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Effectiveness of Active Learning Strategies for Soil Science Course

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Abstract: Common teaching methodologies which are teacher-centered learning do not enhance students' engagement and encourages passive learning which does not develop higher-order thinking. Thus, it contributed to low students' performance which caused increasing failure rate for soil science course continuously within three semesters. Active learning can foster the growth of thinking skills through participation among students and lecturer. The aim of this study to compare the effectiveness of two different type of teaching method applied for soil science course. Participants were randomly selected from Diploma Planting Industry Management (AT110) students from Faculty of Plantation and Agrotechnology. Soil science course was conducted through traditional method or teacher-centered learning in second semester of 2016. Student performances for the semester were analysed and students who were failed and have to repeat the course were identified. Those students who repeat the course was re-enrolled the course for first semester of 2017. For this semester active learning methods were used, consisting of collaborative learning in the field, visual-based instruction and case studies. Student learning was evaluated using classroom tests and final examination results. The best teaching method was applied and monitored from second semester of 2017 until second semester of 2018. T-test show significantly improvement on final examination result of soil science course between traditional teaching method and active learning method ($p < 0.05$). Final examination result shows that student performance was increased between 20-30% when compared with teacher-centered learning. Students actively participate during learning session and

gained interest toward soil science course through active learning methods and the failure rate was decreased which are less than 10%.

Keywords: *teacher-centered learning; active learning; student performance*

INTRODUCTION

Soil science has been recognized as natural science in its own right (Ruellan, 1997) and this course of study deal with a material that has unique properties and behaviour (Churchman, 2010). Therefore, it is important for teachers to relate the unique properties of soil to other disciplines so that the student able to understand the whole concept of this course. This is because soil is integral to many ecological and social systems and it holds potential solutions for many of the world's economic and scientific problems, including scarcity of food, fuel, and water, as well as climate change (Flannery, 2010; Harte mink and McBratney, 2008). Currently, the common teaching methodologies which are teacher-centered learning do not enhance students' engagement. Most of teachers more prefer teacher-centered learning because lecturing provides a convenient and efficient way to deliver content to large numbers of students, particularly in large lecture halls. However, a number of studies indicate that lecturing is not a particularly effective teaching format. This is because it encourages passive learning, results in poor information retention, and does not develop higher-order inquiry and thinking (Ahern-Rindell, 1999). Frequently students stay passively in the classroom they will disconnect from the lecture and start actively with their gadget such as mobile phone. It also fails to stimulate student motivation, confidence, and enthusiasm (Weimer, 2002). Furthermore, teacher-centered learning only allow students observed without actively engage in the process of learning in the classroom which prevents the students to obtain a deeper understanding of the theories or process in the course. This situation might contribute into low student performance. Final examination report had shown increasing trends of failure rate for soil science course from Diploma Planting Industry Management students. The result from the Lecturer's Professionalism Monitoring (PROPENS) showed that most the lecturers apply teacher-centered learning. Soil science course was traditionally taught using a combination of lecture and laboratory sections. Active learning has received considerable attention over the past several years. It often

presented as a radical change from traditional instruction (Michael 2004). Active learning is generally defined as any instructional method that engages students in the learning process. Furthermore, the teacher can meet these complementary goals by focusing on remedies that make content relevant to the intended audience, increasing student-student interaction in class, and encouraging conceptual understanding rather than rote memorization of facts. This learning environment helps teacher to interactively engage with students cognitively and scientifically in the learning process which student able to define concepts, explain theories verbally and writing. It also drives to achieve the course learning outcome stated by the university. Quite remarkably, consistently poor academic performance by the majority of students is basically linked to application of ineffective of teaching methods by teacher to impact knowledge to learners (Adunola, 2011; Elvis, 2013). Nowadays, questions about the effectiveness of teaching methods on student learning have consistently raised significantly interest in the related field of educational research (Hightower, 2010). Therefore, the objective of this study was to compare the students' academic performance through traditional and active learning methods for soil science course.

