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Environmental Sciences Students' Achievements via Conventional and Technology-Based Instructions

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Abstract

This study is about the roles of instruction through technologies on the students' academic performance in Environmental Sciences subject. Totally, 60 sophomore of a Malaysian public university were selected based on convenience sampling. For data collection, students with close pre-test scores were chosen to be in the same group. For data analysis, SPSS assisted to calculate the mean, standard deviation and independent sample t-test. Based on statistical analysis, technology-based instruction affects students' academic achievement positively and they find it more effective in teaching Environmental Sciences compared to conventional approaches. It is highly suggested that teachers put more efforts into teaching by means of technologies to Environmental Science students to help them improve their academic success.

Keywords: Environmental Science, Conventional Instruction, Technology-Based Instruction, Academic Achievement

1 Introduction

Today many schools use technologies in instruction to help students cope easier with the digital era we live in [1]. This approach to use instructional technologies can enhance the full-time availability, inclusion and standard of education. Therefore, the path of success in education passes through the use of modern technological facilities. Information and Communication Technologies (ICT) develop the educational standards by focusing on learning through discussion, delayed time discussion, directed instruction, self-learning, critical thinking, data seeking and analysis [2]. ICT can also improve output, results, administration, instruction, research skills and make significant abilities in students [3].

ICT use is necessary in instruction since it lets both teachers and students use, save or manipulate, data to develop their self-regulatory and active learning skills [4]. Instruction with technologies includes a huge tendency to collaborative learning among both teachers and students. Such a collaboration is not in line with the conventional instructional method. Distance learning gives motivation to both students and teachers to study more even when the class is over [5]. ICT can also help teachers to develop teaching materials and lesson plans [6]. As a result, ICT super-fast development revolutionized education and learning.

In fact, ICT is the tool that lets students learn more effectively through using various sources of information and communication technologies. Such facilities assist students to have a bird's eye view and in depth insight towards different issues. ICT transforms complexity to simplicity and hence comprehensible materials for an easier learning process by simulations of difficult to understandable contexts. Therefore, ICT is a catalyst in fast learning and higher quality of instructional improvements, which by its turn leads to critical thinking and full-fledged understanding [7]. In order to improve the learners' academic achievements, the educational system has to shift from conventional methods of teaching to modern technological methods. The efficient fact about Computer Assisted Instruction (CAI) is that it is not limited to time and place. In fact, it helps learners to study at any time any place with any gadgets accessible to them. This helps interactivity, which personalizes the learning process for students based on each person's needs and learning rate. CAI offers the opportunity for the learners to adjust the learning rate based on the speed that they learn, which is impossible to do so in the traditional style. Therefore, ICT can help to bound low academic performance and on the other hand facilitate instruction.

The results of this study verify the helpfulness of using ICT in teaching environmental sciences. Results also prove that instruction through ICT is more fruitful than the conventional method. Moreover, results confirm the effective use of ICT in achieving higher scores and performance while motivating the students in environmental sciences. Based on above-mentioned advantages of ICT rich instruction, the objective of the study is to investigate the role of ICT on environmental science university students' academic achievement.

2 Review of Literature

Since ICT develops rapidly in every aspect of life, educators and researchers also thought of utilizing such devices in order to assist learners to learn more effectively. Technologies used for instructional purposes provide a more effective learning situation for the students, motivate them and develop more interest in them and as a result help to build up the student centered approach [8]. Since learners are the most important factor in the process of learning, technologies have to be used in the most proper way to construct meaning and understanding for learners [9]. ICT offers chances to the students to learn concepts more smoothly and develop their faculty more diligently with a higher quality. The question raised when researchers wondered if appropriate learning technologies are useful in teaching as well and if such technologies can be based on both teaching and learning

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theories. The best learning outcomes are drawn if a combination of conventional and technology enhanced approaches merge together to build an integrated multi-dimensional principle based on learning theories of technology and constructivism [10]. It was then that researchers poised the computer assisted learning and teaching. In such a context, students are able to design and make their own decisions as an autonomous learner and therefore develop their creative, collaborative, and problem solving skills. In technology based instructional context, learners can evaluate themselves, assess their own progress, criticize their own flaws and enjoy their progress by self-identification of their own performance and achievements [8].

