STUDENTS' PERFORMANCE IN SOIL ENGINEERING COURSE VIA ACTIVE LEARNING

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Abstract: Soil Engineering is one of the compulsory subjects taken by students pursuing a Diploma in Civil Engineering. This is an application subject where students need to have a good fundamental knowledge in Soil Mechanics in order for them to understand and apply the knowledge into real cases. However, the failure rate of Soil Engineering is quite high for every semester; 25-30% of the students taking this subject. Based on the results of a diagnostic test that was given early in the semester, most of the students obtained a C grade in Soil Mechanics; hence, various teaching and learning methods have been implemented to cater to Generation Z's way of learning. The active learning methods are project based learning, group discussions, site visits, 3D models and video making. The aims are to increase the fundamental knowledge of this course, enhance the cognitive and effective domains, help students apply the knowledge into real situations and to reduce the failure rate. As a result, after the three semesters of trying to meet the students' needs and subject requirements, the percentage score of more than 50% for PO2 was achieved.

Keywords: Active learning, Engineering, Latest technology

Introduction

Active learning is a process of learning that requires a student's engagement during the learning period. Active learning can be applied during face-to-face or self-learning sessions. Nowadays, the implementation of active learning in teaching is a must in order to make the classes more attractive and enjoyable for students. Active learning can be applied through methods such as group discussions or through Internet of Things (IoT) such as video sharing on YouTube. As reported by Pervez and Alandjani (2018), emerging concepts of computer sciences and IT skills are mandatory in classroom activities because the interests of Generation Z nowadays are more focused on engaging with technology. In addition, education institutes will not only teach computer science concepts to their students but at the same time will be developing their critical thinking.

Soil Engineering is one of the courses that requires students to apply the basic fundamental knowledge they have learnt in Soil Mechanics. This course consists of one test, two assignments and a final exam with 30%, 10% and 60% allocated respectively. This course mapping is linked to the Programme Outcomes (POs) 1 and 3 as shown in Table 1 below. To summarize, PO1 focuses on fundamental knowledge of the students whereas PO2 caters on the application of the knowledge in real situations.

Implementation of active learning in this course has been applied every semester as stated in the syllabus. There are no specific types of active learning as long as the objectives of the active learning are achieved and parallel with the PO and the CO of this course. Group discussions, project based learning (PBL), site visits, 3D models, video presentations and others are examples of active learning projects in this course. The objectives of this paper are to discuss the types of active learning that has been implemented in this course and to see the connection between active learning and the performance of students in fundamental aspects.

Table 1 POs for Soil Engineering Course

PO(s)
PO1: Apply knowledge of mathematics, natural science, engineering fundamentals and engineering specialization to a wide array of practical procedures and practices
PO3: Create solutions for well-defined technical problems and assist with the system design, components or processes to meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental.

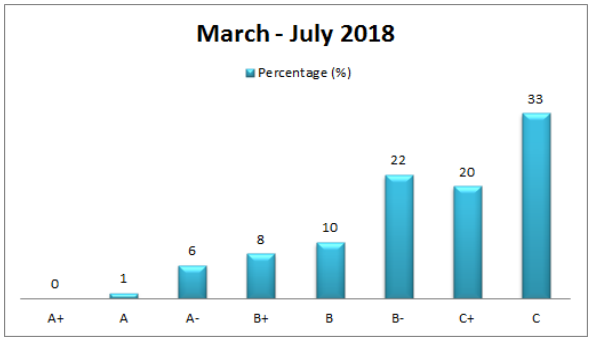
Material and method

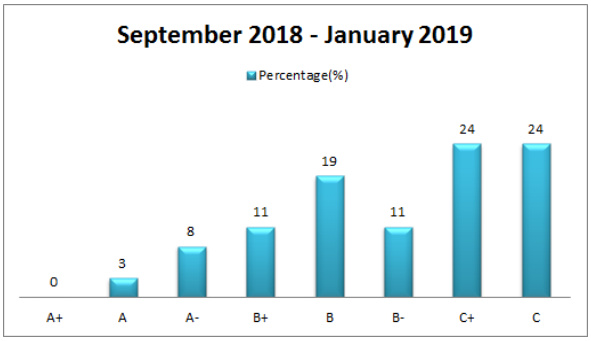
In reference to the syllabus, students taking Soil Engineering course must complete two (2) assignments within the 14 weeks of a semester. The assignments must be designed according to the PO1 and PO2 requirements and the designed questions should be endorsed by the Resource Person (RP) before they can be distributed to the students. There are several types of active learning methods that have been utilised to fulfil the requirements of this course; Project Based Learning (PBL), group discussions, laboratory activities, site visits, 3D Models and video making.

