Using Outdoor Activity to Enhance the Understanding of Science Concepts among Students from Non-Science Background

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Abstract—*University programmes such as Technology Management programme requires students to be exposed to certain science or engineering related courses such as Engineering Science irrespective of their background. The lack of exposure to such courses often poses challenges to both teachers and students in the teaching and learning process. This paper, therefore, examines the influence of learning object and learning activity on the understanding of science concepts by non-science students. The experiment was performed using two groups of students in Technology Management programme in a Malaysian university. While the first group of students, in the first semester, were not engaged with learning object and sporting activities that demonstrated the concepts of speed, distance, and displacement, the second group of students were fully engaged with it in the second semester. The performance of students who were not engaged was compared with the performance of the engaged students. The descriptive statistics and analysis of variance were used to determine the differences between the students' performance in the first and the second semesters in Engineering Science course. The result showed that students' performance in the second semester after being engaged with the learning of object and sporting activities was better than the performance of the first semester unengaged students. The analysis of variance also showed a significant difference. The findings of this study suggest that engaging students with relevant learning objects or activity can enhance their understanding and facilitates knowledge transfer.*

Keyword—Physics concepts; Teaching & Learning; Outdoor Activity; Engineering Science

INTRODUCTION

Teaching science related courses such as Engineering Science (physics) to a group of university students having no science background can be very challenging. Likewise, the students do find it very difficult in comprehending the knowledge to be transferred to them. Teachers who find themselves in such a situation have to devise innovative means of transferring the knowledge to the students for learning to take place. As a result, there is a fast growing interest among researchers on new pedagogical style and learning approaches to provide a more student-centred environment (Bannan, Cook, and Pachler, 2015; Beetham and Sharpe, 2013). However, each approach may be applicable to a specific set of students and environment. While the use of mobile phone may enhance the transfer of knowledge and knowledge construction (Kearney et al, 2015), Science and Engineering related courses such as Physics would require actual operation through outdoor activities to enable students easy acquisition of knowledge among the students (Vygotsky, 1978). In addressing the challenges of teaching Engineering Science (physics) to a Malaysian university undergraduate students of Technology Management programme having no science background, this article compared the academic performance of students in two groups. The first group in the first semester were not engaged in any outdoor activity. The second group in the second semester were engaged in outdoor activity related to the Engineering Science (Straight line motion in Physics).

2 LITERATURE REVIEW

Recently, scholars have increasingly focused on the best teaching methods that provide effective transfer of knowledge to the students. This concern has prompted the search for alternative teaching approaches that complement the traditional method of teaching. One of such common alternative approaches is the student-centred learning that empowers students to take charge of their learning process.

In promoting a more student-centred learning approach and minimising traditional teaching method also known as the teacher-centred learning approach, UNESCO (2012) and Christensen & Knezek (2018) pointed out the need for an instructional paradigm shift as a means to achieving a fundamental change in the way students learn. The student-centred learning is in line with the Vygotskian's (1978) classroom principles which anchor on the on social constructivism theory. It suggests that ''Learning and development is a social, collaborative activity'' and ''Classroom activity should be reality-based and applicable to the real world'' (Vygotsky, 1978). In the same line of reasoning, Lave &Wenge (1998) and Brown (1991) stated that learning should be a processes by which people share ideas and strategies to build solutions and innovations as they interact. Teaching experience has shown that students will likely interact or come together as a group when they are engaged through group assignment or projects.

Engaging students outside the classroom enables them to acquire a comprehensive knowledge through experience which becomes indelible. In this type of learning, academic knowledge or information is not acquired from only a source such as text books; learning is rather interiorised to enable students generate their knowledge through individuals' experiences (Costa, 2015).

Beyond the traditional teaching and learning which anchors on teacher-centred approach, classrooms should rather be a place for constructivist activities and communities of practices (Atif, 2013). In essence, classrooms can also be used to engage students with activities that can enhance their learning process as well as transferring of knowledge. Therefore, using the traditional teaching alone as a means of transferring knowledge to the learners has been challenged by scholars. This practice has been largely criticized because it is known to present concepts that can be found in standard textbooks and does not provide opportunity for learners' engagement and experience in a classroom (Atif 2013).

Past studies have shown that a single type of student centred learning might not be necessarily the best practice for a particular group of students or all fields of study. Consequently, scholars and educator have continuously been in search of the best approach and style to use for transferring knowledge to any particular group of students. Wang Jou, Lv, and Huang (2018) separately examined the influence of model-based flipped classroom supported by modern teaching technology on students' overall performance in communication and cooperation, application and learning, curriculum learning, and participation. The model-based flipped classroom supported by modern teaching technology provided significant improvement and academic performance.

