

5E INSTRUCTIONAL MODEL IN BLENDED LEARNING PLATFORM: EFFECTS ON ACHIEVEMENT AND ATTITUDE OF HIGH SCHOOL STUDENTS IN CHEMISTRY

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ABSTRACT: 5E model of instruction is known to provide a good effect on students' performance in science. This study presents the results of a quasi-experiment conducted to compare the effects of the 5E instructional model and 5E in a blended learning approach to 86 Grade 9 students' academic performance and academic attitude towards science. The groups' academic achievement was evaluated using a researcher-made instrument designed and validated to capture the competencies identified by the Department of Education. Academic attitude towards science was measured using an adapted questionnaire. Results indicated that although there is a significant difference in the test scores between 5E in blended learning platform and 5E model alone, attitude towards learning science did not differ significantly between 5E model versus 5E in the blended learning platform. Students' responses to an open-ended question relative to their experience in a blended learning platform revealed that they like to learn chemistry using online resources as this allows them to go through the materials at their own pace.

Keywords: blended 5E, learning management system, attitude towards learning chemistry, chemistry achievement

1. INTRODUCTION

There has been growing evidence that integrating technology in the classroom provides positive effects on student's achievements and academic performance. An analysis of newer educational technology where students have access to, such as computer-assisted instruction, or integrated learning systems technology, or simulations and software that teaches high order thinking, or collaborative network technologies, or design and programming technologies, shows the positive gains in achievement on researcher's constructed test, standardized test, and national test. Blended Learning Models place the student in the center of the learning process and harness the power of technology to create more engaging, efficient, and success-oriented learning environments [1].

Nowadays, students who are enrolled in high schools are exposed to the use of technology and the Internet. Online browsing and learning is likely the popular choice of students in a non-academic and academic setting. However, students who learn purely online do not have the same opportunities to interact face-to-face with their teachers or peers. While online students can substitute video and interactive simulation features for classroom instruction, some accountability can be lost. Students in online programs require self-efficacy to complete course work on their own [2]. Online learning may be incorporated with face-to-face interaction with the teacher and with their peers in order to manage well the learning of the students. This study is aimed at evaluating the effect of the 5E model and 5E in blended learning platforms on Grade 9 students' achievement in chemistry and academic attitude.

2. BRIEF LITERATURE

There are well-documented studies of declining motivation in science and science careers in secondary schools [3, 4, 5] This problem arises for varied reasons. As stated by an international review carried by International Council of Associations for Science Education (ICASE) and the Australian Science Teacher Association (ASTA) with the support of UNESCO, comparing secondary school students' views of science with other subjects, these associations had reached a clear conclusion on why students might lose

interest. The first reason is that science teaching becomes predominantly transmissive as learning science is simply like a sponge that soaks up knowledge coming directly from teachers or from the textbook. The second reason is that scientific knowledge is dogmatic and correct like there are no faulty facts in science. And lastly, the content of school science has an abstractness that makes it irrelevant, uninteresting and unrelated to student's lives.

It is, therefore, vital that educators should increase the interest of students in science through changing pedagogical approach with the use of technology where 21st-century learners are usually well-adept of using it. Science teachers can motivate students in different levels of educational stimulation with computers such as videos, presentations, and simulations that pique the interest of students.

Blended teaching approach, which uses video assignments in advance of each class to stimulate interest in the topic and provide foundational knowledge, coupled with lectures having in-class problem solving, is a more effective strategy for science education compared with traditional approaches [6]. Blended learning is effective in education, especially in higher education if the advantages of a web environment are blended with face-to-face interaction in courses that contain more visual elements. [7]. It was also found out that the simulations are more effective in delivering the concepts than visualizations due to the interactive nature of their development [8].

The 5E Instructional Model [9] can be used to design a science lesson, and is based upon cognitive psychology, constructivist-learning theory, and best practices in science teaching. The 5E model consists of cognitive stages of learning that comprise engage, explore, explain, elaborate, and evaluate. The model can be the organizing pattern of a sequence of daily lessons, individual units, or yearly plans.

