Assessing Novice Teams in Collaborative Software Engineering Education

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Abstract—**Novice teams is a group of novice student who had just taken software engineering course. Recent researches indicate that assessment approach can be used to improve knowledge and skill of student. The problem in assessment approach is "is assessment approach fair for level of student"?. In collaborative work, assessment is important to gain communication skill, experience, and most importantly promote responsibility. This study perform assessment approach for novice teams that applied in collaborative tool. The assessment approach consists of four components: attendance, discussion, assignment and contribution. In evaluation phase, the result indicate that the collaborative tool is support collaborative work and assessment approach is fair assessment for novice student. The respondent agree above 50% for each assessment component. Although, collaborative work still have the weakness such as collaborative tool only use one diagram.**

Keywords—assessment approach; novice teams; collaborative; software engineering education

I. INTRODUCTION

Software engineering discipline require the professional work to success in the project development. Understanding knowledge and other related skill such as communication skill and teamwork skill is important part to gain successful work in the software project development. In the collaborative work, student not only understanding method and tool that used in the software project development, but also expected to work together with others as a team in the project. Collaboration between students in the team can improve teamwork skill and communication skill.

The problem in the collaborative software engineering is the lack of experience and communication skill [1]. It problem faces by novices that students who do not have experience in the field of software engineering. In this case, novice it means student who had just taken software engineering course. Instructor need to pay attention to these student who had just learned the method and tool in software engineering, especially for collaborative work. In the learning class, novice student should work together as a team to learn methods, techniques, and tools that used in the software development. [2] State that student should understand knowledge and skill of software development phases in order to be competent developer of software.

Assessment approach is one of alternative way to addressed problem in the collaborative work. This approach is a method to measure individual and teamwork performance. [3] Use assessment approach to assess teamwork performance. It focuses on develop teamwork skill. [4] Use assessment tool to measure the level of student in the collaboration and software development. The challenging part in the assessment approach is the level of student in the software development is different; professional level and novice level. Professional level is student who already taken software engineering course and have done learned the variation of method and tool. They can determine what methods and tools should be used in the software development. Different with novice level, student has just learned methods and tools in the software engineering. It indicate that assessment approach should be differentiated based on student's level. Basically, novice teams cannot assessed using component in the professional level. It cannot improve ability of novice teams because the comprehension is not suitable with them ability. For example; novice teams has just learn introduction of model of UML (type of diagram), so the assessment should about UML, related with the diagram. Instructor cannot assess how to determine the diagram based on the case, what notation should be used in the diagram. Novice students did not understand how to determine the notation and diagram. They has just use the diagram for the given case. Different with professional level, they can determine notation and diagram. Instructor should determine what component should be used to assess the novice students. [4] Build tool to addresses the fairness of the assessment. In the collaborative work, novice teams is a group of student with no experience of software development and lack of communication skill. Instructor should pay attention what component should be used to improve ability (understanding of material) and communication skill. Because it important to encourage novice students to interact with other in the teams. Discussion in the team is not only attend and listen the topic that has just discussed, but also they should have suggestion for the related topic. Novice students need to understand the topic, so they can give suggestion in the discussion forum and it will be interactive. This paper describe the assessment component should be used in the collaborative work for novice teams. This paper focuses on how to assess the work of novice students in the team. The assessment apply in modeling part, because requirement modeling is fundamental material for novice students to design the requirement.

II. Literature Review

This section discuss the topic that related to collaborative of student in the software engineering education, assessment component for collaborative work especially for novice teams.

A. Collaborative Software Engineering Education

Collaboration is important in the software development activities. Early process to support software development is to determine member in the project team. Collaborative work not only used by professional level or usually called senior, but also applied in the undergraduate course. The instructor (lecturer) use collaborative work to improve teamwork and communication skill of student. Software engineering education is challenges for instructor how to teach software development, what method and tool should learn in the software engineering course, and most importantly is student can apply method and tool based on software development case. Collaborative work is solution to answer the challenges. In collaborative software engineering education, student should understand not only the subject, but also team that covers leader and other member[1]. Student expected to work together in the team to complete the software product. In the real project, student not only interact with instructor but also expected able to interact with stakeholder. [5] Stated that people in varying environment should join in a group to promote collaborative software development.

The problem in the collaborative work is not only how to understand method and tool used in software development, but also how to interact, communicate and collaborate with other to achieve goal. Student avoid discussion forum in the team because fear to discuss with senior. Senior with higher experience take all role in the project, it can be caused that student with lower experience did not understand the task project. Lack experience and poor communication is major problem in the collaborative work [6]. There are many researcher propose method and tool to addressed the problem. [7] Propose tool to addressed educational issues especially to encourage collaborative teamwork and student interaction in the team. [8] Propose collaborative modeling task to gain society interaction in order to improve communication and coordination task. [9] use web-based collaborative environment for evaluating user interaction.