METHOD

The population for this study was undergraduate students from Faculty of Plantation and Agrotechnology who were enrolled soil science course on semester three (3) at Diploma level. In the second semester of 2016 the students were instructed through traditional teaching methodology for the whole course content within 14 weeks. Students' performance was analyzed through three (3) times of classroom test and the final examination. Students who were failed and have to repeat the course were identified. Those students who repeat the course was re-enrolled the course for first semester of 2017. On first semester of 2017 different methods of active learning were adopted in soil science course to encourage students' engagement in classroom and also to initiate higher-order thinking skills. The active learning approaches that were carried out are consists of visual-based instruction, collaborative learning in the field, and case studies. This active learning was employed during two (2) hours of lecture time per week. Soil science course consists of nine (9) chapters and for the first three- chapter teaching and learning process were conducted through visual-based instruction and next three

chapter was employed collaborative learning in the field while the last three-chapter through case studies. The active learning strategies used for soil science course as follows:

Visual-based instruction:

Lecture of the topics is given together with video for every topic to enhance understanding among students. Instructor use visual physical and digital media to teach abstract concepts. Students are expected to be able to describe the process of soil formation and relate the several factors that affect the soil formation especially in Malaysia through presentation in the classroom. Through presentation it will encourage students to demonstrate what they 'know'.

Collaborative learning in the field:

Students were organized into group and the process of learning was conducted at field where student directly identify the properties of the soil in the field. Students actively feel and observe the properties of soil particularly physical properties followed by discussion with peers and the lecturer. This promote dialog between lecturer and students thus enhance students understanding about the topic given. The construction of knowledge occurs through the exchange of information, the asking of questions, and discussions about and reflections on reality.

Case study:

Students are provided with the real problems and lecturer as facilitator which guide the students find the solutions. Teaching and learning were followed with process a series of discussions of cases. For instance, students are expected to be able to identify the causes of unfertile soil based on its chemical properties and students able to identify agriculture practices to improve soil properties as well as support plant growth. To test the efficacy of different methods active learning versus traditional lecturing, we were comparing both result of classroom test and final examination results by analysing 70 students (n=70) from 110 students who registered this course

for second semester of 2016. Total sample were identified from Krejchie and Morgan (1970). The General Linear Model based univariate ANOVA techniques was applied to examine the effectiveness of teaching methods on students' test scores. The final examination result through teacher-centered learning and combination of active learning methods was compared using T-test. The data were analysed using the Statistical Package Social Science (SPSS) software. The most teaching methodology were identified and were applied from second semester of 2017. The student performance for soil science course were monitored every semester to ensure the effectiveness of teaching methodologies which have been identified and practiced from second semester of 2017 until second semester of 2018.

RESULTS AND DISCUSSION

3.1 Comparison of different teaching methods

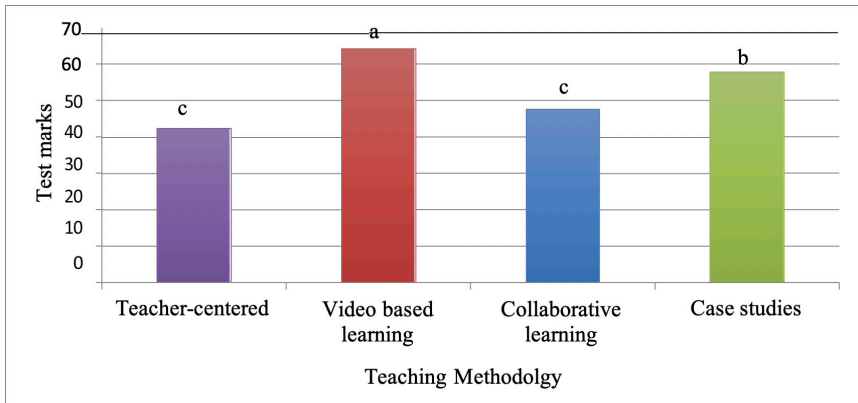


Fig. 1. Mean comparisons of student's test marks for soil science course

Fig. 1. shows video-based learning produced the high mean test marks (64.25%), followed by case studies (57.81%), collaborative studies (47.62%) and the lowest mean test marks was recorded for traditional teaching style (42.43%). The one-way analysis of variance (ANOVA) was employed to evaluate students' test marks according to difference types of teaching

