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Assessing the Effectiveness of K-Cell Application to Promote Active Learning to Learn Theoretical Subject

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Abstract. Teaching theoretical subject requires the lecturer to be more attentive. Some of the students might not pay their full attention, while the others may just turn to be passive when the lecturer dominates the teaching and learning process. Students will normally act as individual in class, when solving any given problem. Reading a lot of materials alone will increase the tense and make them feel bored. The results of few semesters in Malaysia Institute of Information Technology for theoretical subject shows that very less students score distinction marks and quite a number of students failed the subject. This paper is aimed at improving the students' academic performance by introducing Knowledge Cell (K-Cell) that is applied from co-operative learning cell method and considering the RUT and RUPA approaches. This paper then targeted to increase the students' interest towards the theoretical subject, thus encourage them to be more active in the class, which indirectly will increase their level of interaction and understanding. This paper then empirically assesses the effectiveness of the use of K-Cell on students' academic performance. The research was conducted for three academic semesters and the results and feedbacks from 136 samples of the first year students were used for evaluation.

Keywords: Active Learning, Cooperative Learning Application, K-Cell, Learning Cell

1. Introduction

Learning is a continuous activity, and requires the learner(s) to get engage with the learning environment. Learning session will become bored if the class is dominated by only one person and when the students do not have much chance to participate. Cooperative activities practice a democratic implementation, where each group members are given equal and flexible opportunity to share knowledge and experiences [1]. This research focuses on promoting the active and cooperative learning activities for early university students. As we are aware, various approaches can be used for cooperative learning activities and one of them is learning cell. Cooperative learning involves both methodologies and environments, and learners take part in a common activity. Each learner is depend on the other(s), and each of them has their own responsibility [2]. Most of the cooperative learning currently has been upgraded by using a Computer-Supported Collaborative Learning (CSCL) where activities are performed with the help of computers. This is because CSCL is able to support and facilitate group processes and group dynamics in ways that are not possible by face-to-face interactions, however, without replacing this kind of communication [3]. This type of learning is typically tailored for use by multiple learners, working either synchronously or asynchronously, at the same workstation or across networked computers. The purpose of Computer-Supported Collaborative Learning is to scaffold or support students in learning together successfully [4]. The scope of this research is to improve the learning process for the theoretical subject, especially for Introduction of Software Engineering. In order to support the cooperative teaching and learning process, the students are equipped with a cooperative system named Knowledge Cell; K-Cell, that applies the learning cell approach.

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The problem faced in MIIT was the results for theoretical subjects that require remembering and a lot of readings are very low. It seems that the students are not really put their interests in such activity, thus lead to a bad result. Therefore this paper is aimed at achieving the following objectives : *(i) to promote active learning and increase the interaction among students, (ii) to increase the students' interest towards the course (theoretical subject)* and *(iii) to improve the students performance on the final exam papers, obtaining higher grade and reduce the failure rate*.

2. Literature Review

Learning cell refers to a cooperative form of learning in which student working in pairs, alternately ask and answer questions on commonly assigned reading materials. The concept of learning cell was developed by Marcel Goldschmid [5]. A study about the beneficial effects of pair learning was made by [6] which supported the idea of learning cell, whom suggested that the team learns best when having a team size of no greater than two. This is also supported by another study about cooperative learning [7], which reported that learning cell is an effective approach to gain better students' feedback due to its smaller group size. While, [8] classify the process of learning cell as co-operative activities between two parties (pairs) which one side act as a problem solver, while another as a listener. Outcomes of this and other variations on these two-member learning cells are reviewed in [6].