The Flipped classroom practice reverses the two phases of knowledge transfer and knowledge construction that take place in any traditional education process. While knowledge transfer happens when teachers teach, knowledge construction happens after the class but can only be achieved when the students do assignments, homework, actual operation or practice. In essence, knowledge construction among students in the traditional education system will largely depend on the extent of their engagement through practice. In the same vein, Resnick (1987) affirmed that the means by which learner's process, absorb, and apply learned knowledge is largely dependent on the methods of using existing knowledge, experiences, and cognition to interpret new external information on the part of the learners.

In Flipped classrooms, knowledge transfer happens after the class and knowledge is constructed in the classrooms. The former is achieved with the support of information technology while the latter is completed in classrooms with the help of teachers and fellow classmates. The practice of flip classrooms aims to improve the students' acquisition of knowledge, increasing opportunities for knowledge construction and reducing the difficulties encountered in the learning process (Wang et al. 2018).

The free fall motion experiment has advanced our understanding of the mechanism of knowledge construction among students. The outcome of the experiment suggests that while students may physically demonstrate new and correct scientific constructed concept, their knowledge will not be reconstructed. The students will instead activate correct concepts while suppressing existing preconceptions after accepting the new knowledge (Petitto, Holowka, Sergio, Levy, & Ostry, 2004). This experiment has demonstrated that for the knowledge construction process to happen, pre-conceptions must be suppressed without any disruptive reconstruction taking place. Hence, the routes of constructing knowledge involve the process of assimilation or accommodation. Knowledge construction has been described as progressive suppression of previous impressions similar to the processes of assimilation and accommodation. Knowledge construction is not a sudden transformation, but a constant and gradual process (Wang, Lv, Jou, & Zhang, 2016).

Unpinned by the cognitive-development theory, assimilation has been described "as the process by which new external stimulus is incorporated into existing cognitive structures of an organic entity and how new knowledge adapts to existing information; accommodation is where the host changes its own cognitive structure to adapt to new changes to the environment" (Wang, Lv, Jou, & Zhang, 2016).

3 METHOD

3.1 Procedure of Outdoor Activity

Students were instructed to download a recorded football match of their choice from YouTube. Prior to watching the football match, they were asked to draw a football field to scale on an A4 paper. While watching the football match, they were told to concentrate on any kick of the ball or shoot that led to scoring. The position of the footballer that kicked or shot the ball was marked on the A4 paper. The time the ball was kicked and entered into the goal post was recorded. The approximate distance of the ball from the point of kicking to the goal post was obtained by marking the similar point physically on a real football field and measured physically using a tape rule. The speed of the ball was obtained by dividing the distance of the ball by the time it took the ball to reach the goal post. The difference between the ball displacement and distance travelled by the ball was obtained.

3.2 Data Collection

The collected data were the end of semester results for two semesters. The two semesters were labelled Semester A121 and A122 based on the actual semester code used by the university in which the research was conducted. In semester 121 (first semester), the students were taught in the classroom but were not engaged in outdoor activity like it was done in semester 122 (second semester). The end of semester result constituted 60% coursework (assignments and test). The remaining 40% was for the end of semester examination.

4 RESULTS AND DISCUSSION

4.1 Results

The end of semester results of the 115 students in semester

A121 comprising 47 students (40.9%) and A122 semester comprising 68 students (59.1%) were analysed using descriptive statistics. As shown in Table 1, the comparative results of the two semester students indicated that in semester A121, no student score "A+", 17.1% scored "A', 19.1% scored "A-", 19.1% scored "B+", 17% scored "B", 6.4% scored "B-", and 17% scored "C+". In semester A122, 5.9% scored "A+", 45.6% scored "A", 16.2% scored "A-", 20.6% scored "B+", 4.4% scored "B", 2.9% scored "B-" and only 1.5% scored "C+".

Table 1: Examination Results of Two Groups of Students

Grade	A121		A122	
	Frequency	Percentage	Frequency	Percentage
A	8	17.0	31	45.6
A-	9	19.1	11	16.2
A+	-	-	4	5.9
B	8	17.0	3	4.4
B-	3	6.4	2	2.9
B+	9	19.1	14	20.6
C	1	2.1	1	1.5
C-	-	-	1	1.5
C+	8	17.0	1	1.5
F	-	-	-	-
X	1	2.1	-	-

Figure 1 depicts the mean of the examination marks of Semester A121 and A122. The course work accounted for 60 percent of the overall semester result and the remaining 40 percent was the final exams. Both coursework and final exam amounted to 100 percent of the total mark.

