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Effect of Blended Learning Strategy on Secondary School Students' Achievement in Chemistry

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Abstract: ***A new perspective is required in approaching the chemistry teaching and learning instead of rote memorization that has been followed for ages. Employing blended learning strategy can enhance the teaching and learning of Chemistry. Blended learning strategy is an instructional methodology involving the integration of synchronous and asynchronous learning tools for teaching learning process. The present study was aimed at finding the influence of blended learning strategy on secondary level students' achievement in chemistry by comparing it with existing method. The blended learning model employed was a blend of technology enabled synchronous meetings and asynchronous activities. The study employed experimental method with pretest-posttest nonequivalent-groups design. The sample was selected from one of the semi urban CBSE schools in Kerala. A blended learning package comprising of both face-to face teaching and online media was developed for teaching the chapters 'Atoms and Molecules' and 'Structure of the Atom' from NCERT standard IX science textbook. The statistical techniques used for analysis of data are t-test and ANCOVA. It was found that the Blended learning strategy was effective in influencing the achievement in chemistry among secondary school students. The finding of the study has several educational implications for the policy makers, curriculum planners and teachers. If policy makers can integrate blended learning in the subject of chemistry teaching learning it can improve the achievement in chemistry among secondary school students.***

Keywords: Blended learning strategy, Achievement, Secondary School Students, Experimental method

1. Introduction

The three 21st Century literacy skills are information literacy, media literacy and technology literacy. Technology literacy is the ability to use, understand and comprehend technology efficiently and effectively. Technology literacy is an important 21st Century literacy skills. It helps to critically evaluate different aspects of digital content and information. Technology has the potential to address the educational needs of Indian society which is in its journey towards becoming a knowledge super power of the world. It has the power to transform the Indian society to a digital society. A digital revolution in the field of education is the need of the hour.

The National Education Policy (2020) states that, 'Technology will play an important role in the improvement of educational processes and outcomes'. Digital empowerment has to be initiated from school level at a very young age since today's children are tomorrow's citizens. Science classrooms provide a good opportunity to bring in technology into the school scenario. Different disciplines of science provide wide opportunity to connect learners to plethora of technological resources. Bringing technology into science classrooms is one way of knowledge empowerment. It will take away the fear from the minds of learners towards science subjects and make learning of science interesting.

2. Background of the Study

Subjects like science especially Chemistry is thought as a tough subject since students have to learn new skills and procedures. Chemistry being an empirical science requires lot of visualisation to comprehend the different concepts and students are unable to do this visualisation without the use of proper learning resources. Existing instructional methods followed in teaching of chemistry fails to effectively transact the fundamental concepts to secondary level students. More often the teachers fail in optimising the use of proper teaching and learning resources in conveying the fundamental concepts. As a result students fail to understand and comprehend these concepts and they resort to rote memorisation for the sake of marks in examinations.

Simulation and visualisation through proper use of technology are powerful tools to learn physical and chemical processes that are difficult to understand through text and pictures. The conventional teaching methods in Chemistry are not enough to arouse interest in chemistry among the students and do not tap the intellectual, psychological and emotional needs of the students. Only through proper planning of the curriculum and the integration of apt technologies, these problems in the teaching and learning of chemistry can be solved.

The science syllabus incorporates many abstract concepts in Chemistry, which are central to further learning in both chemistry and other sciences. These abstract concepts are important because complex chemistry concepts or theories cannot be easily understood if these underpinning concepts are not sufficiently grasped by the students. There should be an emphasis on exploration, inventiveness and creativity through activities, experiments and technological modules. Proper use of technology can take away the fear developed towards learning chemistry and can generate interest in learning the concepts effectively. Infusing ICT into teaching and learning in chemistry results in improved learning and teaching methods and also it enrich and transform the whole educational process (Al-Balushi, et al., 2017; Dori &

Kaberman, 2012; Abbas, 2011; Tas, Apaydin & Cetinkaya, 2011; Celikler & Aksan, 2011).

