EFFECT OF BLENDED LEARNING STRATEGY ON LEARNING SCIENCE AMONG SECONDARY SCHOOL STUDENTS

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The shift in emphasis from science as a body of knowledge to science as a process of inquiry revolutionized the idea of how students learn science. It is quite accepted that there is a need for tapping the wide applicability of online learning combined with Face-to-Face instruction for enhancing science learning. Blended learning is a pedagogical strategy which skilfully integrates online learning techniques such as online delivery of materials through web pages, discussion boards and email and Face-to-Face instruction. The present research is an attempt to study the effect of blended learning strategy on science process skills and science achievement a4t secondary level. The study was of quasi-experimental in nature and pre-test – post-test non-randomized control group design was employed. The experimental group of ninth standard students was taught six chapters of science using the blended learning strategy whereas the control group was taught the science chapters by the regular teacher using the conventional teaching method. The study revealed that blended learning is more effective than conventional method in enhancing science process skills and science achievement among secondary school students. It implies a greater scope for adopting blended learning strategy to optimise science learning at secondary level.

INTRODUCTION

The construction of deep scientific knowledge results from actively practicing science in a structured learning environment. The shift in emphasis from science as body of knowledge to science as a process revolutionized the idea of how students learn science. The claim that science is a uniquely objective area of human intellectual endeavour is being critiqued and the proposition of learning science within social and personal context started gaining momentum in the academic world. As a result, science teachers are pressurized to provide variety of experiences to learners, which are consistent with nature of science. As well as becoming scientifically literate, today's students must be equipped with process skills that will enable them to observe keenly, successfully communicate, reflect objectively and analyse logically However, many of the teachers find it difficult to perceive science as a process of exploring and in effect, too often, science learning is narrowed down into usual routinized mastery of conventional explanations and techniques of established science. The old pedagogy was criticized for presenting content in lecture format to be memorized. Our school pedagogic practices, learning tasks and the texts we create for learners tend to focus on receptive feature of children (NCERT, 2005). Science teaching becomes all the more challenging in the case of integrating technological tools and techniques into process of learning. In this context, blended learning has its relevance in enriching the quality of learning science by tapping the wide potentialities of providing more flexible ways of learning through online mode and the richness of the 'social presence' in the classroom. Along these lines, Dziuban, Hartman and Moskal (2004) in a research brief noted that blended learning should be viewed as a pedagogical approach that combines the effectiveness and socialization opportunities of the classroom with the technologically enhanced active learning possibilities of the online

environment. This view is supported by iNACOL, the International Association for K-12 Online learning which defines blended learning as combining online delivery of educational content with the best features of classroom interaction and live instruction to personalize learning, allow thoughtful reflection, and differentiated instruction from student-to-student across a diverse group of learners. We can consider blended learning as an educational formation that integrates online learning techniques including online delivery of materials through web pages, discussion boards and/or email with traditional teaching method. It has also wide scope for extending immense opportunity for children to ask questions, describe objects and events, acquire knowledge, construct explanations of natural phenomena, test those explanations in many different ways, and communicate their ideas to others and all of these are critical elements of learning science. Providing several online options in addition to traditional classroom training actually increased what students learned (Graham & Allen, 2005). One of the most specific advantages is the opportunity to quickly establish a sense of community amongst student learners (Garrison & Kanuka, 2004). Within the blended learning classroom, students meet in face-to- face instruction, and then have opportunities to collaborate, communicate with the open dialogue, to experience critical debate through a world-wide open platform which in turn facilitates greater reflection on the part of learners. Therefore, it has wide scope for development of autonomy, self-efficacy and individual organizational skills. While there is substantial blended learning literature on the student experience, course design, and even the professional development of teachers, the most neglected research area is teaching practice: how and why teachers balance the blend of online and classroom components (Torrisi-Steel & Drew, 2013). The researches available were mainly focused at higher education settings and very few researches available on design of blended learning strategy in improving science learning at secondary level. Review reveals that many times, the term 'blended learning' term was loosely used and is a contested concept without having unanimous understanding about various components of it. Considering the criticality of designing blended learning strategy and finding its effect on enhancing learning science including science process skills and science achievement at secondary school level, the present study was planned.

