RESEARCH ARTICLE

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Science Teaching Through Blended learning: An Advanced Approach

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Abstract

Science education is vital to every nation's development. With the advent of modern technology and a mind-shift towards an online teaching-learning process, especially in recent times due to the pandemic, a blended learning approach to teaching science at the school level has become a natural progression. During this time, upper primary level students had experienced an online mode of teaching-learning as the direct receivers from teachers. The upper primary level is the stage where autonomous learning starts. Hence it is the best suitable time to implement blended learning for teaching of science. The present paper portrays the outcomes of science teaching through a blended learning approach implemented for one complete academic session at the upper primary level. The results evidenced the blended learning approach's effectiveness in delivering science concepts to the upper primary level students.

Keywords: Blended Learning, Effectiveness.

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Introduction

Since time immemorial, education has played the most crucial role in the development of society. As man explored his surroundings, he often learned new things. This in turn, helped the system of education evolve. The all-pervasive need of man to evolve, grow, sustain and flourish depends on how one passes one's know-how to the next generation and uses it in the present times for the welfare of the society one lives in.

For the continued development of society and humanity at large, continuous changes, modifications, an open-minded approach to innovations and taking up challenges are a few things that are of utmost importance for sustenance. This became very evident in recent times when countries across the world went under lockdown due to the Covid-19 pandemic. Like every other sector, education also suffered the consequences. But it has made rapid progress in numerous ways to ensure that the exchange of knowledge doesn't stop. It was ensured from kindergarten to university level that education reaches the stakeholders in the best way possible. Technology played a vital role in doing so.

With the advent of various videos and live online classes, teachers at all levels took care of education at all levels. Though there were situations wherein technology could not do justice due to accessibility problems, by and large, it was good for everyone who is involved.

As the students slowly went back to their classrooms after nearly two years, the approach to education had already taken a giant leap in a way not foreseen in the times before the pandemic. Before the pandemic, using technology in education was approached with caution; now it is being accepted with open arms. The teacher and the taught both have mastered some skills regarding using technology during that time. Being back in school and studying in person has its advantages. Adding a component of technology to it may work wonders. Thus, it seems that using blended learning may show great scope in its implementation and use.

Blended Learning (BL)

Blended learning is a mix or combination of both online and offline learning experiences. As two modes are combined, the learning experiences will have a blend of both wherein, the strengths of each can be used for an adequately rich experience for the learners. Hence, the term blended learning is generally used to the practice of using both online and in-person (campus, classroom) learning experiences for the learners. 'Blend' means a mix of a substance with another so that they combine to make a product of desired quality. Along the same lines, blended learning is a way of teaching where the learning takes place due to a blend of different techniques, an online component is a must in this. Over the past two decades, digital modes of teaching have been more popular and used widely in the public schools. Much effort has been taken to bring all government and government-aided schools under the umbrella of technology.

NCFSE (2023) clearly states, "There are many pedagogic practices, strategies, and ideas that are being tried that have achieved various degrees of success. These include flipped classrooms, BL, personalized learning, game-based learning, edutainment, computer-assisted learning, and several others. All of these may be effective in some contexts but not others. There is no one method or use of technology that fits all." It signifies the efficacy of BL.

Rationale

In the past decade educationists across the globe have tried to adopt technology-driven teaching models fulfilling the varied needs of the learners. The classroom-only traditional approach is

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being remodeled to incorporate online training. With an added component of an online module along with the traditional in-person teaching-learning setup, blended learning has showcased some advantages in the past as it makes the delivery of instruction effective and result-oriented right from the beginning. Blended learning is at close quarters to the constructivist learning theory which is based on observation and is a scientific study of how people learn.

Regarding pedagogy, constructivism emphasizes different attributes of meaningful learning such as intentional, active, constructive, cooperative, and authentic learning (Jonassen, 1999). Additionally, a constructivist teacher would encourage students to understand by exploring, observing, and taking responsibility of the learning process on to a great extent. One of the teacher's main roles is to help the students learn, reflect and navigate. A constructivist teacher will help the students develop problem-solving skills through inquiry-based activities in which they can formulate and test their ideas, infer, and conclude from their experience and formulate new ideas. Continuous reflection on their experiences will help them gain clarity and power for their ideas and help them develop a strong ability to integrate new information. Constructivism helps the students become active participants from being passive learners. Science is a subject in which these distinctions can be observed very effectively.