3. Need and Significance of the Study

Many research studies have shown a decline in science interest as students move from elementary to high school (George, 2006; Potvin &Hasni, 2014). Lack of interest in science is due to lack of confidence in science, stemming from insecurity in understanding science (Gafoor &Jaithra, 2012). The interest in the study of subject Chemistry is gradually decreasing among students due to the age old approaches adopted in delivering the content to the learners at the school level. The students dislike chemistry since they lack interest in learning the concepts. Chemistry is a study of properties, composition and structure of substances. It involves the explanation and discussion of complex behaviour of materials. The teaching and understanding of chemistry is slightly different from other science subjects because of the method adopted in explanation of the complex nature of materials. The very basis of understanding chemistry starts from learning the structure of an atom, subatomic particles, symbols of various elements, difference between atom, molecules and compounds, chemical formulae, chemical equations, balancing of chemical equations, atomic structure, valency, atomic number, mass number etc. Students are asked to memorise the above mentioned fundamental concepts in chemistry which makes it difficult to learn these topics. Rote memorization of these concepts leads to short-term memory, lack of interest and dislike towards these topics. The concepts cannot be recollected after a gap which leads to fear of exam and ultimately fear towards the subject chemistry. Thus students slowly develop dislike towards the subject.

A new perspective is required in approaching the chemistry teaching and learning instead of rote memorisation that has been followed for ages. Only through integration of apt technologies, the above said problems in the teaching and learning of Chemistry can be minimised. The learning opportunities provided in science classroom encourage scientific interest (Misra & Srivastava, 2016). Employing blended learning strategy can enhance the teaching and learning of Chemistry. In 2003, the American Society for Training and Development identified blended-learning as one of the top ten trends to arise in the knowledge delivery trade.

Blended learning strategy is an instructional methodology. It is a pedagogical approach involving the integration of synchronous and asynchronous learning tools for teaching learning process. The National Education Policy (2020) stresses the need for blended models of learning: 'While promoting digital learning and education, the importance of face-to-face in-person learning is fully recognized. Accordingly, different effective models of blended learning will be identified for appropriate replication for different subjects'.

Several models have been developed for implementing blended learning. The three blended learning models suggested by Twigg (2003) are the supplemental model, the replacement model and the emporium model. The supplemental model is based on the structure of traditional courses and uses technology resources to supplement traditional lectures and textbooks. Although technology is incorporated, it does not change the structure of the course.

The present study tried to unveil the possibilities of blended learning in the teaching-learning of chemistry by comparing it with existing method. To study this, the supplemental model suggested by Twigg (2003) was employed with some modifications. The blended learning model employed was a blend of technology enabled synchronous meetings and asynchronous activities.

The study was aimed at finding the influence of blended learning strategy on secondary level students' achievement in chemistry by comparing it with existing method.

Objective and Hypothesis

The major objective of the study was:

- To find out the effectiveness of Blended learning strategy on Achievement in Chemistry of secondary school students.

In order to study the above mentioned objective, the following hypothesis was formulated:

- The Post test scores on achievement in chemistry of experimental group exposed to Blended learning strategy will be significantly higher than the Post test scores of control group.

In order to statistically test the research hypothesis of the study it was converted into null form:

H_0: There is no significant difference in the mean post test scores on achievement in chemistry of experimental group exposed to Blended learning strategy and that of control group.

The Design

The study employed experimental method with pretest-posttest nonequivalent-groups design. The sample was selected from one of the semi urban CBSE schools in Kerala. The intact group of 33 students from standard IX A selected as the experimental group was taught through Blended Learning Strategy by the researcher utilising the ICT facilities available in the school. The intact group of 33 students from standard IX B of the same school selected as control group were taught by the regular teacher.