OBJECTIVES

To find the effect of blended learning strategy on secondary school students'

1. Science Process Skills
2. Science Achievement

RESEARCH HYPOTHESES

1. Blended learning Strategy is effective in enhancing Science process skills among secondary school students
2. Blended learning Strategy is effective in enhancing Science achievement among secondary school students

SAMPLING

Purposive Sampling technique was employed in selecting the schools. Two CBSE schools were selected from Bangalore city for the study, one of them having the provision of online learning platform 'thinkquest.org' by Oracle Education Initiatives. BGS National Public School was selected for the Experimental Intervention. The intact group of 38 Ninth standard students of the school was regarded as the experimental group. The intact group of 36 Ninth

standard students of Jyoti Kendriya Vidyalaya, Bangalore was selected as the control group since it is not enrolled in www.thinkquest.org. This ensured that the control group students' access to learning materials through the online platform was completely controlled since the control group students do not have access to that website either in the school or outside the school.

RESEARCH DESIGN

The study is of **quasi-experimental** in nature wherein a pretest-posttest non-equivalent groups design was employed. Pre tests were conducted to both the experimental and control groups to assess Science Process Skill and Science Achievement. The experimental group was taught six chapters of Science using the Blended Learning Strategy whereas the control group was taught the Science chapters by the regular teacher using the conventional teaching method. Then post tests were conducted to both the groups.

TOOLS

A Science Process Skill test and Science Achievement test were developed and validated by the investigator and the reliability coefficient (Cronbach's alpha) for the tests were found to be 0.86 and 0.87 respectively. An interview schedule was prepared to understand the difficulties face by students while learning through blended learning strategy.

BLENDED LEARNING AS A PEDAGOGICAL STRATEGY

The current research adopted blended learning continuum proposed by Eduviews (2009) which ranges from 'classroom instruction which includes online resources with limited or no requirements to be online' to 'fully online curriculum with options for Face-to-Face instruction'. The present piece of research adopted Model 4 wherein the Science classroom instruction is blended with substantial required online elements extending beyond the school day. With the growth of blended learning, pedagogy of blended learning also is evolving. The blended learning models are so flexible and adaptive so teachers can create instructional activities that give students the opportunities to work collaboratively, tapping their interests and abilities in social learning (Eduviews, 2009). A blended learning design suggested by Huang and Zhou (2005) was adapted for the present study. The procedure of designing blended learning strategy consists mainly of three stages:

1. Pre-Analysis
2. Activity and Resource Design
3. Instructional assessment

1. Pre-Analysis: Several observations and analyses were conducted in order to ascertain whether blended learning strategy could be used, and if so, to what extent online learning could be blended with face-to-face instruction. It includes analysis of the science curriculum, environmental features of the school and students' characteristics. The purpose of this task was to lay a sound foundation for organization of learning activities. Based on these analyses, an analysis report was prepared.

2. Activity and Resource Design Stage: The unique feature of blended learning design is that it focuses on which activities and resources are appropriate for the online learning contexts and which activities are appropriate for the classroom contexts. The content analysis of 6 units of 9th standard Science was carried out by specifying various concepts, meaning of those concepts, explanation with examples, and law/theorem. After analyzing the

content, different resources and tools for transacting those concepts were identified and selected and a comprehensive picture of the strategy was worked out. The teaching-learning materials like write-ups and videos to be uploaded on the www.thinkquest.org web site, thought provoking questions to be asked to the students through message board and the demonstration/experiments to be carried out during the face-to-face instruction were designed. In addition to this, project descriptions to be uploaded on the online project page and the criteria for the evaluation of the project were also prepared.

Instructional Assessment Stage: The final step in the design of blended learning strategy is the instructional assessment. Instructional assessment is based on the instructional objectives and the activities carried out. It is mainly the assessment of students' worksheet, work done online by analyzing the articles published in students' web page, their online interaction with others, examination of content knowledge through tests, participation and interaction during face-to-face sessions etc.

