

Effect of ICT Integrated 5E Learning on Higher Order Thinking Skills in Science: A Literature Review

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Abstract

In this reviewed article, researcher described an innovative way of teaching through ICT Integrated 5E learning model on Higher Order Thinking Skills in science in this modern era. Science teaching is not easy task for the teachers while demonstrating any experiment in the classroom. In present days' most of the teachers use 5E learning model to construct the knowledge, focus on strengthen higher order thinking skills understanding in science. It focuses on create knowledge, factual knowledge, hands on activities demonstration to construct meaningful knowledge among the learners. Present study examine the benefits of ICT integrated 5E learning for higher order thinking skills in science through a systematic review of published articles from 2010-2022. Approx 30 research articles satisfy the studies these criteria. Present study also suggests to learners, teachers and teacher educators may get additional support by this approach to complete the course of science. In this way, it is important to implement the construction of learning modules with the help of ICT integrated 5E learning model on higher order thinking skills in science.

KEYWORDS: 5E Learning Model, ICT Integrated Teaching Learning, ICT Integrated 5E Learning and Higher Order Thinking Skills

Introduction

Science is a compulsory subject taught at school level. It helps in collection of most reliable and valid knowledge to human beings. Science is knowledge and knowledge is power of modern human beings. Science is ultimately a social need. We are learning many things from the society without any logic i.e. based on natural phenomenon. Finally, this matter is spread in our society with many rectifications for the benefits of the society i.e. Science.

Science syllabus is a document that gives details of the content of subjects to be transacted and the skills, knowledge and attitude, which are to be deliberately fostered together with the stage-specific objectives. In India, NCERT develops exemplar syllabus for all stages of school education. States can adopt/adapt NCERT syllabus or can develop their own syllabus on the basis of the National Curriculum Framework (NCF). The NCF of 1975 and The National Curriculum for Elementary and Secondary Education (NCFSE): A Framework 1988 recommended that general science should be a core compulsory subject up to Class X and learner-centred curriculum. The NCF suggests that science education should aim at developing well-defined abilities in cognitive, affective and psychomotor domains such as spirit of inquiry, creativity, objectivity, courage to ask questions and aesthetic sensibility. At the secondary stage (Classes IX and X), the aim of teaching science would be primarily directed towards problem solving and decision making through the learning of key concepts which cut across all disciplines of science.

Time to time Central Government has executed many commissions and committees for development of science teaching at school level. The Education

Commission (Kothari Commission 1964-66) has played an important landmark for its depth and expanse of vision of education in India. This led to the introduction of the science teaching and vocational education since secondary level. Sri Ishwarbhai Patel in 1977 recommended that science at the secondary stage should be offered through two equivalent alternate courses. The 'Course B' was to be a composite course in science to be taught through a single textbook. For 'Course A', it recommended a discipline orientated approach in which physics, chemistry and biology were to be taught as separate subjects. NCFSE-2000 recommended that teaching science and technology in Classes VI to X as a single discipline. The National Curriculum Framework-2005 recommended that hands-on activities, inquiry-based science curriculum, and active participation of the learner in the construction of their knowledge.

Science teachers are using different approaches like behaviouristic, constructivist and ICT for teaching in classroom. Behaviouristic approach is a teacher-centred approach of learning which is not accepted by many educators now because of its inadequacy to develop important intellectual capability in students, such as decision-making, problem solving, creativity, and critical thinking skills. Gradually, the understandings about learning of science have changed with the developments in psychology and epistemology that have moved towards constructivist approach which is learner centred. The NCF-2005 emphasised on learner-centred approach to achieve the objective of the science curriculum. Therefore, a pedagogical shift is occurred from teacher-centred to learner-centred in teaching-learning process.

In present days' many constructivist model approaches are in practice i.e. 5E model, Problem Based Learning Model, Meta cognitive Learning Cycle, Interpretational Construction Model (ICON Model etc. In these widely acceptable model is 5E learning model and it has five phases i.e. engage, explore, explain, elaborate and evaluate. It gives students a constructive nature to construct the concept and reflect by them that's why it becomes very common model to teach among the learners. But teachers are unable to provide concrete concept among learners and from overcome from this situations the teachers are using ICT integrated teaching for better outcome.