The Procedure

A blended learning package comprising of both face-to face teaching and online media was developed for teaching the chapters 'Atoms and Molecules' and 'Structure of the Atom' from NCERT standard IX science textbook. 'kalzium' software and virtual labs were incorporated in the blended learning package. It is developed by British computer Software Company 'Canonical Ltd'. It is a full-featured chemistry application of a virtual periodic table of elements. It is free software which can be downloaded with the help of internet. Kalzium software was selected for the study since it

best suits the topics selected for experimental intervention. Materials were so designed that learners can learn from them without much help from a teacher. Components of learning package included virtual periodic table, atomic structure of different atoms, learning activities to work with, and also experiments to be carried out through online labs. The online labs is developed by Amrita CREATE, the centre for Research in Advanced Technologies for Education by Amrita University in partnership with CDAC, the centre for Development of Advanced Computing, Mumbai.

In the study the kalzium software is used to teach about the structure of an atom, the different subatomic particles present in an atom, Dalton's atomic theory, learning the symbols of various elements, differentiating between atoms, molecules and compounds, writing chemical formulae of different molecules, ions, mole concept, molecular mass, electron distribution of different atoms, difference between valence electrons and valency, atomic number, mass number etc.

For learners to access the learning materials of the package they were directed to sign in to website www.rollapp. com using a Gmail account. RollApp is an online application virtualization platform and enables to launch virtually any third-party software application in the cloud and use it inside a standard web-browser. The students can access it from a desktop, laptop or even from a mobile phone with internet connection. In the study the learners could access the Kalzium software with limited options. In the study the investigator used o-labs to demonstrate the experiment on law of conservation of mass, alpha particle scattering experiment in Rutherford's model of an atom etc. For accessing Olabs there should be internet connection. It can be accessed from a desktop, laptop or even from a mobile phone. The investigator has used the free access option which can be utilised without signing into the website.

To measure the performance of students before and after the experimental intervention an achievement test in chemistry from two specific units from IX standard NCERT science textbook was prepared and standardised by the investigator. The test consisted of 40 multiple choice questions of one mark each for 35 minutes. It was administered as pre-test and post-test before and after the experimental intervention respectively. The statistical techniques used for analysis of data are t-test and ANCOVA.

4. Results

An independent t-test was performed on the post-test scores on achievement in chemistry of control and experimental group to check whether there is any significant difference in the post-test performance between control and experimental group on achievement in chemistry. The results are presented in table 1.

Table 1: Comparison of t-test scores of the control and experimental group on the post-test scores of achievement in chemistry

Variable	Group	No. of cases	Mean post-test score	SD	t-value	P-value
Achievement in Chemistry	Control	30	13.13	3.655	6.084**	< 0.01
	Experimental	30	24.27	9.333		

*** Significant at 0.01 level*

The mean post test score of achievement in chemistry for control group is 13.13 and that of experimental group is 24.27 with a standard deviation of 3.655 for the control group and 9.333 for the experimental group respectively. The t-value obtained is 6.084 and P-value is less than 0.01. Hence the test statistic is significant at one per cent level of significance for achievement in chemistry. This result shows that experimental group has significantly higher post test score on achievement in chemistry compared to control group. We can conclude that there exists a significant difference in the post-test performance between control and experimental group on achievement in chemistry. It indicates the effectiveness of blended learning strategy on achievement in chemistry of the experimental group.

In addition to the above analysis an attempt was made to compare the gain scores on achievement in chemistry for experimental and control group. The difference in gain score of control and experimental group were tested for significance using independent t-test. The results of comparison of gain scores on Achievement in chemistry for experimental and control group is given in Table 2.

Table 2: Comparison of gain scores on Achievement in chemistry for experimental and control group

Group	No. of cases	Mean pre-test score	Mean post-test score	Mean gain score	SD	t-value	P-value
Control	30	8.97	13.13	4.17	2.96	6.178**	< 0.01
Experimental	30	9.90	24.27	14.37	8.54		

*** Significant at 0.01 level*

Mean gain score of achievement in chemistry of experimental group is 14.37 and that of control group is 4.17. The t-value 6.178 is significant at 0.01 level as the P-value is less than 0.01. This again shows that there exists significant difference in the gain scores between control and experimental group. Higher mean gain score in experimental group points to the effectiveness of blended learning strategy for improving achievement in Chemistry. The bar graph showing the mean gain scores on achievement in chemistry for experimental and control group is given in figure 1.