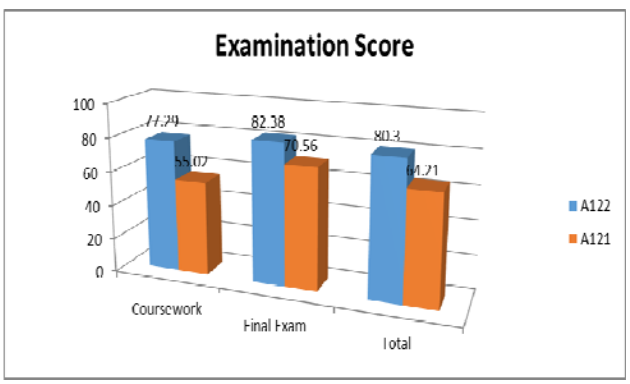

Figure 1: Mean of Semester A121 and A122 Results

For the coursework, results indicated that students from semester A122 semester had the highest average score (mean=77.29) compared to the other groups of students in semester A121. Similar results was also found on the final exams in which the students from the same semester A122 scored the highest marks (mean=82.38) compared with A121 (mean = 70.56). Overall results also indicated that students from A122 semester had the highest score (mean=80.30).

Figure 2 presents the percentage of the various grades among the students in semester A121 and A122. The percentage of the students in Semester A121 that scored "A" and "A-" was 36.1%. The percentage of the students that scored grade "B+" was 19.1%. Grade "B" was 17.0% and grade "B-"was 6.4%. A better result was produced by students A122 in which 5.9% scored "A+", 45.6% scored "A" and 16.2% scored "A-".

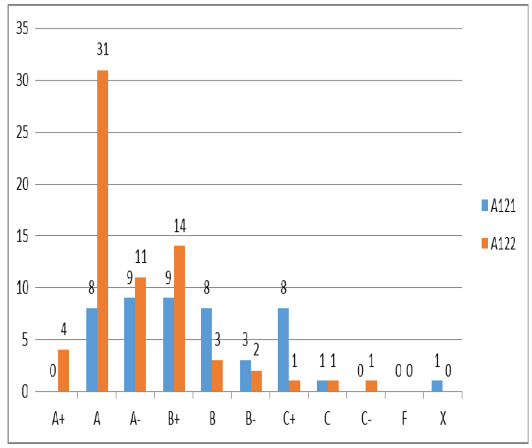

Figure 2: Frequency of the various grades in semester A121 and A122

Table 2 presents the mean score of the examination marks. The final semester results consisted of 60 percent of coursework (assignment and test) and 40 percent from the final exams. In semester A121, the mean score obtained was 77.27% which accounted for 66.37% of coursework. In the end of the semester examination, the mean score was 55.02% which accounted for 22.01% of the final semester examination. In semester A122, the mean score was 82.38% which accounted for 49.46% of the coursework. Mean score in the end of semester examination was 70.56% which accounted for 28.22% of the end of semester examination. The total mean score in semester A122 was 77.75% compared with 68.49% in semester A121.

Table 2: Mean of Semester A121 and A122 Results

	Mean	
	A121	A122
Coursework	77.29	82.38
60 percent	46.37	49.46
Final Exam	55.02	70.56
40 percent	22.01	28.22
Total (100%)	68.49	77.75

Table 3 shows the comparison of the mean result and independent sample t-test to examine the differences between the performance of the two groups of students in semesters A121 and A122. For the coursework, results indicated that students' performance from A122 semester had the highest average score (mean=82.38) compared to the other group of students in semester A121. Similar results in the final exams revealed that the performance of students in semester A122 had the highest score (mean=70.56). Overall results also indicated that students' performance from semester A122 had the highest score (mean=77.75). Result of independent sample t-test indicated statistical significant differences between the result of semester A121 and A122. The overall results were as follows: coursework (t=-2.833, p<0.01), final exam (t=-4.563, p<0.01) and total score (t=-4.438, p<0.01).

Table 3: ANOVA for Semester A121 and A122 Results

	Semester (mean)		T	Sig.
	A121	A122		
Coursework	77.2851	82.3825	-2.833	0.005
Final Exam	55.0213	70.5588	-4.563	0.000
Total	68.4894	77.7500	-4.438	0.000

4.2 Discussion

The higher academic performance demonstrated by students in semester A122 suggests that the sport outdoor activity that was used to engage the students has a significant impact on their learning and knowledge construction. The highest and lowest grade scored in both semester are four (4) "A+" and three (3) "C- to C+" grade in semester A122 compared to Semester A121 in which no student scored "A+" grade and a total of 9 students scored the "C to C+" grade. It can therefore be inferred that outdoor activities can enhance students' learning process. The findings of this paper complement the existing body of knowledge on the impact of outdoor activities on students learning process (Lave & Wenge, 1998; Brown, 1991; & Costa, 2015).

5 CONCLUSION

This paper has advanced our understanding on the impact of using outdoor activities to enhance students' learning process. This paper has demonstrated that students with no science background can still be taught basic science concepts by incorporating outdoor activities into their learning process. This paper has demonstrated that the engaged students in semester A122 performed better than the unengage students in semester A121. The difference in the class size of the students in semester A121 and A122 is a major limitation to this paper. Future research could examine the same set of students to minimize the diversity among two groups of students.

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