methodologies. Tukey test shows students' test marks was significantly ($p = 0.000$) increased through active learning except for collaborative learning which no significant differences existed when compare with traditional teaching method. Video based learning was the best teaching methods that consistently with the finding by Shephard (2003) who reported that video can be a powerful teaching medium. Video seize students' attention thus motivating them and engaging them with the course especially for students who are 'visual learner'. It also can help students visualise how something works especially for the topics of soil formation which a lot of chemical process occur along the formation of soil where the process difficult to fully explain using text or static image (Schwartz and Hartman, 2006).

3.2 Comparison between teacher-centered and active learning

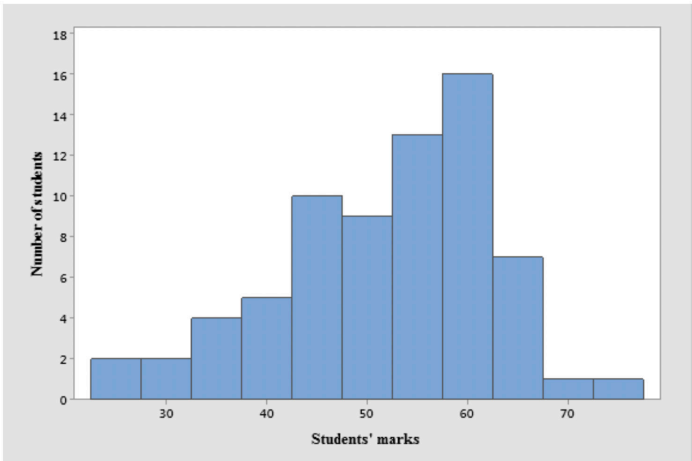


Fig. 2. Distribution of students' final marks through teacher-centered learning

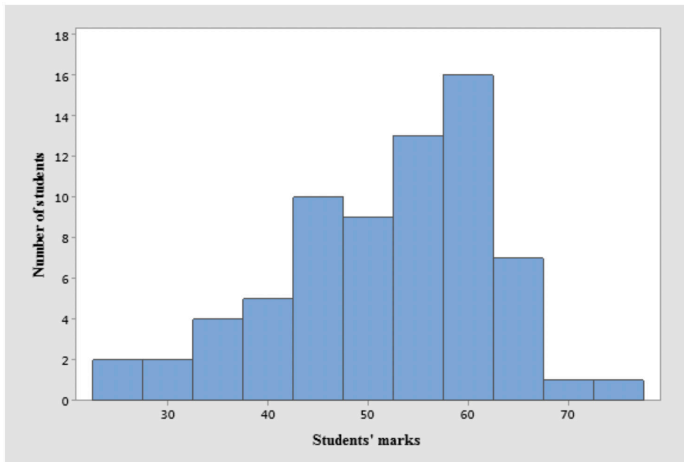


Fig. 3. Distribution of students' final marks through active learning

Fig. 2. shows the distribution of final examination marks from 70 students for soil science course on second semester of 2016 through teacher-centered learning. It shows the lowest range of final examination marks was 19-21 % while the highest range marks was 47-49%. It was noticed that, most of student obtained marks between 39% to 47%. Fig. 3. shows distribution of final students' marks which the students were instructed using active learning methods on first semester of 2017. It shows the lowest range of final examination marks was 22-32 % while the highest range marks was 72-77%. More than 60% of the students obtained marks over 50%. With the comparison between active learning methods and teacher-centered learning, it clearly shows improvement by the students during their study. The increment about 20% to 30% for each student through active learning methodologies.