The quality of education can improve by using technologies since technologies provide many opportunities for the students to stimulate them to learn what they are interested in more [11]. Students learn and understand better and more confidently when they are exposed to use technologies in their process of learning [12]. This can help students to be successful and achieve higher performance.

For an effective ICT integration to instruction, some points should be taken into consideration by teachers such as teachers' experience, their education and attitudes, their ICT literacy, computer self-efficacy, professional development, leadership support, technical support, availability, pressure to use technology, government policies about ICT education and technological characteristics [13]. Buabeng-Andoh, [14] studied about factors that affect ICT use and its integration to performance improvement and categorized three different types of barriers in ICT use including teacher level, school level, and system level. The first level of obstacle is related to teachers. They mostly have a low level of competency in ICT use. Teachers are not confidant enough about using ICT. The number of professional teachers who are able to use ICT is limited and there are not many programs that train qualified teachers to learn more about ICT use in classrooms. The second level of difficulty is related to schools. Many schools lack effectively enough infrastructures for administrating ICT at school, even those facilities that they may have, need maintenance or updating. Many schools still need instructional programs or softwares. ICT is not available in many schools and line accessibility is still like a dream to many places. Many schools lack enough projects that are related to learning and understanding. The other important factor is at the system level, which still follows traditional educational systems, curricula and organizational structures. Any of these drawbacks are solvable if we can estimate which factor is the most impeding one to be able to handle it correctly.

Genlott and Grönlund, [15] identified how ICT can be effective in Mathematics instruction at the secondary level. The result was that ICT is an effective factor in teaching Mathematics, while it was compared to traditional way of teaching. Skryabin, et al., [16] also found out that ICT has a positive contribution to student academic performance in science. Carrillo, et al., [17] did a similar study and found that ICT helps students to perform better and achieve higher marks in Mathematics but it is not as effective in language exams. However, Ebrahimi, [18] found that ICT can help in reading English texts. Ghavifekr and Rosdy, [19] came to the conclusion that teaching through ICT is mostly more effective and successful than the traditional teaching approaches and it helps students to achieve higher marks. Krause, et al. [20] found that using ICT is helpful in getting higher scores of chemistry and students and teachers also perceive its effectiveness.

Jamali, et al. [21] reviewed the use of ICT in computer assisted project-based learning in STEM (Science, Technology, Engineering and Mathematics) classes and found that since educationists decided to use ICT in their classrooms, students showed a higher performance and could understand scientific concepts easier and deeper. Additionally, Subramaniam, [22] proved that ICT and especially computers are helpful tools in teaching and learning science and helps students to get better outcomes. Moreover, students' attitude towards learning through computer assisted project-based learning was positive in learning science subjects [23].

In case of technology use on environmental studies also studies affirmed the same results. For example, [24] and [25] confirmed that technological game-based teaching of environmental sciences is an effective approach to teach and learn the concepts. Lane, [26] also showed the drastically high satisfactory level of most teachers and environmental science students using new technologies.

3 Methodology

Pre-test Post-test Equivalent Group Design was used for this experimental study. Participants in this study were categorized to equivalent experimental and control groups according to their pre-test scores.

3.1 Sample

Since a similar study was done on Malaysian high school students [27] , the researcher decided to choose the population for this study among environmental engineering undergraduate students in a public university in Malaysia. This study used few units of environmental sciences such as water treatment, soil enhancement, and air pollution in order to evaluate respondents' performance. The top sixty students including 33 females and 27 males were selected as samples among 95 students who were tested initially. Pre-test comprised of 50 multiple choice questions to evaluate students' knowledge at the pre-test before treatment. Participants were categorized in two equivalent groups of 30 students in each of experimental and control groups.

The students participating in this study were normally distributed, because they were from the same university, studying for their second year of environmental sciences on undergraduate level. In addition, to enter this course, students had to sit for a pre-test to be chosen to participate in this study. They were the ones with higher marks in the pre-test, who could succeed to participate in this course. Therefore, they were normally at the same level of knowledge before the course. The students were carefully arranged to be at the two classes based on their marks in a way that the classes were homogeneous in terms of the normality and similarity of students' level.

