SE courses was presented by Salleh et al. [11]. They performed a systematic literature review (SLR) of empirical studies that investigated factors affecting the effectiveness of PP for CS/SE students and studies that measured the effectiveness of PP for CS/SE students. Results showed that students' skill level was the factor that affected PP's effectiveness the most. The most common measure used to gauge PP's effectiveness was time spent on programming. In addition, students' satisfaction when using PP was overall higher than when working solo. Their meta-analyses showed that PP was effective in improving students' grades on assignments. Finally, in the studies that used quality as a measure of effectiveness, the number of test cases succeeded, academic performance, and expert opinion were the quality measures mostly applied.

6 CONCLUSION

From the survey, it shows that lecturers and students prefer pair work approach over group approach and individual works approach in their teaching and learning in requirement engineering subject. So as a matter of fact, pair work may help the student in engagement learning in requirement engineering subject. Somehow which method is actually the best method that really help and improve the student engagement learning in this requirement engineering subject. On the other hand, the concept of student engagement has growing importance in serving two higher education objectives: institutional and individual development. At the institutional level, there are certain positive policies and practices associated with student engagement which directly increase institutional productivity [12]. Student engagement helps administrators to identify activities that engaged students and areas of improvement in higher educational institutions [13]. With proper resource allocation to boost student engagement, learning productivity can be increased with fewer costs.

Overall, there is a balance need in group and pair. But student more prefer to work in pair which involved human interaction such as discussion, interview an so on. As a result, it shows that verification, validation and modelling process are more towards pair work, because they can discuss in pairing and more effective compare individual work. From the survey we can conclude that even though pair work approach have been adopted in the class activities and it is partially applied by the lecturers but the student frequently use the pair work approach in their learning process. Pair learning is important and need to enhance specially to engage in students learning. Which means that the pair work approach in requirement education should be bring further to see how far its effectiveness in improving student engagement in requirement engineering education.

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