The idea of conducting this research was based on the poor results of the diagnostic test and PO2 requirement. The diagnostic test was administered during the first week of the semester to give the lecturers enough time to plan their teaching methods based on the results of the test. Figure 1 shows the result of the diagnostic test for three consecutive semesters during the conducted study time frame focusing only on the grade for Basic Soil Mechanics. We can see that the majority of the students obtained a grade of C+ and C will have difficult time understanding Soil Engineering course.

At the end of the semester, the students' performance in terms of POs and COs will be analysed to make sure the outcomes of this course are within the requirements of the faculty. As shown in Table 2 below, the average passing results of at least 50% of PO2 is very low compared to the PO1 for the three consecutive semesters prior to this study. This may be due to the lack of understanding of the questions, inability to interpret the questions into the standard solutions and lack of implementation skills such as calculations as PO2 questions demand calculation and application of concepts.

The limitations of this paper are the types of active learning applications in the three previous semesters and the performance of the students based on the achievement of PO2; PO2 is linked to the implementation of the learnt knowledge to real situations.





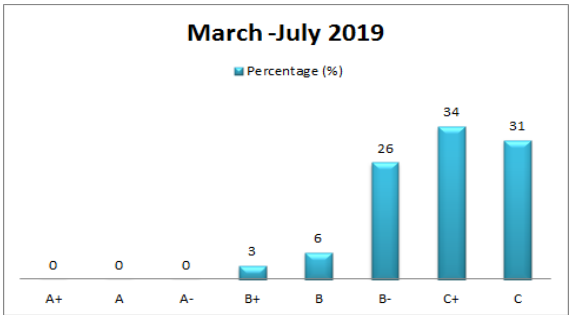


Fig. 1 Percentage of grade achievements in fundamental subjects (prerequisite) through Diagnostic test for 3 semesters.

Table 2 Achievement of PO1 and PO2 for Soil Engineering Course

Semesters	PO1 (%)	PO2 (%)
September 2016 – January 2017	72	44
March 2017 – July 2017	68	41
September 2017 – January 2018	80	45

Project Based Learning (PBL)

PBL is one of the top scorers of active learning because this type of active learning will cover all the elements such as group discussion, presentation, report writing, searching for information and others. As stated by Pervez and Alandjani (2018), PBL helps students to understand the subjects more while Pervez et al. (2018) reported that PBL can change students' attitudes from passive to active behaviour in the classroom. In this Soil Engineering course, students are given a standard JKR/ SPT borehole report. In groups a of minimum of two and maximum of four students, they must analyse the report and come up with a graph and a calculation of the bearing capacity of soil at a certain depth. The result of this analysis will focus on the suitability of the bearing capacity to the shallow foundation design for a double-storey house. Next, a full report on the type of soil that they are dealing with, the calculation of the bearing capacity for the certain depth, the justification of suitability of designing a shallow foundation in the area and the conclusion of the assignment will be made. References from books, journals and others should also be included in the report.

Group Discussion

Group discussion is one of the active learning methods with the aim of creating and sharing of an idea. This method is very popular to brainstorm ideas not only in the classroom but also throughout an entire organization. In Soil Engineering, a group discussion is utilised for students to solve simple questions which normally will take between 10 to 20 minutes of brainstorming. As a result, group discussions help students to become more active in the class rather than being passively focusing on the lectures. This method is proven successful with reports by Subramani and Iyappan (2018) where they stated that group discussions can motivate the learning process.