The Central Board of Secondary Education (CBSE) states that science is a subject that helps students to develop well-defined abilities in the cognitive, affective ad psychomotor domains. Science helps to enhance the essence of inquiry, creativity, objectivity, and aesthetic ability (CBSE, 2021). Evidently, due importance is given to science education at the upper primary stage by CBSE which aims for a holistic development of attitude amongst the students towards open-mindedness, ideas, and application of science in daily life as well as for higher education. Department of Education in Science and Mathematics (DESM), New Delhi, has developed an online course specifically for teachers teaching science up to class VIII. It aims to enhance teacher's understanding, abilities, skills, attitudes and practices regarding the nature and role of the subject and how children learn science. It will, therefore, flexibly facilitate capacity enhancement to many teachers, particularly those whose access to educational resources or capacity-building programs is limited. This course is essentially aimed at teachers who teach Science at Upper Primary Level. Teachers can improve their domain and pedagogic skills required to teach science at this level. Enhancing the professional capacities of the teachers is need of the hour.

The upper primary stage demands that several opportunities should be provided to the students to engage them with the processes of science like observing, recording observations, drawing, tabulation, plotting graphs etc., whereas the secondary stage also expects abstraction and quantitative reasoning to occupy a more central place in the teaching and learning of science (CBSE, 2021). This also happens to be a stage when memories start taking a concrete shape for the future to come. As this is the foundation stage for concept formation as well as personality development, conducting research for this age group shall be most interesting. Additionally, as per the Learning Outcomes at the Elementary Stage (NCERT, 2017) and Position Paper on Teaching of Science (NCERT, 2006), the curriculum at the upper primary stage intends to develop process skills of science which include observations, posing questions, searching various resources of learning, planning investigations, hypothesis formulation and testing, using various tools for collecting, analyzing and interpreting data, supporting explanations with evidence, critically thinking to consider and evaluate alternative explanations, reflecting on their thinking. With these aims in mind, the role of technology for achieving the goals can be very well envisioned.

In the recent past when the covid-19 pandemic struck, teachers and students alike underwent a sudden and massive change in the mode of delivery of instruction. This has broadened the acceptance and the feasibility of blended learning in recognition of the opportunities and the flexibility this method offers. This is considered a step towards global advancement in academics and related pedagogies. Now, students have become true learners as in the earlier system, they were taught by the teachers, which has been replaced by learning within and beyond the classroom from mentors and other e-resources, with the onus of learning more on the part of students. The use of learning is not going to be bracketed only to achieve marks and degrees but for lifetime use of knowledge for a better career, choice of a profession living a better life in general. There is a totally different and qualitative world ahead. Hence, the harmony of pedagogical and technological knowledge of teachers may make a difference.

Along with many pedagogical practices and strategies, adding a component of technology may create wonders. A flipped classroom method with an active learning classroom (online/offline) along with all study resources given a day or two in advance and the actual session starting with a quick quiz followed up with doubt clearance can be quite an effective way of learning, which is internalized, collaborative, experiential, bottom-up, as distinctly different from traditional teaching. Likewise, there are BL, personalized learning, game-based learning, edutainment, computer-assisted learning, and many others.

The purpose of the present study was to find a balance between online and offline learning modules and hence, develop a strategy in which both components were integrated together to provide a learning experience to the students. The effectiveness of the said strategy as a part of the blended learning approach shall help the teaching community to understand the efficacy of the same for a particular group.

Objectives of the Study

- To develop a Blended learning strategy with the appropriate combination of online teaching modules and face-to-face teaching in the classroom.
- To study the effectiveness of the Blended learning strategy with reference to students' achievement.

Hypothesis

The following null hypothesis was tested under the present study:

"There will be no significant difference in the mean achievement scores of the experimental group and control group students in the achievement test of science."