2.1. Why Learning Cell and How it Works?

This research focuses on the learning cell and not other cooperative technique because the researcher has a strong belief that a group size of two can create effective sharing session. There is an extensive review of the literature concerning team size and its effects to support this assertion. There is strong theoretical and empirical evidence that a group size of two is adequate to achieve the benefits of peer learning, as long as the learning task involves positive interdependence and individual accountability [9]. The learning cell is effective for increasing the group understanding as it involves small discussion [10]. This research is also intended to promote active learning among students. Active learning is a type of instruction method, where the learners will actively participate in the learning activities rather than passively listening to a lecture [11] and this approach is supported by learning cell. Active learning occurs when learners/students are given the opportunity or called upon to do any course-related activities rather than passively watch, listen and taking notes (Felder and Brent, 2009). This will generate better thinking skills because learners generate rather than receive knowledge. The role of the instructor is more to facilitate rather than dictate. Active learning process can be supported with the use of technology to increase the attractiveness of the active learning process [12].

Learning cell involves a student working on a given task with a pair. Learning cell allows student to generate ideas on certain topics by asking various questions according to his pre-reading. Not only that, the student will also experience new learning styles, where he/she needs to teach his/her partner, partly and alternately. These activities will definitely increase their understanding since the students are required to think by themselves before the actual/formal lecture is taken place. As described by [10], the preparation for the learning cell class requires every student to prepare a series of questions to ask his/her group member. However, the student must also prepare the solution to each question posted/prepared. When the discussion starts, they will start asking question to their partner, listen to the alternative response by his partner and compared to his own answer. They will then find a conclusion about which answer is better or how to get a better solution based on two different answers. These activities happen before the formal lectures are taken place. This means, the students must at least read, think, write, and discuss the material before the real lecture is taken place. Directly, his technique prepares the students for more active learning, rather than just being a spoonfed, wait and listen for the answers. The learning cell comprises only two people, where each student will share the same responsibility by learning one half of the material and then teaches one other student, who, in turn, teaches the first student the other one half of the material [5]. Thinking that the concept of learning cell is able to increase students interaction, and make them actively involved in all tasks and activities, the researcher think that this technique is suitable to be applied for theoretical subject and decided to start with a pilot study to find out whether or not it is able to achieve the research objectives.

3. Methods

The preparation for the new learning cell experience was made by developing a prototype that applies learning cell technique. The selection of the name for the prototype is made suitable with its purpose to conform to the learning cell concept, K-Cell which stands for Knowledge Cell, where the students are inspired to share their knowledge by corresponding, co-operating, working and enjoying themselves when using it.

Since the aim of this study is to increase the level of students' interest in learning theoretical subject, thus, the students sampled came from the first semester students who registered for Introduction to Software Engineering (ISE) course at Malaysia Institute of Information Technology (MIIT) for three academic semesters, commencing on 2010 – 2011 (2010 (Sem 2), 2011 (Sem 1), 2011 (Sem 2)). The syllabus of this subject requires understanding and auxiliary reading. Since the students are the first semester students, who has lack exposure about software engineering discipline, therefore the discussion or knowledge sharing are seemed as the most suitable approach to increase students' level of understanding as well as interests.

Table 1 Number of Students by Academic Semester

Academic Semester	No. of Students
2010 (Sem 2)	42
2011 (Sem 1)	48
2011 (Sem 2)	46

For each semester, the class is allocated with 120 minutes per session, held for twice a week. To accommodate students with better, interactive learning environment, K-Cell that applies the learning cell technique is used throughout the semesters. In our first cell learning semester, students were given the sovereignty to choose their own cell partner. However, during the second semester of cell learning, the group formations were determined by the system, by mixing their ability levels according to the lecturer's suggestion. The total numbers of students are 42, 46 and 48 for three different semesters. Hence those students were divided into two classes session. Since K-Cell remain the concept of two group members, thus, the number of groups for each semester is around 21 – 24 groups and they were provided with sufficient number of personal computers.

3.1. The Process

All activities are taken place in a cell (the virtual class) and the student from the same group will be placed in different (far and isolate) workstation to avoid offline conversation. The method of their interaction is by having a text discussion and attachment of various files is supported. During each experimental semester, the total of six K-Cell activities were handled in the class. The six sessions focus on six different chapters which require a lot of reading and understanding, and it was conducted before every formal lecture took place. Two different approaches were made, which were identified as RUT (Read, Understand, Teach) and RUPA (Read, Understand, Prepare, Ask).

