EFFECT OF BLENDED LEARNING STRATEGY FOR SECONDARY SCHOOL SCIENCE STUDENTS

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ABSTRACT: *The advent of digital technology has dramatically changed the routines and practices in most arenas of human exertion. Information and Communication Technology has paved the way for accelerating a paradigm shift in the teaching-learning processes. Several research findings support that online learning enhances learning as well as higher order thinking skills. However, all topics in science cannot be transacted completely online. Moreover, science as a discipline demands certain modes of transaction such as experimentation, demonstration and discussion. Therefore, blended learning as a pedagogical strategy for facilitating learning by skillfully blending online learning techniques such as delivery of materials through web pages, discussion boards and/or emails with the effectiveness and socialization opportunities of face-to-face instruction become significant. Though the blended learning strategy is gaining momentum all over the world, most of the researches on blended learning focus on higher education. In this context, the present study attempts to find the effect of blended learning strategy for secondary school science students.*

Key Words:

INTRODUCTION

The terms and circumstances of human existence are changing with the advent of science. We are so accustomed to live in a world of science that we seldom stop to think about how science is constantly changing our way of life. The vast and explosive scientific and technological revolution has produced a fantastic growth of scientific knowledge in most fields of human activity. As a result, many societies are experiencing a change in the ability profile of their human resource needs. Therefore, the education system is confronted with pressure to adopt educational programmes that reflect new ways of learning.

Learning is a journey and has intrinsic merit if it moves in the right direction, thus requiring significant shifts in many aspects of teaching-learning processes. Developing the right paradigm is the most important of all. The learning paradigm is more than an incremental change in an institution's organizational procedures or priorities. Rather, it involves a holistic and system-wide change away from the instruction paradigm and the organizational structures that reflect it. Learning paradigm that frames learning holistically, recognizes that the chief agent in the process is 'learner' and he/she constructs knowledge out of his/her own experiences. Learning has to be organized in such a way that learners can learn how to become architects of their own learning processes (UNESCO, 2003). In some instances, a newly constructed idea fits easily into the structure of existing understanding. In other cases, the construction of new understanding catalyzes substantial revision of existing knowledge into a new and more coherent framework.

Learning science is something students do, not something that is done to them. In learning science, students describe objects and events, ask questions, acquire knowledge, construct explanations of natural phenomena, test those explanations in many different ways, and communicate their ideas to others. Understanding science requires integration of a complex structure of many types of knowledge, including the ideas of science, relationships between ideas, reasons for these relationships, ways to use the ideas to explain and predict natural phenomena, and ways to apply these ideas to many events.

The construction of deep scientific knowledge results from actively practicing science in a structured learning environment and therefore it is essential to consider science as a process of constructing knowledge. To encourage independent learning in science, the inquiry aspect of science should be related to the structure of scientific knowledge and the investigative strategies of science. The very nature of science is such that a wide variety of learning experiences can be provided for learners to help them explore the world.

INFORMATION AND COMMUNICATION TECHNOLOGY IN LEARNING

Recent developments in the field of Information and Communication Technology (ICT) are revolutionary in nature. The ability to use ICT effectively and appropriately is essential to allow learners to acquire and exploit information within every sphere of human activity. ICT is not an initiative introduced purposefully into an existing system in order to bring about improvement, but a major perturbation that has established the existing order and led to a large number of unpredictable changes (Somekh, 2007). The creative potential of ICT can be unleashed when we actively make use of it.

INFORMATION AND COMMUNICATION TECHNOLOGY IN SCIENCE LEARNING

Information and Communication Technology has an important role to play in science learning. In recent years, there has been a shift from the use of science as a vehicle through which students learn and use ICT skills, towards the use of ICT skills as tools to assist learning in science. There has also been growing interest in providing differentiated instruction to individual students by tapping the wide potentialities of ICT. Research suggests that ICT can be used to strengthen procedural knowledge and that the main forms of ICT, which are relevant to school science activity, include: multimedia software, information systems, publishing and presentation tools and computer projection technology (Osborne & Hennessy, 2003). ICT could reduce both the time and resource constraints in practical work. Newton and Rogers (2003) suggest that the intrinsic propertie*s* of ICT helps for time saving or handling data, and there are potential learning benefits from the manner in which ICT is used in the science classroom.

ICT can provide access to wide range of resources that are of high quality and are relevant to scientific learning. In some cases the resources fill gaps where there are no good conventional alternatives; in other cases they complement existing resources. The multi-media resources available enable visualization and manipulation of complex models, three-dimensional images and movement to enhance understanding of scientific ideas. ICT can improve the quality of data available to students. Information learned from the internet can be more up to date, and data obtained include more frequent and more accurate experimental readings.