Explanation of the Term

Blended learning

A mode of learning in which the face-to-face learning paradigm is supported by an online or a technology-driven component to make the teaching-learning process more customized and flexible, making the learning process more effective and productive for both the teacher and the taught.

Operationalization of the Terms

Achievement

'Achievement' means the marks obtained by the upper primary school students in the Achievement test of science (post-test).

Effectiveness

The effectiveness of science teaching through blended learning was judged based on the significance of the difference in mean achievement scores of the experimental and control group students in the post-test.

Relevant teaching points

'Relevant teaching points' means the teaching points which were identified and suggested by the experienced science teachers based on the criterion that they can be taught effectively by using blended learning approach.

Delimitations of the Study

The present study was delimited to the air force schools, which impart education to the children of air force personnel with some seats for civilians, too. These schools are affiliated to the Central Board of Secondary Education (CBSE) and run by the Indian Air Force Educational and Cultural Society, India. Also, the present study was delimited to the students of class – VI only.

Methodology

Population

There were 129 air force schools divided into 8 commands around the country during the academic year 2022-23. Out of these 129 schools, there were 49 pre-primary schools, 32 primary schools, 5 middle schools, 16 secondary schools, 22 senior secondary schools, and 5 associate schools. A total of 7,725 students studying in class – VI of the 5-middle level, 16 secondary level, 22 senior secondary level, and 5 associate air force schools comprised the population for the present study.

Sample

The sampling method is the process or method of drawing a definite number of individuals, cases, or observations from a particular universe, selecting part of a total group for the investigation. In the present study, three air force schools were selected randomly from the population. Intact classes of standard VI from two schools were selected as the sample for the study. Out of these two classes, one class was treated as an experimental group, while another class was treated as the control group under the study. The experimental group comprised 146 students, whereas the control group comprised 162 students. A group of 20 students from the third school was selected randomly for the initial try-out/pilot study. The details of the same can be seen in Table 1.

Table 1: Sample of the study

No. of students under pilot study	*No. of students under experimental group*	*No. of students under control group*
20	146	162
Total sample size	308	

Design of the Study

Research design refers to the plan and strategy that guides the researcher towards the steps to be taken to reach the desired objectives. The present study was an experimental research. The study was based on a "Post-test only Control group Design", under the true experimental research design of experimental research.

Post-test-only control group design is a research design in which experimental and control groups are only compared on a post-test measure. It is assumed that participants' results on any pre-test administered before the experimental manipulation's introduction would be equivalent across the groups due to the random assignment of individuals to conditions. (APA, 2015).

Plan and Procedure

The plan and procedure were carried out in six different phases as shown below in Figure 1:

Phase: I Semi-structured Interview of the teachers

A semi-structured interview was conducted for a group of five selected teachers (experts) to get experts' opinion about identifying and selecting relevant teaching points for science teaching, which can be taught effectively with the help of a blended learning approach.

Phase II Development of blended learning strategy

Upon consultation with the teachers wherein different technological and online components can be delivered through various ways to the students as a part of BL strategy in the subject of science. Hence, 11 e-books were developed by the researchers. Those e-books were developed on the online app known as 'Book Creator'. This app was chosen as it is a very inclusive and creative app for content creation for students. 'Book Creator' has many built-in tools that can be used cohesively to develop interactive e-books. Various modalities like choosing color schemes, adding and formatting text, adding a creative look to a page, embedding videos from YouTube, adding or recording audio, using remixable templates, using multimedia tool sets, adding animated emojis, embedding files, adding images and shapes, converting speech to text, making comics, publishing and reading the e-book online, showing analytics, integrating third-party app like Canva, Giphy, Bitmoji Google maps, etc. makes this app an ideal choice. The e-books were developed and validated as a cardinal aspect of BL strategy with reference to their relevance, feasibility, and effectiveness.