EXPERIMENTAL INTERVENTION

The intervention was carried out for 69 Periods of 45 minutes each extending about 20 weeks. The experimental group was taught the six units of Science (Matter in Our Surroundings, Is Matter Around Us Pure, Force and Laws of Motion, Gravitation, Why Do We Fall Ill?, Natural Resources) using blended learning strategy. F2F instruction included lecturing, discussion, demonstration and experiment and Power point presentation. Out of the 69 periods of transaction, 20 periods were allotted for online learning.

Online learning was facilitated using a web based learning platform such as'thinkquest.org. A web page was created by the researcher in 'www.thinkquest.org', through which online activities were undertaken. Various write ups on topics like gravitation, natural resources, matter etc were uploaded as the content progressed in the Face-to-face instruction. The PowerPoint presentations used in the classroom and other relevant video clips were also uploaded using the provision 'upload'. Meanwhile, lecturing, demonstrations and experiments were undertaken in the classroom as the content demanded. The discussion in the classroom was continued in the discussion forum using message board and visa-versa. Online threaded discussions on various curricular issues were conducted. Students were asked to publish various write-ups on their own web page by referring the various websites prescribed by the researcher and referring online library materials available in the website. Students were also instructed to watch the video uploaded in researcher's web page and critical review of the video was posted by students. Further discussion on the topics was continued during the face-to-face instruction. Students interacted with other members of the online platform, which included both teachers from their own school as well as students and teachers of different schools and countries by using the facilities such as message, ask me, list, vote etc. The feedbacks and varied perspectives students gained online were further expanded upon by the researcher during face-to-face sessions.

For an example, students were asked to go through the web links provided on the researcher's web page on Buoyancy and Archimedes Principle and further discussion was carried out in the classroom by elaborating students' ideas. Students performed experiments in groups to get hands on experience on Archimedes' Principle. The applications of Archimedes' Principle were again discussed in the classroom and video of experiment on Archimedes' Principle was uploaded on the web page of the researcher. The video provided through the online learning platform helped the students to revise the procedure of the experiment and thus helped in reinforcing the learning. In addition, students interacted with the researcher on various issues

in buoyancy online to get more clarity. Based on the guidelines provided by the researcher, students created their own web pages and published write ups on various topics. For example, after being given explanation on 'gravitation' during face-to-face instruction, students were asked to go through the web page created by the researcher and were asked to prepare their own write ups on gravitation. Necessary feedback was provided to the students by the researcher and the discussion on the topics continued during the face-to-face instruction.

The researcher interacted with the students by making use of the provision 'message board' by asking some questions to answer or encouraging students to comment on various issues put forwarded through the web page. An online project also was conducted by students on 'Pollution' and criticality of the project was in data collection by interacting people from the locality to identify the immediate concern and through online interaction with students and teachers of other countries to understand the global significance of 'pollution'. A skit was followed and the video of it was uploaded for a larger reach. As exemplars, a few snapshots are presented below.

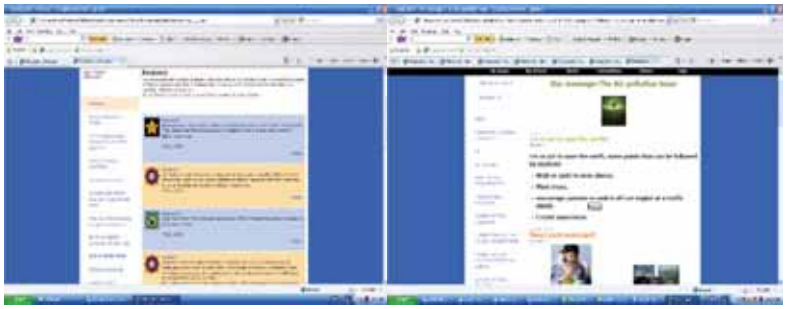

Figure 1: Snapshots of the online project

Conventional Method of Teaching in Control Group

In the control group, any kind of online learning was absent. The topics were being taught through demonstration and lecturing, followed by responses from students. The interaction with the teacher and among students was limited. A few experiments were conducted in an isolated manner in the lab and they were not a continuation of the lectures/discussions held in the class.

After the intervention, post- tests were conducted to both the experimental and control groups. The obtained data was analyzed using ANCOVA and the details are given below.