B. Assessment Approach for Collaborative SE Education

In the learning and teaching of software engineering course, student are expected to gain the skill of understanding of requirement modelling. In collaborative work, student not only gain the individual skill but also teamwork skill. Student should collaborate with other to achieve finished software product. For novice teams, they should acquire the knowledge (especially modeling part: notation, diagram) to be competent software developers. Novice teams is group of novice students that has just learning software engineering, they have no experience in software development phases: analysis, design testing, and implementation. Professional teams consist of senior student who have studied software engineering coruse. They understand all phases in the software development. Professional teams already assessed in software development project. So, they know the rules in the assessment of software project. Its one reason why assessment approach for student should be differentiated based on level of learning process.

[3] State that the assessment approach should be based on software engineering course that has been learned in the class, student's activeness, and collaborative learning. Different course is different behavior in class, it influenced the assessment approach for student; Activeness is important in the assessment to evaluate student's activeness in group. Activeness can improve the responsibility of novice students in the team; the lack of experience and communication skill is problem in the collaborative learning. Novice students avoid forum because they fear to interact with other member.

Instructor should determine what's component are suitable for novice teams in order to promote collaborative work. For example, peer assessment (peer evaluation) is not suitable for novice teams. First, student did not have enough ability to evaluate other team; second, student have just learn software engineering course covers modeling part, it means that student not understand all material and it can be caused peer evaluation will be unfair. Third, student confuse how to evaluate other teams, they did not know what parameter should be use in the peer evaluation. [10] Discuss about the fairness of students' assessment. The problem in the assessment is grade of student. Grade of student is difficult in project development, especially novice teams, because the product is vary from task to another task. Another factor is individuals' contribution is hard to identify.

III. Assessment Approach

The assessment approach for novice teams is different with professional level or senior. The component in the assessment should related with students' grade, course, and the result.

A. Attendance

In the project team, the discipline need to be considered to train students' responsibility in the team. One obstacle in the team is discipline. Student with poor communication avoid group meeting and cause misunderstanding in the next work. Attendance component used to encourage novice teams to interact with other, improve responsibility, and reduce fear in the group meeting. Instructor should monitor students' attendance in the team. It easy to do when applied in the class, but how to apply in the collaborative tool. Instructor should monitor student who active in the team such as discussion forum, students' comment, suggestion of the work of assignment, and recommendation about the project task.

B. Group Discussion

Student lack communication is major problem during discussion. Especially novice students, avoid group meeting and discussion because fear to interact with other. It happen because they did not understand all material and confuse how to speak in discussion forum. Instructor should pay attention about communication skill. Training of discussion is important for student to reduce fear, gain communication skill, and most importantly be active in the discussion forum. In the assessment approach, discussion aim to evaluate interaction of student with other student. In collaborative tool, the evaluation can be done using chatting forum, private discussion, or instant messaging. The assessment is evaluate how many student interact with other student, how many student active in the forum, and how many student give suggestion about work of team. Instructor should

monitor students' discussion in the collaborative tool, in order to know that student really active and interact with other.

C. Project Assignment

The rule of assignment should be different with the rule in the assignment in class. Each member have responsibility to do the assignment. Although team assignment, each member must do the assignment. Usually, student with lower knowledge and experience did not completing the assignment, the assignment always handle with other student have intention of finish it. It can be caused that student with lower knowledge cannot improve their knowledge, because they did not have effort to learn and understand the assignment. In the collaborative tool, the portion of project assignment based on the work of each member. For example, the team consist of 4 members, each member have responsibility to completing the project task. In addition to, the mark is different for each member. It aim to improve understanding of material. Instruction must give punishment for student if did not complete of assignment. First, the punishment is the mark of each will be reduced by 30% if one of member did not completing the assignment. Second, if the student did not complete the assignment, the punishment is student will be expelled from the team. It aim to reduce indiscipline of student. Instructor often monitor novice teams to evaluate project assignment.

D. Student Contribution

Contribution of student is one of alternative to improve discipline in the team, in order to promote experience, understand knowledge and collaborative work. In collaborative software engineering education, novice students expected to understand how to use method and tool to apply their knowledge. Like project assignment, student should contribute in the team to get the high marks. Students can attach their works in the collaborative tool and give it explanation. It can be a new topic in the forum and the discussion will be interactive. Between students give suggestion about their work. The evaluation is how many student contribute in the collaborative tool such as how many student attach the diagram, notation and the example of case study. Although team project, the portion of students' contribution is individual assessment. Because the assessment aim to improve experience and knowledge. Student expected to learn from other student, gain new knowledge and new experience in the team.

