The Effect of ICT-Based Multimedia Use in Activities on Science Students' Achievement and Motivation in Learning

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ABSTRACT

It is evident from the research in education that integration of ICT-based multimedia in the learning process could improve students' achievement and enhance motivation to learn. The objectives of this research were to investigate the effect of ICT-based multimedia integration in classroom activities on students' achievement and their motivation to learn as against the effect of the use of traditional methods in students' activities. The design of the research was quasi-experimental in which 50 grade 7 students of a private school participated in this study. Two intact groups of 25 students were randomly assigned to the experimental group and the control group. Same pre-test was administered to both groups. Both groups were taught the same science lesson and students of the experimental group were assigned to carry out an activity using ICT-based multimedia and those in the control group carried out the same activity using papers and colours. At the end of the activity the same pre-test was conducted as the post-test on both groups. Motivational scale based on the Keller's ARCS model of motivation was administered on the experimental group to study the degree of motivation to use ICT-based multimedia to carry out activities. However, results indicated that there was no significant difference in achievement between students who did activities with ICT-based multimedia and those who completed activities using papers and paints.

Nevertheless, the motivation to use ICT-based multimedia in activities by the students who were engaged in activities of ICT-based multimedia was found to be high.

1. INTRODUCTION

Computer assisted instructional strategy will be more effective as the 21st century student is born with technology and is a digital native (Prensky, 2001). Many researchers have shown that multimedia involvement is the best method for teaching and learning process enhancing students' achievement (Kapri, 2017). Students will do better in school and be more interested if they can make PowerPoint presentations in class while learning. Multimedia in the same classroom setting engages students more. The effectiveness of students in the classroom may be improved by encouraging them to actively seek information and then offer it to their peers in the form of engaging video clips and images under the facilitation of the teacher (Sugeng & Suryani, 2018). Learning through Multimedia instructional formats shows more positive effects on the learner to understand concepts clearly and create a fun learning environment. According to Herrington (1995), there are guidelines to build multimedia applications for an effective education. Instructional paradigm will shift from passive to active giving more opportunities for practice to the learner. Learners with lower levels of expertise benefit more from the multimedia instruction than those with greater levels of knowledge (Mayer, 1999).

This student- centered method is important for better learning. The active learning process through students' presentations with multimedia engagement enhances their' achievement and motivation. This experimental research tries to find out if doing ICT-based activities in class that use multimedia methods improves students' achievement and motivation to learn. When creating a multimedia learning experience, the teacher's role changes from instructor to facilitator. When a session permits students to go through stages of learning at their own speed, classroom management becomes more challenging. This is especially true when students work together to explore multimedia sources or share computers. Furthermore, students who are not as tech-savvy may have to spend more time learning computer skills to obtain information rather than concentrating on course topics. (Sosnowski, n.d.). However, it has been found that over-dependance on multimedia and PowerPoint by the teachers may have negative effects on students such as difficulties in responding students' queries and addressing learning difficulties (Juan & Yahaya, 2019). Developing learning experiences that would motivate students to learn is instrumental in students' achievements. One model that could be used in designing instruction is ARCS (A: Attention, R: Relevance, C: Confidence and S: Satisfaction) model of motivation by Professor Keller. Drawing students' attention to learn, making learning relevant to their life, building confidence in learning and ultimately allowing them to be satisfied with their learning outcomes are addressed in ARCS model (Keller, 2008).

According to the Human Information Processing Theory, content knowledge received by a learner is semantically encoded in his long term memory as schema activity (Baddeley, 2001). For this schema to be concertized, the information should be retrieved from the memory and be used for a meaningful activity (Gagne, Briggs & Wager, 1992). In this study, it is investigated how e-learning methods could be more successful than traditional activities.

As in the Fig. 1 the conceptual framework of the study is illustrated as an influence of the instructional strategy used by the students in activities preceded by the exposure to the content of a lesson on their achievement score. The

independent variable has two levels: ICT-based multimedia use and paper-based traditional method. The dependent variable is students' achievement score based on the post test immediately after the activity. Prior knowledge students may have about the content acts as a moderator variable. The motivation to use ICT-based multimedia in doing activities is considered as an associated variable.