The ICT in schools has been subsumed in the Rashtriya Madhyamik Shiksha Abhiyan (RMSA-2009). Now ICT has been integrated in each school which is a one of the major components of the RMSA to develop teaching learning scenario in the present context. Its work as catalyst to connect the students with the help of digital devices and ruled over geographical barriers. The National Policy on Information and Communication Technology (ICT) in School Education (2012) says that Use of ICT for quality improvement also figures in Government of India's flagship programme on education, Sarva Shiksha Abhiyan (SSA). Again, ICT has figured comprehensively in the norm of schooling recommended by the Central Advisory Board of Education (CABE), in its report on Universal Secondary Education, in 2005 with the convergence of technologies. It has become imperative to take a comprehensive look at all possible information and communication technologies for improving school education in the country. The comprehensive choice of ICT for holistic development of education can be built only on a sound policy. The initiative of ICT policy in school education is inspired by the tremendous potential of ICT for enhancing outreach and improving quality of education. ICT integration can be broadly defined as a process of using any ICT tools i.e. web, multimedia programs, learning objects and medium can enhance students learning in their environment (Williams, 2003).

Effective ICT integration into the learning process has the potential to engage learners. ICT can support various types of interaction: learner-content, learner-learner, learner-teacher, and learner-interface (Chou, 2003; Moore, 1989). ICT integrated teaching learning process become more lively and concrete to enable the students active for learning.

Higher-order thinking skills are part of top of the pyramid of Bloom's Taxonomy. From bottom to top, the skills are: Remember; Understand, Apply, Analyze, Evaluate and Create. Teachers need access to models of how students acquire and assimilate these thinking skills, so that they can develop and implement appropriate activities, and accurately diagnose and guide students as they move through units or lessons that make of these tools.

It shows that ICT integration and constructivist model have great influence over the learners in their subjects. By keeping this view researcher has construct his research title over effect of ICT integrated 5E learning on higher order thinking skills in science. It has three dimensions i.e. 5E learning model, ICT integrated teaching learning process and ICT integrated 5E learning which effects the higher order thinking skills of learners.

Some of the findings of the relevant studies are discussed in the following paragraphs.

Previous Research Studies:

Martin & Bybee (2022) conducted a study on the cognitive principles of learning through the 5E Model of Instruction. The researchers intended to view the effectiveness of 5E learning model and its theoretical contributions to make its effects on learners' achievement. The research found from this study 5E model is effective for the students because it provides enough time to understand the concept, getting opportunities to discuss among the friends and engaged them in discussion for better learning based on known to unknown concept.

Shivam and Mohalik (2022) conducted a studied on effectiveness of ICT Integrated 5e Learning Model on Higher Order Thinking Skills in Biology at Secondary Level. The present study was intended to know the effect of ICT integrated 5E learning model in teaching biology subjects on higher order thinking skills among secondary school. Researchers have chosen quantitative design; quasi-experimental method, 65 samples were categorised in control and experimental group in this study. They have done experiment for two months and collected data, which collected data analyzed through jamovi (1.6) open-source software and found that the ICT integrated 5E learning model were significant for 5E learning model and its positive effect on higher order thinking skills among the students.

Bakri & Adnan (2021) conducted a studied on effect of 5E Learning Model on Academic Achievement in Teaching Mathematics: Meta-analysis Study. The researcher intended to examine the use and benefits of the 5E learning model approach in teaching mathematics. The researcher have gone through more than 20 research articles to draw a conclusions and results show that conceptual knowledge, procedural knowledge and procedure for better implementation in mathematics subject for better learning outcomes.

Tarun (2021) conducted studied on pre-service teacher experiences of the 5E instructional model: A systematic review of qualitative studies. The researchers intended to identify the factors that influence how pre-service science/math teachers implement the 5E instructional model and the challenges and barriers they face in doing so. Sixteen studies were identified in various electronic databases, and a meta-ethnography method was used to review the qualitative studies. The findings illustrate

that the experiences of the pre-service teacher varied. Time, resources, method courses, training, field experience, beliefs, content knowledge, and classroom size were identified as influences on the practice of pre-service teachers.

Seifu (2020) studied on Determinants of information and communication technology integration in teaching-learning process at Aksum University. The study was intended to investigate factors that determine the integration of Information and Communication Technology (ICT) in teaching-learning process in Aksum University. The result of the study was that personal and institutional factors can determine ICT integration in teaching-learning practices.

Pierre and Andala (2020) studied on Information and Communication Technology (ICT) Integration and Teachers' Classroom Pedagogy in Selected Secondary Schools in Nyanza District- Rwanda. The researchers intended to analyze the influence of integration of ICT in education on teachers' classroom pedagogy in secondary schools in Rwanda. This study used a descriptive research survey design. The data in this study were gathered from head teachers and teachers from sampled schools. The sample size in this study was 84 respondents out of 132. Purposive and simple random sampling techniques were adopted to obtain the required number of respondents. Questionnaire and interview guide were used as main tool for collecting primary data. The results of the study indicated that teachers integrate ICT in teaching and learning process as shown by the mean of 3.42 which expressed as high mean and the study found that both teachers and students use ICT tools and equipment during teaching and learning process.