Fig. 1: The RUT Approach

As shown in Figure 1, the RUT process requires each student (pair-wise) to read the pre-assigned materials. The first student will read the first half, while the other student will read the other half of the material. Once they are done with the reading within allocated time, they have to alternately take the responsibility to teach his/her partner about what he/she had learned. A discussion will take place online, while the lecturer has access to all the conversations. The RUT process will benefit the students, because by

teaching his partner, the student is actually learned for himself too. The more he teaches, the more he will understand.

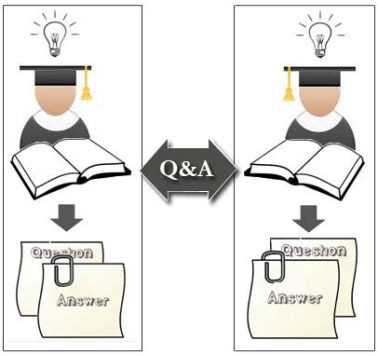

Fig. 2: The RUPA Approach

Another approach known as RUPA (shown in Figure 2) involve assigning both students with the same material(s), where they have to read from the beginning to an end. After that, they will prepare a set of questions (according to Bloom's taxonomy that was provided earlier in every RUPA session). However, each of them needs to attempt the questions by themselves first. Later, both of them will work closely by alternately ask the question to each other, and compare their partner's answer with his pre-defined answer. After that, they will start discussing on those solutions in order to get one ideal solution. All of the discussion will be logged, and each group needs to submit their final answer as well as their logged discussion to the lecturer at the end of the session. The quantity of reading material is reduced (only included the important topics and sub-topics in order to offset the amount of work involved in preparing the discussion questions. Ample thinking time is given depending on the task level and difficulties. The allocation of time for both RUT and RUPA is summarized in Table 2 below.

Table 2 The duration (in minutes) for Each Task in the Session

RUT Session	
Task	**Duration (mins)**
Group formation and task explanation	10
Materials reading	45
Prepare notes / main points	20
Teaching partner	35
Lecturer's (ULASAN LECT)	10
TOTAL	120
RUPA Session	
Group formation and task explanation	10
Materials reading	45
Prepare question and solution	30
Q&A with partner	30
Lecturer's (ULASAN LECT)	5
TOTAL	120

3.2. Grading and Evaluation

To practice fair implementation, all the tasks were graded individually, because learning cell is about working together with a pair but the contribution by everyone is essential (is the most counted). That is how leaning cell assures no sleeping partner, indirectly 'force' the students to work harder and put more efforts towards every given task. The performance of every student in the cell is the most counted. This includes their commitment, response, interaction, as well as discussion. The most active student with the correct answers and show better understanding will gain better marks. Different rubrics will be used, depend on the assessment type, level, and topic. The total marks will be displayed in monthly basis. The students can review the final marks as well as marks and comments from the instructor for each task or subtask. The following instruments were used to evaluate the effectiveness of the K-Cell application:

- Final exam paper to assess the students' academic performance
- A set of questionnaires to assess the students' opinion about the K-Cell implementation

4. Results and Discussions

This section discusses the results obtained after implementing K-Cell for three semesters at MIIT. After implementation of RUT and RUPA approach, the formal lecture will take place, delivered by the lecturer. During this time, students face fewer problems to understand the lecture as they have read and discuss about those topics with his/her partner before. The learning session became more interesting as it will serve as a revision for the students and they could share their ideas too. We have conducted two different type of assessments in order to review the effectiveness of the K-Cell which are final examination result as well as a set of questionnaire distribute to students at the end of each semester concerning about their opinion of K-Cell implementation for the particular subject. For comparison purpose, the results of the two previous semesters before the K-Cell implementation were noted, and were used as comparison with the current results.