BLENDED LEARNING

Like many advances in educational practices, blended learning is defined and implemented in multiple ways. Blended learning is a hybrid of online learning and Face-to-Face (F2F) instruction using a variety of learning resources. Blended learning is a flexible learning strategy that integrates innovative and technological advances of online learning with interaction and participation of traditional classroom learning. Thorn (2003) describes blended learning as a way of meeting the challenges of tailoring learning and development to the needs of individuals by integrating the innovative and technological advances offered with the best of traditional learning. North American Council for Online Learning [NACOL], an International Association for K-12 Online Learning, 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 differentiate instruction from student-to-student across a diverse group of learners. Carter (as cited in Battye & Carter, 2009) defines blended learning as a strategic and considered approach to teaching and learning that effectively integrates different models of teaching and styles of learning whereby both face-to-face and online learning are each made better by the presence of the other. Ultimately, the exact definition of blended learning, beyond some combination of online and face to-face learning may not matter. Kim (2007) has classified learning into three key dimensions: physical class based versus virtual, formal versus informal, and scheduled versus self-paced. There are several possible combinations that can be formulated out of these three dimensions. He has defined blended learning as a combination of two or more of all possible learning types. He has given one important qualifier to this definition. At least one of the learning types must be a physical class based type and at least one other learning type must be online learning type. This is to make sure blended learning remains a combination of some form of traditional learning and some form of online learning.

Blended learning reflects more conscious and intentional approach in designing optimal instruction or learning environments following the strategy of blending components while the blended character of traditional instructional contexts is largely the result of habit (tradition), convenience or happenstance (Rossett & Frazee, 2006). A superficial understanding of blended learning is that it simply adds non face-to-face elements into the traditional course structure. But this most often results in a dysfunctional phenomenon known as the “course-and-a-half” (Educause, 2010). Schools may be particularly susceptible to this trap if the added online elements are simply based on the latest technology, which can give a false impression of true innovation.

The key assumptions of a blended learning design given by Garrison and Vaughan (2008) are:

- Thoughtfully integrating face-to-face and online learning
- Fundamentally rethinking the design to optimize student engagement
- Restructuring and replacing traditional class contact hours.

Blended learning is 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. The pedagogy of blended learning is based on the assumption that there are inherent benefits in face-to-face interaction as well as the understanding that there are advantages in using online methods (Clark & Patrick, 2007). Blended learning is used to describe learning that mixes various event based activities, including face-to-face classrooms, live e-learning, and self paced learning (Valiathan, 2002). Providing several online options in addition to traditional classroom training actually increased what students learned. (Dean, Stahl, Sylvester & Pearson, 2001; Graham & Allen, 2005). Blended Learning, the teaching practice that combines teaching methods from both face-to-face and online learning, is an established, rapidly growing instructional model that is proving highly effective in helping schools and districts address the challenges of student achievement, limited resources, and the expectations of 21st century learners (Eduviews, 2009).

Ingredients of Blended Learning

Five ingredients of blended learning proposed by Carman (2005) are:

Live events: Synchronous, teacher led learning environments in which all learners participate at the same time. For many learners, nothing can replace the ability to tap the expertise of a live teacher.

Self-paced learning: Learning experiences that the learner completes individually at his/her own pace and time such as recorded live events, Internet or CD-ROM based learning; it implies on-demand learning at a pace that is managed or controlled by the learner.

Collaboration: It implies more dynamic communication among learners that brings about knowledge sharing. Collaborative learning has more advantages which are not available from traditional instruction because a group can accomplish meaningful learning and solve problems better than any individual alone can. It can be extended from discussion in the live classroom to synchronous communications in chat room or in open discussion forums and asynchronous communication by using e-mail and threaded discussion.

Assessment: It is both live and online measure of learner's knowledge to determine prior knowledge as well as to measure learning transfer.

Performance Support: These are the reference materials that enhance learning, retention and transfer. It may be printed references, downloaded multimedia learning objects, documentation etc.