Table 2. Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Teacher-centered	70	20.43	48.00	40.9466	4.99896
Active learning	70	24.00	75.00	51.9000	10.72063

Based on the teaching method applied, the mean reveal that active learning methods produced the high mean score for final students' academic

performance (mean = 51.90) and teacher –centered method shows slightly low mean score for final students’ academic performance (mean = 40.94). This result is consistent with the finding by Lindquist (1995) who indicated that student-centered methods promote greater mastery of the subject than centralizing the flow of knowledge as a one-way channel from the lecturer to the student.

Table 3. Paired Sample T –test

	t	df	Sig. (2-tailed)
Teacher-centered– Active learning	-8.423	69	.000

Table 3 Shows paired sample T – test show the significant difference between final examination result of soil science student for teacher centered method and active learning method (p = 0.000). Through active learning engagement in the classroom and open activities during laboratory session at field, students actively participate and gained interest toward the soil science subject. Students involvement during learning session also help them to understand subject much better compare traditional method or teacher centered learning styles. Thus, it is confirmed that students’ passively in the classroom or no involvement in the teaching and learning process could lead them score poor academic performance (Hake, 1998).

3.3 MONITORING ACTIVE LEARNING METHOD

Since 2014 until 2016 most of soil science lecturer were teach this course through teacher- centered leraning. Fig. 4. shows the failure rate more than 10% for every semester within that two years except for first semester of 2015. The highest failure rate was 19.80% which involved of 81 students. Thus, the active learning method were applied for the course started from first semester 2017 until second semester of 2018. The implementation of active learning significantly shows student improvement for the course for the first semester of 2017. It was noticed that, the failure rate for the soil science course were decreased by semester after creating active learning environment in the classroom. It is not only improved student performance for this course but developed their higher order thinking and student

engagement through activities, discussion and group work.

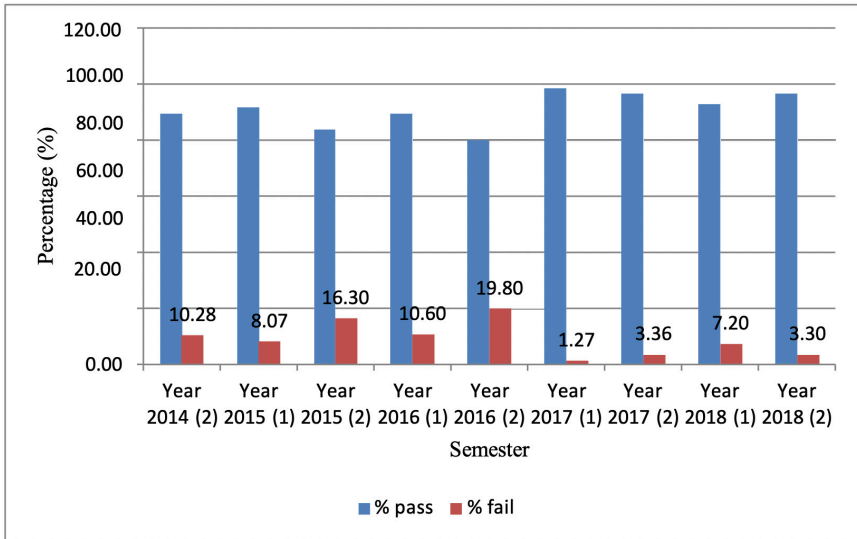


Fig. 4. Students' performance for soil science course from year 2014 to 2018

CONCLUSION

Teacher-centered learning environment with a presentation from the course neither promotes learners' participation nor build the required level of reasoning among students. Combination of active learning methods in soil science course significantly improved students' academic performance. Thus, teacher should create an atmosphere of interactive learning in classroom to enhance students' development and experiences as well as students' academic performance. Through this active learning also improved the other soft skill or competencies such as teamwork and collaboration, readily valued by employers which also can increase employability among graduates.

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