Anggraeni & Suratno (2020) studied on the development of the 5E-STEAM learning model to improve critical thinking skills in natural science lesson. The present study was intended to understand the effect of 5E learning model on STEM and result showed in phase wise in each steps. All the result was positive effect on STEM subject through 5E learning model.

Komalavalli (2019) studied on effectiveness of teaching mathematics using 5e Instructional Model among class-IX Students. The researcher intended to see the effect of 5E instructional model in mathematics among class ninth students. The result of the study revealed that positive effect of 5E learning model on class Ix students and there is no significant differences among girls and boys of same class.

Ranjan & Padmanabhan (2018) conducted a studied on 5E Approach of Constructivist on Achievement in Mathematics at Upper Primary Level. The present study intended to find the effectiveness of 5E approach of constructivist on achievement in mathematics of upper primary students. The present study was a quasi-experimental study, wherein a control and experimental group were employed. The results of the study revealed that teaching through the 5E approach of constructivism is effective in enhancing achievement in mathematics of upper primary level as compared to traditional method.

Tambaya (2017) conducted a studied on effectiveness of 5E instructional model on academic performance. The researcher found that 5E teaching cycle has significant impact on students to perform in biology subject.

Alshehri (2016) studied on effect of 5E instructional model on achievement in mathematics subject. The result of the study was positive impact of 5E instructional model on achievement in mathematics among fifth grade students.

Chhatoi and Mohalik (2016) studied on effects of meta-cognitive skills on achievement and found that there is no significant difference in meta-cognitive skills of boys and girls of elementary school students and there is a significant difference in

meta-cognitive skills of students having parental education qualification and students with high order or low achievement at 0.05 levels.

Kamarudin and Yusoff (2016) studied on effects of higher order thinking skills and found that s thinking skills. It also provides opportunities and support in thinking styles.

Ghavifekr & Rosdy (2015) conducted a study on teaching and learning with technology: Effectiveness of ICT integration in schools. The present study was intended to analyze teachers' perceptions on effectiveness of ICT integration to support teaching and learning process in classroom. For this study researchers have used survey and questionnaire among 101 teachers from 10 public secondary schools in Kuala Lumpur, Malaysia. The data was analysed in both descriptive and inferential statistic by using SPSS (version 21) software. The results indicate that ICT integration has a great effectiveness for both teachers and the students.

Singh and Chan (2014) studied on teacher readiness on ICT integration in teaching-learning: a Malaysian case study. The studied intended to examine the knowledge level, attitude towards the use of ICT in teaching learning and barriers faced by the school teachers. Result revealed that ICT integrated teaching learning process has a great impact on connection in classroom can be effective for students'. Learning happened much effective and attitude of teachers vary teachers to teachers.

Bera and Mohalik (2013) conducted a study on effect of concept mapping on achievement and found that there is a significant difference in mean achievement score of students taught by concept mapping and convectional method of teaching at 0.05 levels.

Zhao et al. (2012) studied and showed the effectiveness of 5E Learning Cycle Model of teaching in changing participant's pedagogy and practice.

Rachmawati & Johan (2010) conducted a study on ICT integration in teaching learning process. The study found that ICT based learning were significantly differences between those who have learn with this method and it helps in transferring of knowledge from one to another.

Educational Implications:

The present study will have significant implications for ICT integrated 5E model on Higher Order Thinking Skills in science for school teachers. It will also have significant implications for educational planers for better ICT integration 5E model on higher order thinking skills in the curriculum of secondary school level. The study will helpful for understanding the concept of ICT integration 5E model and practices of higher order thinking skills to enhance the quality of teaching science at secondary schools. It will be useful in knowing the area of strength and weakness in the ICT integrated 5 E model recommended in syllabus. Similarly, educational planers can think for orienting school teachers, head teachers for enhancing quality of science teaching in their institution. It can also be used at higher education institutions for better output. It creates concrete thinking to abstract thinking which helps in higher order thinking for all types of learners. It also be used in special education, it helps in create the set up for better use in all level of education sector. It creates meaningful concept among the learners.

The study can suggest the best ways of using ICT integrated 5E model on higher order thinking skills in science for teachers and head teachers, teacher educators, planners and executors.

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