3.2 Instrument

The pre- and post-tests were constructed to measure the prior knowledge of the students and compare it with their knowledge after the treatment. Three experts in the environmental science department confirmed the validity of the test. Moreover, Spearman-Brown Prophecy which was 0.88 showed the reliability of the research tool. The level shows the reliability of the test and that it was in the statistical ranges.

3.3 Procedure

To control secondary variables, the same lecturer was selected meticulously among the lecturers of the environmental department with the high qualification and experience to teach both the treatment and control groups. The lecturer was an associate professor with about fifteen years of

teaching experience at a public university. In addition, she graduated at the same university and has been working at different research groups on different environmental projects for years. Moreover, she was marked as an excellent teacher by the students of the previous semester through the university online evaluation system for the lecturers.

Before the experiment, the researcher arranged a meeting with the lecturer to let her know the purpose and the procedure of this study. The lecturer was told that it was essential for the validity of the study that she could not be biased or influential in the results by providing different information, exercises, or assignments to the two groups. In fact, in that session the content of the course was elaborated to the lecturer and she was asked to teach the same topics such as water treatment, soil enhancement, and air pollution on the same order to the students of the two classes. The goal of the classes was to teach environmental sciences to undergraduate students. So learning the content knowledge was priority in this classes. By having the same topics, the same timing, the same lecturer, similar students, and the same pre – and post-tests, the researcher was able to measure which method is more effective in teaching: conventional or ICT-based instruction. Figure 1 shows the procedure of this study in details.

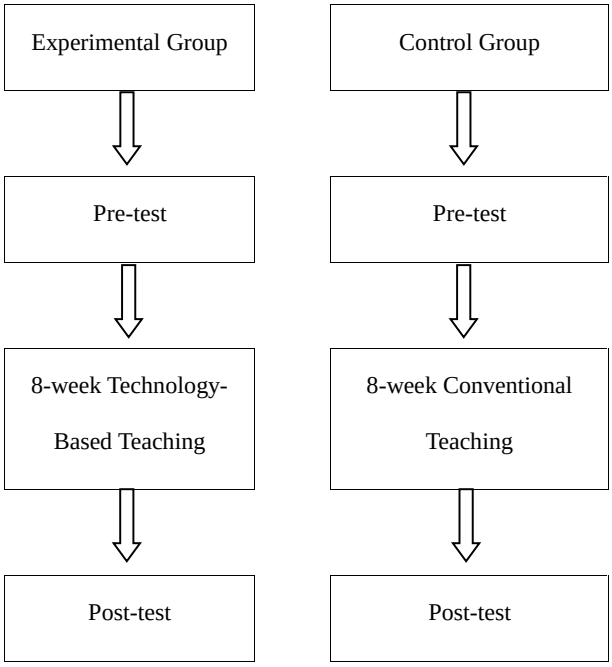

Figure 1: Procedure of the Study

In the control group, the traditional method was applied. In this class, the lecturer mainly used the textbook and the board to explain the materials. She provided students with some assignments to be done in the classroom as their class activities and tasks. Students had to discuss in class with each other in person to find some answers for the assignments. They were not allowed to google anything or use their gadgets to search for answers. There was no extra assignment to be done after class to make sure that they are not using internet sources or other technologies to solve them.

On the other hand, in the experimental group the lecturer was asked to teach the course by using ICT. The ICT for teaching involved using emails, social media and Whatsapp group to be connected together 24/7. Moreover, students were provided with tablets to use in the classroom for their in-class activities and tasks. The same assignments that were used in the other group were being sent through email and students could discuss in the social media and Whatsapp group with peers and the lecturer. The lecturer used projector and slides in class to teach the content. After 8 weeks of the above instructions, the same post-test was organized for both groups at the same time.