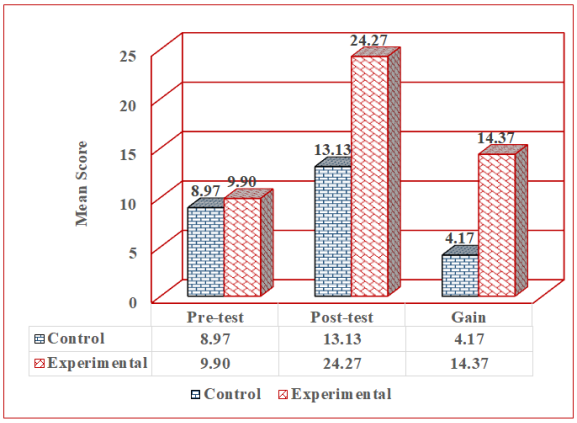

Figure 1: Mean scores of Achievement in chemistry for control and experimental group

Further, ANCOVA was calculated using the pre-test score as the covariate and the results are given below in table 3.

Table 3: Results of ANCOVA for comparing Achievement in chemistry among control and experimental group by taking pre-test score of Achievement as covariate

Source	df	Sum of Squares	Mean Square	F-value	P-value
Pre-test score of Achievement	1	546.96	546.96	13.175**	0.001
Group	1	1488.11	1488.11	35.845**	<0.01
Error	57	2366.373	41.515		
Total	60	25754			
Corrected Total	59	4772.6			

*** Significant at 0.01 level*

The P-value for the pre-test scores of achievement is 0.001 and is less than 0.01; hence the F-value (13.175) was found to be significant at 0.01 level. As the p-value is less than 0.01, F-value for group (35.845) was found to be significant at 0.01 level. We can conclude that there exists significant difference in post test scores on Achievement in chemistry of experimental group exposed to Blended learning strategy than that of control group. Hence the null hypothesis (H_0) stating that '*There is no significant difference in the mean post test scores on Achievement in chemistry of experimental group exposed to Blended learning strategy and that of control group'* **was rejected** and the research hypothesis *'The Post test scores on Achievement in chemistry of experimental group exposed to Blended learning strategy will be significantly higher than the Post test scores of control group'* **was accepted**.

5. Findings

The results indicates that post test scores on Achievement in chemistry of experimental group exposed to Blended learning strategy was significantly higher than that of control group. Thus the Blended learning strategy was effective in influencing the achievement in chemistry among secondary school students.

Educational Implications

The findings of the study in the area of chemistry teaching and learning by blending online learning with face-to-face teaching have several educational implications for the policy makers, curriculum planners and teachers. Incorporating different models of blended learning in the classrooms can influence the achievement in chemistry among secondary level students. The blended learning model adopted in the study is economic in terms of ICT related infra structural facilities required for the implementation and also in terms of time. It can be implemented in any schools with minimum ICT facilities even in remote areas in the Indian context. Once the students are introduced to the online resources they can access it from anywhere, anytime with minimum support from the teacher. The active role of teacher can be slowly reduced to that of a facilitator and that of the learner from passive listeners to active learners through integrating different blended learning models in the curriculum. Blended learning strategy can be integrated in all the school subjects of the curriculum.

6. Recommendations

The findings of the study on the blended learning strategy among secondary school students has implications in the present scenario of digital India programme – the flagship programme of government of India launched in 1st July 2015, with a vision to transform India into a digitally empowered country. ICT integration in the area of chemistry teaching and learning can accelerate the process of digital empowerment of secondary level students. If policy makers can integrate blended learning in the subject of chemistry teaching and learning it can improve the achievement in chemistry among secondary school students. It can also remove the dislike or fear towards the chemistry subject and makes the learning process more interesting. The teachers should be oriented towards the efficient use of blended learning strategy in the regular classrooms.

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