ANALYSIS AND FINDINGS OF THE STUDY

I. Effect of Blended learning Strategy on Science Process Skills

The following null hypothesis was formulated to find the effect of blended learning strategy on science process skills among secondary school students.

H_{01}: There is no significant difference between experimental group and control group in adjusted mean science process skill scores when their *pre-science process skill* is taken as a covariate.

The adjusted mean post test scores of science process skills of the experimental and control group when the mean pre-test scores of science process skill is adjusted to 17.27 are tabulated as below.

Group	N*	Adjusted Mean Scores of Science Process Skills	
		Pretest	Posttest
Experimental Group	38	17.27	23.32
Control Group	36		20.50

* 'N' denotes the number of students who appeared for both pre-test and post-test on science process skills.

Table 1: Comparison of adjusted mean scores of science process skills between experimental group and control group

To test the statistical significance of the mean scores, 2X2 ANCOVA was administered on the post test scores, taking pre-science process skills as covariate. The result is presented in the following table.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Groups	236.949	1	236.949	17.213	.000
Error	977.373	71	13.766		
Total	37110.000	74			

Table 2: ANCOVA result of science process skills of experimental group and control group with pre-science process skills as covariate

The above table reveals that the difference in the adjusted mean post test scores in science process skills of the experimental group and the control group is significant as $F=17.213$ and $p<0.01$. This indicates that blended learning strategy is more effective compared to the conventional method of teaching in developing science process skills. The result is in agreement with that of Bayrak and Bayram (2009) that web based instruction which considers student centred collaborative learning environment enhances science process skills better, compared to traditional teaching. The result of the study is also in tune with the result obtained by Tan, Yeo and Lim (2005) that computer supported collaborative learning enhances science process skills of secondary school students. In addition, the finding is in congruence with that of Saat (2004) that web based learning environment helps students to acquire science process skills. This result is in agreement with that of the finding of Ferreira (2004) that multi sensorial activities and dialogue help children to develop science process skills. Hence one possible reason for the positive effect of blended learning might be the flexible classroom dynamics and learner centeredness with greater engagement by students. Students were provided with such learning experiences that actually triggered students to 'do science'. In addition to this, various multisensory activities such as demonstration, computer assisted instruction, experimentation, videos and simulations uploaded online and the online projects gave students opportunities to observe, classify, compare and infer. The different modes of activities which were sequenced appropriate to the content gave students opportunities to explore more about nature and resulted in the development of science process skills.

II. Effect of Blended Learning Strategy on Science Achievement

The following null hypothesis was formulated to find the effect of blended learning strategy on science achievement among secondary school students.

H_{02}: There is no significant difference between experimental group and control group in adjusted mean science achievement scores when their *pre-science achievement* is taken as a covariate

The adjusted mean post test scores of science achievement of the experimental group and control group when the mean pre - test scores of science achievement is adjusted to 27.55 are tabulated as below.

Group	N*	Adjusted Mean Scores of Science Achievement	
		Pre test	Post test
Experimental Group	35	27.55	38.12
Control Group	36		33.80

* 'N' denotes the number of students who appeared for both pre-test and post-test of science achievement.

Table 2: Comparison of adjusted mean scores of science achievement between experimental group and control group

To test the statistical significance of the mean scores, 2X2 ANCOVA was performed on the post test scores, taking pre-science achievement as covariate. The result is presented in the following table.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Groups	328.296	1	328.296	16.632	.000
Error	1342.225	68	19.739		
Total	95081.000	71			

Table 3: ANCOVA result of science achievement of experimental group and control group with pre-science process skills as covariate