IV.   OUR APPROACH

We propose assessment approach for novice teams that apply in the collaborative tool. The assessment focuses on experience, knowledge improvement, and responsibility. The component of assessment consist of: attendance, discussion, assignment, and contribution. In table 1 show that propose assessment approach based on the other model: T. Kilamo's Assessment, J.Chen's Assessment, and Utomo's Assessment.

TABLE I.   PROPOSE ASSESSMENT APPROACH FOR NOVICE TEAMS

Utomo's Assessment (2015) [1]	Propose Assessment For Novice Teams (2016)
1. Individual Assessment Component: - Assignment - Peer Evaluation **(w * assignment) +** **(w * peer evaluation)** 2. Teamwork Assessment Component: - Assignment - Discussion - Contribution **(w * discussion) +** **(w * contribution)** .: w is weight of assessment	Component: 1. Attendance 2. Discussion 3. Assignment 4. Contribution Calculation: (w * attendance) + (w * discussion) + (w * assignment) + (w * contribution) w : weighting is determined by instructor Teamwork assessment is calculated from average of above assessment

We revise Utomo's model because there is component not suitable for novice teams. First, peer evaluation component is not suitable for novice teams because they did not have experience and knowledge to evaluate other member and team. Second, in Utomo's, assignment apply in two assessment (individual and teamwork assessment). The model is not suitable for novice teams, because students can avoid the individual assessment and they still get the mark of assignment (average of team's mark). In our approach, the assignment based on the work of each member. If student did not contribute in their teams, they did not get the assignment. Third, the weighting is determined by instructor. Because the instructor have role to control the improvement of novice teams. Our approach is intended for novice student, so main goal is students' improvement such as experience and knowledge. In teamwork result display all mark of each member. Based on the average of each member, we can know the improvement of novice teams, student with high responsibility in attendance nor project assignment. Not only instructor, but also student can evaluate their result (self-monitoring) that aims to gain better result than other teams on the next project. In individual result, display student mark itself that contribute for teams such as mark of attendance, discussion, assignment and contribution.

V.   IMPLEMENTATION

The important part of collaborative software engineering are material (such as diagram, notation), group forum, and the assessment. In the collaborative tool, student expected to work together in the tool. Work together is not about work in the same time or same place, but student as member interact with other member in the tool. For example, student A create use diagram and then attach it to the forum. In other place, student B, C, or D give suggestions, recommendations and revisions about the diagram.

Discussion
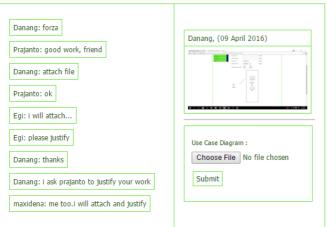
Ularius

Member Of Group:
maxidena, Danang, Prajanto, Egi,

Danang: forza

Prajanto: good work, friend

Danang: attach file

Prajanto: ok

Egi: i will attach...

Egi: please justify

Danang: thanks

Danang: i ask prajanto to justify your work

maxidena: me too.i will attach and justify

Danang, (09 April 2016)

Use Case Diagram :
Choose File   No file chosen
Submit

Figure 1 Discussion Forum

Nr. Of chat	9
Nr. Of your chat	4
Nr. Of Usecase	1
Nr. Of your work	1
Active Discussion(%)	44.4444444444
Active Work(%)	100,00

Your Result

Teamwork Result

Figure 2 Discussion Evaluation

Forum is effective way to gain communication skill between novice students. Student will speak what they want to share in the forum, at least, give comment for friends' work. In this collaborative tool, we did not use chat, instant messaging or private massage because communication for novice teams is general, it means the topic is address for all member. The weakness of chat, IM, or private massage is privacy communication. It communication tool is not suitable for novice teams, because allow student to communicate with another student. It means that the topic is not share for all member. In figure 1 show that student collaborate with other member in the tool. Each student must active in the forum to get high mark in the team. All activity in the collaborative will be assess in order to promote activeness of student.

In figure 2, activity of student assessed based on how many student active in the forum. The highest students' active in the forum will be parameter for other member. Not only speak on the discussion forum, but also the work of student will assessed too. This assessment component aim to gain activeness,

improve communication skill, and student did not avoid the projects' task. Because, the collaborative tool still developed in prototyping, discussion component have weakness. The measurement of students' active is not effective using the number of the highest of chatting. Collaborative tool should remove the word that not related with the topic or not important during discussion such as "and", "although", "but", and etc. For the next, our research will addressed this problem in order to completing collaborative tool for novice team.

VI. EVALUATION

We use questionnaire and review method to collect the data. The data has been collected when distributing the questionnaire to UTeM student, especially for software engineering undergraduate course. The questionnaire was created in Google docs that aim to easy distribute it. In table 2, the question focuses on collaborative work, novice assessment, and user interface. For question 8, the question focuses on understanding material of Software Engineering. In the collaborative tool, we had just apply use case diagram. Student expected to understand not only the notation, but also how to arrange the notation to be a diagram that can be read based on case.