MODELS OF BLENDED LEARNING

Blended learning can be implemented using a wide range of models. Eduviews (2009) summarizes the continuum of models that can be used in schools as:

- **Model 1**: Fully online curriculum with options for face-to-face instruction
- **Model 2**: Mostly or fully online curriculum with some time required in either the classroom or computer lab
- **Model 3**: Mostly or fully online curriculum with students meeting daily in the classroom or computer lab
- **Model 4**: Classroom instruction with substantial required online components that extend beyond the classroom and/or the school day
- **Model 5**: Classroom instruction that includes online resources with limited or no requirements for students to be online

DEVELOPING CRITICAL THINKING THROUGH SCIENCE EDUCATION

Science is more than a detailed organization of minute facts and complicated theories. It also includes a vast array of inter-related factual information, concepts and theories which provide us with one particular way of understanding the world and ourselves. A critical approach to teaching science recognizes that science teaching should not over-emphasize narrow mastery of conventional explanations and techniques of established science. Science teaching should be structured in such a way that it can provide flexibility and opportunities to develop deeper and more accurate thinking among students. Students should be allowed to think about their own thinking in order to make their thinking clearer and more accurate.

Scientific teaching demands active learning strategies to engage students in the process of science and to develop their scientific reasoning. Critical thinking can be best taught through an experiential learning process.

This approach rests upon experiential and constructivist learning models and encourages instructors to fully engage students in the learning process (Otten & Leszczynski, 2006). Not surprisingly, excellence in science teaching focuses on development of students' critical thinking skills. Therefore science teaching learning environment has to be structured/restructured in such a way to provide experiential learning experiences to learners so that critical thinking can be developed among learners.

Problem Solving

The overarching aim of science education is not to steer all students towards a career in science, but to create a populace of knowledgeable students about scientific ideas, modes of thinking, and scientific practices so that they can make informed decision about science and technology issues of global interest. Harlen (2010) conceives the goals of science education not in terms of the knowledge of facts and theories but a progression towards key ideas which together enable understanding of events and phenomena of relevance to students' lives. One of the enduring problems that educators in the field of science face in designing science units is how to ensure a well-structured knowledge base without overburdening students with facts, formulae and inert knowledge and how to enable learners to solve problems effectively and efficiently. Chalmers and Fuller (1996) observe that students do not always apply strategies they have learnt to other contexts, because they are unaware that they are relevant to the task. It may be that even when they recognize that a particular strategy is relevant, they do not know how to apply it. Over emphasis on rote learnt content and terminology still characterizes much of our science teaching at secondary level. If teachers hold transmission approaches in their teaching with a focus on content coverage, students are forced to adopt surface learning approaches. To avoid this, learners need to be given opportunities to develop understanding of concepts and process skills, and be given ample opportunity to practice them in the context of the subject matter domains where they will have to use them.

DEVELOPING PROBLEM SOLVING THROUGH SCIENCE EDUCATION

The goal of every teacher is to develop students' understanding of the content being taught in the class, as well as to assist them in their development to become independent and thoughtful problem solvers (Bransford, Brown, & Cocking, 2000). Identifying the best means by which to accomplish this goal has been the aspiration of educational researchers for many years. Many researchers indicate that the use of problem solving instructional models and techniques to teach science influences the problem solving skill of students. Problem solving skills are promoted by providing an environment rich in potential for exploration and by encouraging students to reflect on their actions (Hass & Parkay, 1993). Reid and Yang (2002) found that inappropriate chemical knowledge prevents students' problem solving ability in chemistry and students become unsuccessful problem solvers if chemistry instruction does not provide them with an adequate set of rules to follow or do not help them to understand chemical knowledge during the learning process. Since problem solving ability is itself transferable, at least within a given subject matter field, facility gained in independently formulating and applying one generalization is transferable to other problem areas in the same discipline (Ausubel, 1969). He again says that aptitude in problem solving involves a much different pattern of abilities than those required for understanding, and retaining abstract ideas. He asserted that the ability to solve problems calls for qualities such as flexibility, resourcefulness, improvising skills, originality, problem sensitivity and venturesomeness. Although appropriate pedagogic procedures can improve problem solving ability, relatively few good problem solvers can be trained in comparison with the number of persons who can acquire a meaningful grasp of various subject matter fields.

Recent research has identified a prescriptive model of problem solving, although there is less agreement as to which techniques are appropriate. Attention must be paid to both the problem solving process and the specific techniques associated with important personal characteristics. That is, individuals and organizations must have a problem solving process as well as specific techniques congruent with individual styles if they are to capitalize on these areas of current research. Bilgin and Karakirik (2005) suggests Mole Solver (MS), a computer based problem solving environment that facilitates, monitors and improves the students' problems solving skills on 'mole concept'. A computer simulation is a powerful tool to enhance learning by providing opportunities for learners to develop skills in problem identification, seeking, organizing, analyzing, evaluating and communicating information (Akpan, 2001). Efforts are required from science teachers to enhance problem solving among children in addition to content enrichment. Science teaching should provide students with opportunity to ponder and explore problems and hence their capacity to solve problem inturn gets elevated. More researches in science education are required to identify innovative strategies which promote problem solving among students.