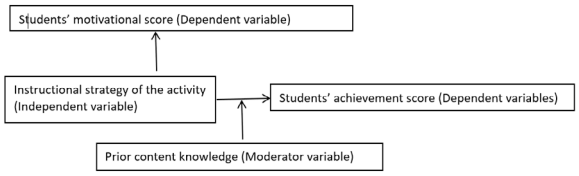

Figure 1: Conceptual Framework of the Study

1.1 Research Problem

Lack of a comprehensive assessment whether ICT-integrated multimedia-based activities and student-centered in-class activities enhance students' achievement and motivation in learning science compared to traditional methods.

1.2 Research Questions

1) Does teaching science using ICT integrated multimedia-based activities enhance students' achievement more than traditional methods of doing in-class activities?

2) Does the use of educational multimedia-based, student centered in class activities enhance students' motivation in learning science?

1.3 Objectives of the Study

1. To investigate whether ICT-based multimedia use in doing activities enhances students' achievements over the traditionally used methods.
2. To find out the effect of ICT-based multimedia use in students' activities on their motivation to learn.

Based on the objectives of the study the following hypothesis were formulated.

1. Students who learn science through activities using ICT-based multimedia obtain higher achievement scores than those who learn via paper-based science activities.
2. Students are highly motivated to do science activities using ICT-based multimedia.

2. METHODOLOGY

2.1 Research Design

The approach of this research was mainly quantitative but, qualitative data were also collected as observations while the participants were engaged in activities. The design of this research was quasi-experimental in which activity strategy was the independent variable with ICT-based multimedia and paper-based method as the two levels. The achievement score was the dependent variable. In addition to that survey method was also used to study the motivational effect of ICT-based multimedia on the participants.

2.2 Sample and Instruments

Convenient sampling method was used to identify the participants of this study. Two intact groups of 25 each (two parallel grade 7 English medium classes of a private school) were selected and experimental group and control group were randomly selected out of these two groups. A test paper of multiple choice and short-answers questions was used as the pre-test and the same test paper was used as the post-test in which the questions were reordered. A scale of 20 items, based on Keller's Instructional Material Motivational Survey (Keller, 2010) of Likert style was administered to measure the motivational effect. Observational notes were used to collect qualitative data.

2.3 The Method of Collection and Analysis of Data

In the first phase of the study, the pre-test was administered to both experimental and the control group on the content of the lesson "Internal structure of the earth" , a section of the 8th unit in the Grade 7 science curriculum. Then the same lesson was taught to both groups simultaneously using an instructional video as well. In the second phase, each group was subdivided into groups of 5 and assigned activity each based on the lesson taught. Each sub-group of the experimental group was directed to the ICT laboratory and instructed to build a multimedia-rich PowerPoint presentation on the lesson they were taught. Each sub-group of the control group were assigned the task of making a poster using cardboard and paints. The researcher observed the engagement of the participants in the activities and recorded on a field-book. The time allocation was 50 minutes end of which each group was asked to make a presentation of their artifacts. At the end of these presentations post-test was administered to all participants. The scale on motivation was administered to the experimental group only. The observations were analyzed by categorization of data using the Grounded Theory approach.

3. RESULTS AND ANALYSIS

The pre-test and post-test answer scripts were marked and total score for each participant was calculated. Then the scores were analyzed using inferential statistics. As the sample size was less than 30 in each group, Mann-Whitney U Test (https://www.socscistatistics.com/tests/mannwhitney/default2.aspx) was used to test whether the difference in means between experimental group and control group in the pre-test and in the post-test is statistically significant. The significant level applied was p=0.05, two-tailed. Returns of the motivational questionnaires were analyzed in terms of the motivational elements in ARCS model of motivation (Keller, 2010) by grouping the items of the scale to represent each element. The observations were analyzed by categorization of data into several aspects. The motivational scores are tabulated in Table 2.

Table 1: Inferential Statistics for pre-test and post-test

Test	Experimental Group: Mean(SD)	Control Group: Mean(SD)	P value	Significance
Pre-test	65.84 (18.29)	67.52 (19.94)	0.704	Not significant at p<.05
Post-test	75.6 (15.06)	72.4 (18.26)	0.589	Not significant at p<.05