Site visits and laboratory activities

Another type of active learning that has been implemented in this course is site visits. Students are required to make site visits to artificial slope areas within the campus. They must measure the dimension of the slope by using ropes and measuring tapes or they can use a modern survey equipment. All the data surrounding the dimension slope will be used in the next calculation phase. During the site visit, students must take an in-situ soil sample, bring it to the laboratory, test it to get the value of unit weight of the soil, and use the value in the calculation phase. This type of active learning really helps the students to increase their psychomotor skills as well as their effective and cognitive domains.

3D Model

3D model prototypes making is one of the latest active learning tools implemented in this course. This 3D model allows students to understand the concept of this subject's fundamentals first before they can analyse the question and transform it into 3D model prototypes. Students must choose a suitable design and correct dimensions before it can be tested. This active learning not only expands the students' innovation skills, imagination and creativity but also increases their confidence level at the same time. In 2018, Pervez and Alandjani reported that 3D prototyping and printing allow lecturers and students to create practical prototypes of real-world systems with similar functionality to enhance learning experience.

Video making

In this era of technology, videos are one of the main communication media. Day in and day out, students that belong to Generation Z are busy recording and uploading videos on their social media accounts. Taking advantage of this situation, this course has chosen video making as one of the methods in active learning. Students are required to make a video on the process of the calculations starting from the beginning until the solution is found. It may look like a simple activity, but the students truly enjoy making the video. Other students can also watch the videos once they are being uploaded on YouTube by these students. Pervez et al. (2018) mentioned that by implementing video making in the learning process, it will make education more accessible, well organized and effective.

Results and discussion

A survey was conducted to get an overview from the students' perspective on the implementation of active learning in this course. 24 students were involved in this survey and the results are as shown in Table 3. With a 4.10 mean score, it has proven that students believe active learning is very helpful and useful in helping them learn. With a mean score of 4.06 which is the second highest point proves that the students can assess their psychomotor skills through active learning. The third highest mean score of 4.04 shows that through active learning method, students are able to understand the coursework better.

Table 3 Mean score on active learning can assess students' cognitive, affective and psychomotor skills from student's perspective

Survey	Mean score	Level of agreement
I feel that active learning is a helpful and useful method in the teaching and learning process.	4.10	Agree
I find that the assessments in this system are suitable with Outcome Based Education (OBE) requirements.	3.96	Agree
I find that this method of teaching can assist the students in understanding the course better.	4.04	Agree
I find that this method of teaching is not helping much in understanding the course.	2.42	Not agree
I can use the theories learned in this course to design 3D models.	4.02	Agree
The active learning implemented in this course helps me become a problem solver.	3.98	Agree
I feel that this active learning approach can assess the students' effective skills.	4.03	Agree
I feel that this active learning approach can assess the students' psychomotor skills.	4.06	Agree
The time required to finish the project is between the students learning time.	4.01	Agree

I feel that through this active learning, team spirit can be built and polished.	3.89	Agree
Average	3.85	Agree

The passing result of at least 50% of PO2 has increased during the study time frame. Even though the increment is not that high by comparing the value of PO2 in Table 2 and Table 4, it has a significant value. Table 4 shows the results of PO2 for each respective semester.

It is also important to note that the rearrangement of the topics in this course syllabus plays a role. Back in the March-July 2018 semester, the arrangement of the topics started with topic one – "vertical stress in the soil", and ended with topic five – "subsurface exploration". This first topic is the head of the course where 30 marks are obtained from this topic in the final exam question. Starting from the September 2018 - January 2019 semester, the arrangement of the topics was changed; topic five became topic one. This new arrangement has helped students to get an overview of the whole course before they have to go through the calculation phase. This is a very important aspect indeed because through the overview process, students will develop their imagination and common sense.

Table 4 Achievement of PO2

Semesters	**PO2 (%)**
March – July 2019	52
September 2018 – January 2019	51
March-July 2018	49

Conclusion

Any teaching and learning method without damaging its objective should be considered as an innovative method of teaching and learning as it is believed that the objective of teaching is passing on the information or knowledge to the students. Active learning is one of the innovative methods that can be improvised from time to time in order to make sure the main objective is achieved.

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