IMPLICATION OF BLENDED LEARNING STRATEGY FOR SCIENCE STUDENTS

Organization of learning process has been characterized from the past as predominantly 'teacher controlled'. If education is to provide an adequate preparation for the 'information society', schools should empower learners to become more active and responsible so that they can acquire productive skills and higher order thinking skills. Paradigm shift of learning ensures the focus of learning towards knowledge construction rather than rote memorizing some facts. Therefore more emphasis should be given to those modes of learning where self-regulation and authentic learning are possible.

Science education should prepare individuals to utilize science for improving their own lives and for coping with an increasingly technological world. This is possible only when learners are allowed to think critically, reflect and analyse their own learning process. Then, students will be able to solve problems effectively and thus can ensure maximised learning. Higher-order thinking requires students to manipulate information and ideas in ways that transform their meaning and implications. This transformation occurs when students combine facts and ideas in order to synthesise, generalise, explain, hypothesise or arrive at some conclusion or interpretation. Manipulating information and ideas through these processes allows students to solve problems and discover new meanings and understandings. Research into problem solving has indicated that one needs considerable domain-specific knowledge and skills to pose, represent, and solve problems within that domain. Critical thinking, one of the important higher order thinking skills is a pervasive and self-rectifying human phenomenon, which constitutes interpretation, analysis, evaluation and inference. Science education looks for innovative strategies to develop these higher order-thinking skills and to make learning science meaningful.

Acquiring higher order thinking skills has been widely recognized as one of the main objectives of science learning and efforts are required to improve critical thinking of students by providing meaningful learning experiences. 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). Much teaching is still conducted on this basis, while insufficient attention is paid to learning strategies (UNESCO, 2003). Only a very few percentage of bright/gifted students who are capable of building their own learning strategies learn best and vast majority of other students are typically pushed aside and labeled weak, poor, etc. The new focus is on the process of learning and providing environments and tools that encourage everyone to become successful and responsible learners. In moving away from a deficit model of curriculum and towards independent learning, Information and Communication Technology [ICT] has to play a very important role. Various Researches revealed that computer technology can support learning and is especially useful in developing the higher order skills such as critical thinking by engaging students in authentic, complex tasks within collaborative contexts. There is a growing shift all over the world, from the use of technology as a delivery devise for school children to use of technology as a tool for exploration of knowledge and self-learning. A major pedagogic contribution of ICT is that it facilitates an alternate way of approaching differentiation. It becomes possible to define differentiation by learner choice, a process that is both dynamic and iterative. National Curriculum Framework-2005 brought out by National Council of Educational Research and Training envisages that providing children more direct access to ICT and allowing them to mix and make their own productions and to present their own experiences could provide them with new opportunities to explore their own creative imagination. National Focus group on Education Technology (NCERT, 2005) pointed that even though most software tools allow an ordinary user to concentrate on the tasks at hand, it is not normally possible to respond to the different demands of the user. In this context, there is a greater need for optimizing learning paths for learners with different learning styles, exploring the maximum potential of ICT.

Despite the recent advances of blended learning in the field of education, there is little research into how online learning is actually being used in schools by blending face-to-face instruction or how learning platforms can benefit learning. Current evidence and research suggests that the use of online learning platforms is in development stages in all sectors, and is particularly nascent in many secondary schools, with this technology being used mainly to share information or as a document repository. Although learning platforms are designed to impact learning approaches, research findings about these forms of use, or its impact on science learning, its scope for providing learning experiences catering to the needs of students belonging to different learning styles, the difficulties faced by students while learning through online learning platform, are not drawn.

The relatively recent and emerging researches focus on the effect of blended learning on various subjects and in different contexts. As mentioned, several international studies have been conducted in the area of blended learning; most of them are in higher education and in industrial or business environment than in school level teaching. Researchers in India have hardly explored this area of research. In this context, it is critical to design a blended learning strategy in science at secondary school level and to find its effect on higher order thinking and learning science.

CONCLUSION

The study was an attempt to find the effect of blended learning strategy on critical thinking, problem solving, science process skills and science achievement among secondary school students. Learning style does not have influence on experimental group students' critical thinking, problem solving, science process skills and science achievement after being exposed to blended learning strategy. To summarize, the study found that, by effectively blending online learning with face-to-face instruction, higher order thinking and science learning among secondary school students can be improved. Blended learning strategy can be considered as one of the new initiatives of pedagogical approaches for integrating ICT in science education.

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