As mentioned in Section 1, one of the objectives of this research is to improve the students' performance on final exam papers. The results of the K-Cell implementation in compared with the traditional and individual learning are displayed in the following table 3.

Table 3 The Comparison of Traditional and Active Learning Based on Students' Score on Final Exam Paper

	Traditional Learning / Individual		**Active Learning / K-Cell**		
Semester / Score	2009 (Sem 2) (n = 32)	2010 (Sem 1) (n = 40)	2010 (Sem 2) (n = 42)	2011 (Sem 1) (n = 48)	2011 (Sem 2) (n = 46)
A	1 (3.1%)	0 (0%)	3 (7.1%)	4 (8.3%)	7 (15.2%)
B	6 (18.8%)	16 (40.0%)	19 (45.1%)	21 (43.8%)	22 (47.8%)
C	16 (50.0%)	17 (42.5%)	18 (42.8%)	22 (45.8%)	17 (36.9%)
D	4 (12.5%)	4 (10.0%)	2 (5.0%)	1 (2.1%)	0 (0%)
F	5 (15.6%)	3 (7.5%)	0 (0%)	0 (0%)	0 (0%)

After three semesters of K-Cell implementation at MIIT, the result shows a severe improvement. The failure rate has decreased while the 'A' scorer has slightly increased. This is believed due to the students' early preparation as they were indirectly 'forced' to study in order for them to gain marks during the K-Cell activity in class, which in turn, have benefited them because they have gain good result. The most successful semester is '2011 (Sem 2)', with the total number of students 46, there were 7 students which is equal to 15.2% has scored 'A' and none of them failed this subject. For every experimental semester, there is no failure recorded which made the objective (iii) achieved.

As an alternative of assessing the students feedback and attitude on the active learning implementation using K-Cell, set of questionnaires were distributed to all students for each experimental semester. We use five-point Likert scale for most of the questions, scale 1 represent the 'strongly disagree' and 5 for the 'strongly agree' answer. Among the feedbacks are summarized and presented in the following table.

Table 4 The Students Feedback on Questionnaire (The Percentage)

Question / Scale	**1**	**2**	**3**	**4**	**5**
1. Your level of satisfaction learning with pair	0	10	20.6	66.2	4.4
2. Your level of satisfaction with the time allocated for each task?	6.6	23.5	57.4	9.6	2.9
3. Would like to get engage in this kind of activity again?	0.7	0.7	3.7	42.6	52.3
4. How well your partner collaborates and communicates?	1.5	5.8	74.3	8.8	9.6
5. The degree of this approach helps you understand faster and better?	1.5	4.4	22.1	63.2	8.8
6. K-Cell has increased your level of interest to learn the subject?	0.7	0	17.6	71.4	10.3

In most cases, the students indicated positive attitude on the active learning implementation. Many students commented that they had learned to accomplish the work on time, as the system will automatically shut the time off accordingly. Most of the students were satisfied to work in pair (item 2, score for scale 4 is 66.2% and scale 5 is 4.4%). Almost 95% (scale 4 and 5) students would like to get engage in this kind of

activity again and the students also give a very positive feedback for item 6, which concerns about the students interest. This shows that this implementation is effective in increasing the students' interest to learn theoretical subject, and at the same time had helped the students learn better and faster. This made the objective (i) and (ii) achieved.

5. Conclusion

From the experience, we can conclude that the performance of working in group is better than individual performance. Working through the RUT and RUPA approaches would not only benefit students in terms of their academic performance, but to increase their teamwork skill as well. A higher percentage of students successfully completed the course in the experimental semester, plus the positive respond received toward the cooperative group shows that this active and cooperative learning approach is effective to be applied for theoretical subjects. This approach will be continually used for other subjects with the hope to receive better feedback and results. Thus, we suggest that students are more engaged in the course material and learn the material better when they are working with peers, in group.

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