Analysis of the data showed that the experimental group which was exposed to blended learning strategy showed significant improvement in achievement in science compared to the control group which was taught through the conventional method. The result is indicated by the F value ($F=16.632$ and $p<0.01$). The result of the study is in tune with the result obtained by Moodley (2004) who studied the effects of computer-based dynamic visualization simulations on student learning in high school science and found that students' understanding and performance were better in classes where teachers used the computer-based dynamic visualizations to complement their traditional teaching. Since there are research findings (Sridevi, 2008) which indicate that the science process skills were significantly associated with the achievement levels of students, it can be inferred that the reasons for the improvement in science process skills can be implied to the similar results in science

achievement. The most plausible reason might be the reinforcing effect of multiple modes of transaction catering to the individual learning style. It might have helped the students to understand the concepts clearly and the reflection of participants in online forums might have helped them to analyse the concepts in different contexts. Since both online and face to face classroom activities were carefully organized with large student participation, possibility of transforming the content and absorb, assimilate or accommodate into their existing cognitive structure 'schema' was intense and therefore they could understand and apply his/her own learning in other contexts as well. Those activities were complementary to each other and might have reinforced to result in better Science achievement.

IMPLICATIONS

The present study was taken up in the context of blending online learning with face-to-face instruction in science learning. The study highlights positive effects of blended learning strategy over the conventional approach in fostering learning science among secondary school students. The findings of the research have several implications in the present educational system. The study presents a model of integrating online learning with face-to-face instruction in secondary schools. Thus, the present research has implications on framing Government policies to improve quality of Science learning. The study may initiate discussions in education sector for evolving new initiatives in pedagogical approach to enhance meta-cognition among learners and to empower students to become 'Global Learners'.

CONCLUSION

The study was an attempt to study the effect of blended learning strategy on Science leaning among secondary school students. The study found that by effectively blending online learning to the Face to Face instruction, science process skill and science achievement could be improved and the learners can be transformed into global learners. Blended learning strategy can be considered as one of the new initiatives in pedagogical approaches by integrating ICT in science education.

References

Bayrak, K. B., & Bayram, H. (2009). The effect of web based learning method in science education on improving the students' scientific process skills. Paper presented at the *International Conference: The Future of Education.* Retrieved from http://www.pixelonline.net/edu_future/common/download/Paper_pdf/ENT31-Bayrak.pdf

Dziuban, C., Hartman, J., & Moskal, P. (2004). Blended learning. *Educause Centre for Applied Research Bulletin*, *Issue 7.* Retrieved from http://net.educause.edu/ir/ library/pdf/ERB0407.pdf

Eduviews. (2009). *Blended Learning: Where online and face-to-face instruction intersects for 21st century teaching and learning.* Retrieved from http://www.blackboard.com/resources/k12/Bb_K12_WP_BlendedLearning.pdf

Ferreira, L. B. M. (2004). Role of a science story, activities and dialogue modelled philosophy for children in teaching basic science process skills of fifth graders. *Dissertation Abstracts International, 65*(6), 2069.

Garrison, R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *Internet and Higher Education, 7*, 95-105.

Graham, C.R., & Allen, S. (2005). Blended learning environments. In C. Howard & J. V. Boettecher & L. Justice et al (Eds.) *Encyclopedia of distance learning* (pp. 172-179). Hershey, PA: Idea Group Inc.

Huang, R., & Zhou, Y. (2005). Designing blended learning focused on knowledge category and learning activities – Case studies from Beijing Normal University. In C. Bonk & C. Grahams (Eds.), *Handbook of blended learning: Global perspectives, local design*. San Francisco, CA: Pfeiffer Publishing.

Moodley, S. (2004). The effects of computer based dynamic visualization simulations on student learning in high school science. *Dissertation Abstracts International, 65*(8), p. 2941.

National Council of Educational Research and Training. (2005). *National Curriculum Framework*. New Delhi: NCERT.

Saat, R. M. (2004). The acquisition of integrated science process skills in a web-based learning environment. *Research in Science & Technological Education, 22*(1), 23-40.

Sridevi, K. V. (2008). *Constructivism in science education.* New Delhi: Discovery Publishing House Pvt. Ltd.

Tan, S. C., Yeo, J., & Lim, W.Y. (2005). Changing epistemology of science learning through inquiry with computer-supported collaborative learning. *Journal of Computers in Mathematics and Science Teaching*, 24(4), 367-386.

Torrisi-Steele, G., & Drew, S. (2013). The literature landscape of blended learning in higher education: The need for better understanding of academic blended practice. *International Journal for Academic Development 18*(4), 371-383.