TABLE II.   SURVEY QUESTIONNAIRE

No	Statement
1	Setting up group communication
2	Setting up active share the work of student
3	Setting up attendance of student
4	Setting up project assignment
5	Display result of assessment
6	Setting up collaborative work
7	Setting up the use of diagram (material)
8	Easy to use and understand
9	Interesting interface
10	User interface

In the evaluation part, we involve novice student to evaluate collaborative tool and the assessment. The participant is a first year student who had just take software engineering course. Each participant was given tutorial about collaborative tool. Then, they create team covers one leader and 4 members and requested to answer the questionnaire. The questionnaire consist of 8 questions using likert scale (SA, A, N, D, SD), 1 question using yes/no answer, and 1 question using essay.
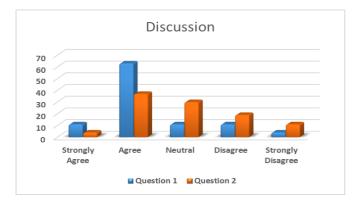
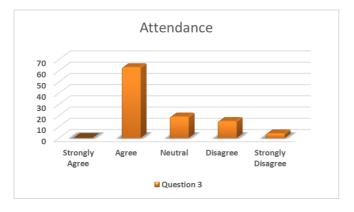Figure 3 Percentage of Group Discussion

Figure 4 Percentage of Attendance

In figure 3, Question 1 and 2 focuses on communication of student in the team. The respondent agree that collaborative tool is useful to communicate in group. In addition to, the respondent agree that after use the collaborative tool, they did not confuse how to start the conversation with other member. The respondent answer agree above 50% (average of Question 1 and 2) and strongly agree above 7.5%. We conclude that the respondent agree that student need discussion component to facilitate collaborative work. In other word, the respondent agree that the tool involve discussion component.

In figure 4, Question 3 focuses on attendance of student the team. The chart show that the respondent agree above 60% collaborative tool is useful to monitor attendance of student. For attendance component, the assessment is different with other component. In this component involved instructor to monitor students' attendance. Instructor often check the list of attendance included active in group discussion.

In figure 5, question 4 focuses on project assignment for each member on the team. Assignment component is addressed to each member. The question will deliver to member based on the diagrams' submission to instructor. If student not yet submit the diagram, they did not get the assignment. The cart show that the respondent agree above 50% that collaborative tool provide fair assignment for team. The respondent agree that assignment deliver to all member. It reduce lazy student in order to avoid complete assignment.

In figure 6, question 6 and 7 focuses on improve knowledge of student about material and contribution of student. Collaborative tool provide component of use case
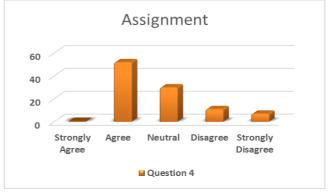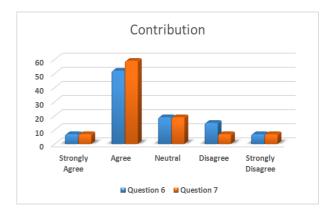

Figure 5 Percentage of Project Assignment

Figure 6 Percentage of Contribution

diagram that used for student to practice create use case diagram. Then, the diagram should deliver to the discussion forum. In every submit diagram for instructor and forum, it will be counted and added to the mark report. The cart show that the respondent agree above 50%, collaborative tool is useful to facilitate student apply their knowledge about what they learned in the class. The weakness of collaborative tool is only provide one diagram, there is use case diagram. Collaborative tool should provide structure diagram and behavior diagram in order to measure understanding of student learning kind of diagram for modeling of requirement analysis.

VII. CONCLUSION

Assessment approach not only assess the ability of student, but also aim to improve communication skill and knowledge. In collaborative tool, assessment approach can be used to promote collaborative work. Assessment approach for novice teams should pay attention the level of student. Novice student is student who had just learned software engineering, they cannot assess like professional level or senior student. For novice teams, assessment approach aim to encourage the responsibility of student to attend discussion forum, submit project assignment, and active to contribute for team.

In this study, we propose assessment approach for novice teams that consist of 4 components: *attendance, group discussion, project assignment, and contribution*. The assessment approach was applied in the collaborative tool and already used by novice student in UTeM. Based on the evaluation stage, the participants agree that the system support collaborative work and the assessment approach is fair assessment for novice student.

VIII. FUTURE WORK

There are many weakness in the collaborative tool, especially focuses on assessment component:

a. Add stemming technique or stop-word removal in order to remove "unimportant word".

b. Add some diagram in order to give variation the work of student and promote understanding knowledge and students' contribution

c. Enhance notation of diagram such as association, include, and extend line.

For the next research, we will improve our collaborative tool and addressed all the weakness of system, especially for assessment component.

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