4 Results

The objective of this study was to evaluate the role of ICT on the performance of university students in environmental sciences. This study was an experimental study in nature that was conducted and analyzed based on the results from descriptive and inferential statistics. Table 1 shows that the t-value of independent sample t-test was -0.412, which in $p>0.05$ is not significant because it is less than t-value at $p=0.05$. In addition, the statistical results show that there is not any pivotal similarity between the achievement of the two groups. The results in the pre-test reveals that in the control group, the mean was 69.39 and the standard deviation was 3.67, while in the experimental group, the mean was 69.17 and the standard deviation was 3.21. Therefore, the two groups' performance went on the normal curve distribution. Table 2 shows that the t-value of independent sample t-test was 15.628, which in $p<0.05$ is significant because it is more than t-value at $p=0.05$. Moreover, the statistical results show that there is not any pivotal similarity between the achievement of the two groups. The results in the post-test reveals that in the control group, the mean was 70.18 and the standard deviation was 3.56, while in the experimental group, the mean was 89.37 and the standard deviation was 3.24. Additionally, the results show that the experimental group students achieved higher marks compared to the control group students.

5 Discussion

Technologies and therefore instructional approaches to teaching and learning is evolving day after day. The role of technological improvements and their assistance in teaching and learning lead to positive outcomes in societies where chose to use them as facilitators in the process of learning and teaching. The aim of this study was to understand the role of ICT on undergraduate environmental sciences students' academic achievement. Students' results on the pre-test shows that both groups performed similarly before the experimental treatment. In case of the students' performance after the treatment, it is inferred that those who went through the ICT instruction received higher marks and achievements in comparison with those who studied under the conventional teaching approach. These results are the same as what [16] found out that ICT can improve students' achievements.

Table 1: Difference between the pretest achievement scores of experimental and control groups

Groups	N	Mean	St. Dev.	SE	Mean Diff	t-value	p-value
Control	30	69.39	3.67	0.98	-0.22	-0.412	0.632
Experimental	30	69.17	3.21				
Insignificant	df = 58		t value at 0.05 = 2.0106				

Table 2: Difference between the posttest achievement scores of experimental and control groups

Groups	N	Mean	St. Dev.	SE	Mean Diff	t-value	p-value
Control	30	70.18	3.56	0.97	-19. 19	-15.628	0.000
Experimental	30	89.37	3.24				

*significant df = 58 t value at 0.05 = 2.0106

Similarly [28] found that ICT use in instruction helps students' performance and scores in science. Similarly, [29] affirmed that ICT can improve students' performance and scores. Hussain and Suleman, [30] concluded that students achieved better results when they went under instruction through ICT compared to students who went through conventional method of instruction. Likewise, [31] concluded that ICT helps students to process data better and understand the subject deeper, also he continued that their comprehension and memory improved by using technologies in their instruction. Chao, et al. [32] found that teaching and learning via ICT can lead to more compelling and effective results and achievements compared to traditional methods. On the other hand, few researchers reported that ICT had no effect on the scores or achievements of their participants and that there is no significant relationship between ICT use and students' academic achievement [33].

All in all, based on the findings one can easily infer that technology based instruction can be an essential method in improving our today's educational systems. Nowadays, students prefer to even learn through ICT and we as teachers cannot resist to their preferred way of learning. Specialized university students are not exceptions and this study proves that the young generation is so much interested in technology and its usage in their educational environment. In case of this study, which is contributing to environmental sciences teaching, it is proven that university students doing their major in environmental sciences are keen to use technological devices in and out of their classes to enjoy and learn their lessons more efficiently.

6 Conclusion

In the twenty-first century, the fast ICT development has brought a revolution into societies and has affected people's needs. Accordingly, ICT significantly influences education and instruction. Findings of this study show that in case of environmental sciences students, ICT integrated classes assist students to achieve better results and improve drastically in their studies. Using ICT approach turned to be more promising in teaching environmental sciences students.

As a result, it is recommended that lecturers are better to use ICT in teaching environmental sciences. It is even more rewarding in case lecturers in environmental sciences get more trainings to familiarize them with ICT use in instruction. In this regard, universities can be great helps in assisting their lecturers to get proper ICT skills, programs, and devices. In short, universities and the educational systems are recommended to improve their infrastructures so that both students and lecturers can benefit from the technology-based instructions.

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