Table 2: Analysis of Motivational Effect on Students

Motivational effect by Attention		
Item No.	Item	% of
1	Going to computer lab to learn science was a new experience	94
2	Creating PowerPoint presentations to learn science was a new experience	90
3	I like to repeat using multimedia strategies and learn through computer-based activities	78
4	I like to repeat doing group activities in the computer lab	90
	Motivational effect by Attention (1,2,3,4 combined)	88
Motivational effect by Relevance		
5	Creating presentations helped to learn about nature of the earth	89
6	Creating PowerPoint presentations improved memorizing power of the lesson	92
7	Creating presentations helped to improve ICT skills	93
	Motivational effect by Relevance (5,6,7 combined)	91
Motivational effect by Confidence		
8	At the beginning it was easy to use computer	33
9	Later it was easy to use computer with the necessary guidance	89
10	First, I had less knowledge to type, put animations, draw diagrams, multimedia and create the presentations	49

11	Later I did well with necessary guidance from the teacher and the other group members	98
	Motivational effect by Relevance (8,9,10,11 combined)	67
Motivational effect by Satisfaction		
12	I like to do group activities by using multimedia strategies	94
13	Nice diagrams, animations, videos and pictures were used while creating PowerPoint slides	99
14	All the friends in the group prepared beautiful slides appropriately in the presentation	92
15	It is good if I get more chances to learn with multimedia strategies like PowerPoint	93
16	Multimedia strategies provides opportunity for self-learning	83
17	I like to learn with creating PowerPoint presentations more than preparing classroom charts	86
18	Immediate feedbacks increase the interest to learn	92
19	Impatient to get an opportunity to learn using more multimedia strategies inside the computer lab	86
20	We love to go computer lab and learn science concepts using more multimedia-based strategies	98
	Motivational effect by Relevance (12,13,14,15,16,17,18,19,20 combined)	91

Effective motivational effect (the combined effect from Attention, Relevance, Confidence and Satisfaction) calculated by considering the students who voted for strongly agree and agree to the items of the ARCS-based motivational scale was 84.25%

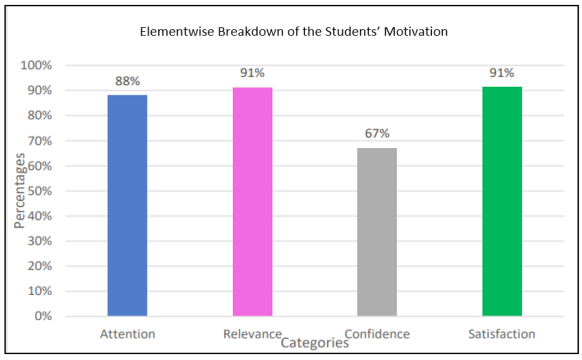

Figure 2: Motivational Analysis of the participants in the Experimental Group

3.1 Analysis of observations

Following is a summary of the observations made while the students were engaged in the activity.

Experimental Group

- Students were highly motivated and interested in the computer lab and they were happy and motivated to engage with creating PowerPoint presentations.
- Students had gathered and used multimedia material from the Internet for their presentations.
- Some students had technical issues and teacher guidance was important
- Collaborative skills among group members and other groups were high during the process. They helped each other
- Students did presentation sessions well. They were happy to show their creative presentations with animations to the class. These presentations attracted more attention than the paper-based versions of the same subject matter.
- Few students were behaving negatively.

Control Group

- Students were happy and motivated on creating presentations using bristle boards and Students worked collaboratively among group members.
- They were initially motivated, but as time passed, some students became bored.
- Students presented their chats in a creative manner. But some groups were not that much interested in presenting sessions.

4. CONCLUSIONS

As per the statistical analysis in the Table 1, before the intervention both the experimental group and the control group were similar with respect to the moderator variable prior content knowledge.

The hypothesis 1 that "Students who learn science through activities using ICT-based multimedia obtain higher achievement scores than those who learn via paper-based science activities" was not supported.

In contrast, the students who were engaged in activities involving ICT-based multimedia had shown a high motivation in terms of ARCS model of motivation, hence the hypothesis 2 was supported. The observations made lead to the conclusion that students would be highly motivated to learn through ICT-based multimedia than using traditional methods. Engaging students in ICT-based environments could improve collaboration in learning.

The duration of the engagement of the students in both mode of learning has not been long enough to have a significant effect. Further, if the tests were conducted again after a longer lapse of time, the effect on retention of the content by the two different methods could also have been studied. The small sample size could also have an effect on the results. It is suggested that similar study be conducted with bigger sample size, over a longer duration and at least two tests: immediately after the intervention and after a pre-calculated lapse of time.

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