The computer-based blended learning approach is found to improve students' retention in chemistry [10].

A meta-analysis found that, on average, students in online learning conditions performed modestly better than those

receiving face-to-face instruction. The advantage over face-to-face classes was significant in those studies contrasting blended learning with traditional face-to-face instruction but not in those studies contrasting purely online with face-to-face conditions [11]. However, due to the complexity of blended learning, it is suggested that explicit evaluation on awareness and reflection in blended technology-enhanced learning be considered [12]

3. METHODOLOGY

The study used the quasi-experimental design where two intact groups of high school students enrolled in a public school were randomly selected as participants of the study. One group was considered experimental while the other was the control. In the experimental group, the lessons were taught via the 5E in a blended learning model, while in the control group, the lessons were given via 5E instruction alone.

3.1 Participants of the Study

The participants of the study are 86 Grade 9 students enrolled in a public high school. These students belong to intact groups and were randomly selected among the available Grade, 9 classes.

3.2 Data Gathering Procedure

In this study, quantitative and qualitative data were collected. To collect quantitative data, the student's achievement on the pre-test and post-test results were evaluated. To gather qualitative data, a survey was made on student attitudes to chemistry learning and students were asked to answer an open-ended question relative to their online experience.

The instruction was delivered using a blended learning approach that provides face-to-face instruction with an online component in every lesson. Face-to-face class time consisted of teacher-led discussion, whole group question and answer sessions, one-on-one teacher assistance, and student group activities. The online component provided additional resources and support for students outside of the face-to-face environment. If students missed class they used online resources to catch up and submit assignments. The online learning was offered through the schoology.com learning management system. Online resources provide clear guidance to supplement to the face-to-face learning and include videos and web sites to reinforce face-to-face content, course resources (e.g., lecture PowerPoints), and provide teacher communication and feedback of assignments, quizzes, and discussion post.

A control group was used in this experiment. The control group was students under 5E instruction alone. The lessons were taught via face-to-face learning in the classroom environment and no access to online lessons. Following the intervention, post-tests were provided to both groups.

3.3 Statistical Treatment

To describe the data, descriptive statistics were employed such as mean and standard deviation Analysis of Covariance was used to analyze the data collected from the achievement test and academic attitude.

3.4. Research Instruments

3.4.1 Chemistry Achievement Test

In order to measure the students' achievement in chemistry, achievement test appropriate to the knowledge and comprehension in the cognitive domain was developed considering the learning competencies prepared by the Department of Education. For the purpose of developing the achievement test, an achievement test composed of 50 multiple choice questions was developed guided by a Table of Specification (TOS). This achievement test in chemistry was piloted to 50 students in 10th-grade students enrolled in a public high school. Item analysis was then conducted. Test items with discrimination index from 0.3 to 0.5 were retained, while those with the item discrimination index lower than 0.2 were excluded. In addition, the achievement test was evaluated by three science teachers who have at least five years of teaching experience in science. In line with the suggestions of the 3 science teachers, the necessary revisions were made, and the achievement test was finalized for the study.

3.4.2 Scientific Attitude Test

The science attitude questionnaire consisted of 20 questions adapted from Test of Science-Related Attitudes (TOSRA) by the works of Fraser (1978) on the development of a test of science-related attitudes. This test contained a number of statements about science and the students were asked what they think about these statements. The responses on the questionnaire was a range of 1 to 7 scale. 1 is assigned as "strongly disagree" and 7 as "strongly agree". 1 represented the lowest and most negative impression on the scale, 4 represented an adequate impression, and 7 represented the highest and most positive impression.

4. RESULTS AND DISCUSSION

Results indicated that both groups of students are comparable in terms of their knowledge in chemistry as demonstrated by their pretest scores. The posttest scores show that the students in the 5E blended learning platform performed better than students exposed to 5E model alone.