Phase: III Initial try-out of blended learning strategy

The developed BL strategy was initially tried as a pilot study on a group of 20 students under this phase, to establish its face validity in checking the instructional and educative value of the developed e-books. For this purpose, the e-books were shared with the group of 20 students and their feedback were collected regarding the feasibility and effectiveness of all e-books using Google Forms. Based on their suggestions, necessary modifications were made in the e-books. All the topics and sub-topics planned for the session were covered in the developed e-books. Thus, the e-books essentially were made chapter-wise as per the Science Textbook for class VI, prepared by NCERT. Therefore, they covered the planned syllabus for the whole academic year in the experimental school.

Phase: IV Implementation of blended learning strategy

As a part of BL strategy, the developed e-books were shared with the students of experimental group from time to time, before the commencement of a new lesson. A total of 11 chapters were taught through BL in which the e-books were shared with the help of subject teacher on a created WhatsApp group of the class

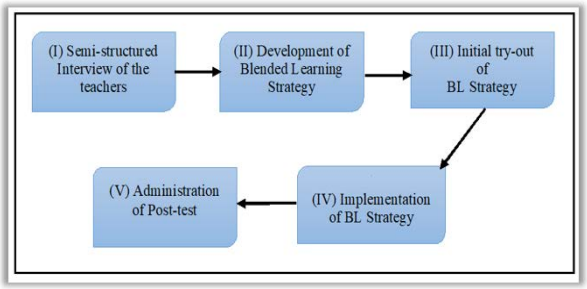

Figure 1: Plan and procedure

Table 2: Calculated measures on post-test achievement scores

Group	*N*	*Mean*	*S.D.*	*df*	*t-value*	*p-value*
Experimental	146	35.39	5.99	306	4.1246	< 0.0001 *Significant*
Control	162	32.34	6.89			

through different links prior to formal regular classroom teaching. The students could access the e-books whenever needed through the links in an online mode on their respective devices throughout the academic session. The students of the experimental group were explained about the blended mode of learning, the e-books and how to use and access them. The students of control group were taught in a regular classroom setup by their respective subject teacher using the conventional method.

Phase: V Administration of post-test

After completion of the syllabus of science in the selected schools, that is, at the end of the academic year 2022-23, a post-test was administered on both, the experimental and control groups. An achievement test of science was administered as a post-test under this phase, especially with a view to test the stated hypothesis and ultimately to judge the effectiveness of the implemented BL strategy.

Tool for Data Collection

An achievement test of science was used as a tool to collect the data under the present study. The researcher constructed this test based on the identified teaching points of science. It was in the form of multiple-choice type questions and was administered as a paper-pen test. This achievement test was used as a post-test to judge the achievement level of the students in science. The constructed achievement test was validated based on the suggestions given by a team of expert teachers.

Data Analysis

The main purpose of the present study was to study the effectiveness of the blended learning strategy with reference to students' achievement. Hence, with a view to test the null hypothesis, the collected data in terms of students' achievement scores were analyzed with the help of a parametric statistical technique. The detail of the calculated t-value is given in Table 2.

Table 2 shows that the calculated t-value of 4.1246 exceeds the t - critical table value for a two-tailed test at both .05 and .01 levels. Hence, the null hypothesis is rejected. It can be interpreted that, there was a significant difference in the mean achievement scores of the experimental group and control group students in the achievement test of science.

Findings of the Study

The significant difference between the mean achievement scores of the experimental group and the control group in the achievement test of science showed that teaching of science through a blended learning approach was significantly more effective than traditional classroom teaching in terms of students' achievement. It can also be revealed that the BL strategy found to be effective for science teaching at upper primary level.

Conclusion

The findings of the present study showed that integrating an online mode of learning with face-to-face teaching enhances students' interest in learning science. The present study's findings also revealed that the blended learning mode helps clarify concepts better as it encompasses the multiple intelligence theory, which caters to all kinds of learners. It can also be inferred that learning with both online and face-to-face components helps the students understand the concepts better. It can be deduced from the present research that blended learning helps in better retention of the concepts of science at the upper primary level. It was observed from the non-formal reactions of the students that blended learning has been an effective way of learning in the subject of science. A similar model can also be developed and implemented for other school subjects, mainly to study its effectiveness.

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