Table 1. Achievement Tests Results of the Students

Methods of Teaching	N	Pretest		Posttest	
		Mean	SD	Mean	SD
5E Model	40	13.40	3.177	28.62	5.69
5E Blended Learning Platform	46	12.96	2.804	32.43	5.68

In order to determine whether there was a significant difference in the achievement test scores between the 5E group and the blended 5E group of students, and Analysis of Covariance (ANCOVA) was used. Statistical analysis showed that achievement test scores of the 5E group and blended 5E group are significantly different as shown in the findings presented in Table 2 below.

Table 2. ANCOVA Results on Students' Achievement

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	431.640 ^a	2	215.820	6.912	.002	.143
Intercept	2607.825	1	2607.825	83.520	.000	.502
group	338.417	1	338.417	10.838	.001	.116
Error	2591.581	83	31.224			
Total	83881.000	86				
Corrected Total	3023.221	85				

a. R Squared = .143 (Adjusted R Squared = .122)

5E in the blended learning platform is a good teaching strategy or approach in teaching science subjects. The activities given online with face-to-face instruction from the teacher were proven to help the students exercise their understanding of the given materials as evaluated from the results in both pre-test and post-test. The links, doc files, simulations and games are given in the learning management

platform in the 5E blended learning approach were proven to motivate the students to enhance their learning in chemistry concepts. Moreover, the uploaded videos also become another learning resource for the students. Referring to the students' open-ended questionnaires given to them after the treatment regarding 5E in a blended learning approach, students showed their appreciation to the teaching method by writing positive comments.

Examples of these comments are:

"It helped me by easily studying the lesson and also you can easily learn in it because of many sources of information."

"Online components contribute to my learning by giving full control. Also, it makes me work faster than I would do otherwise and take in more information"

In terms of academic attitude, the questions in the survey instrument are more about science related attitudes. The students' responses are centered on how they value science and the activities in the classroom. Table 3 indicated that the Grade 9 students' attitude towards science is somehow positive in both pretest and posttest.

Table 3. Over-all Means of the Academic Attitude of the Students

Methods of Teaching	N	Pretest			Posttest		
		Means	Interpretation	SD	Means	Interpretation	SD
5E	40	4	Positive	.401	4.10*	Positive	.357
Blended	46	4.13	Positive	.586	4.12*	Positive	.658

*0-1.75 – very negative attitude 3.6-5.25 – positive attitude
1.76-3.5 – negative attitude 5.26- 7 – very positive attitude

To determine whether there is a significant difference in the attitude of the students exposed to different treatments, an Analysis of Covariance was used.

Table 4. ANCOVA results of Students' Scientific Attitudes

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1.823 ^a	2	.912	3.341	.040	.075
Intercept	11.143	1	11.143	40.842	.000	.330
group	.005	1	.005	.020	.888	.000
Error	22.644	83	.273			
Total	1475.463	86				
Corrected Total	24.468	85				

a. R Squared = .075 (Adjusted R Squared = .052)

Results of data analysis using ANCOVA in Table 4 showed no statistical difference in the pretest and posttest of academic attitude responses for students under 5E and blended 5E strategy. This indicates that student attitude related to learning science remained unchanged. Attitude towards chemistry has been problematic among high school students. They considered chemistry as important but remained neutral in their response to pursue chemistry in the future [13]. There is a study that claimed positive effects of chemistry virtual laboratory on both achievement and attitude

[14]. However, there is low correlation between chemistry achievement and attitude [15].

5. CONCLUSION AND RECOMMENDATIONS

5E in Blended Learning Platform is helpful in improving the achievement of Grade 9 students in chemistry. This study, therefore, suggests that 5E in blended learning strategy could be applied in other subjects as it shows is effective in teaching science as well. Science teachers may pursue a guided online learning modality for students to provide a diverse and exciting learning experience to motivate students for science. Accordingly, the challenge in developing blended online learning courses is to find a combination of synchronous and asynchronous activities that leverage the technology affordances of each mode, are within the capabilities of instructors, and satisfy the preferences of learners[16]. Blended learning is the new direction for science instruction because digital technologies and the rapid emergence of new knowledge will impact the way our students learn [17] and it often results in better learning outcomes [18] and development of self-regulation and self-direction [19].

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