Developing Science Process Skills of Secondary Students through an E-content Package

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Introduction

Historically, school science teaching emphasises on the development of process skills. UNESCO (Bangkok, 1978) has recommended understanding science processes as one of the most important objectives of the integrated science programmes, followed in the middle school classes (Grades 6, 7 and 8) of Indian schools. While planning the Integrated Science Curriculum for the middle school students (Grades 6, 7 and 8) of Indian schools, NCERT, New Delhi, has identified the process approach as one of the core elements of the science course. To fulfil the objectives, the contents of the system are to be selected and presented in such a way that it would influence the brain, heart and hands of the learners. A thorough study of the document 'Integrated Science Curriculum: An Introduction' (NCERT, 1982) states, "A science curriculum must stress more on the processes than the products of science". An innovative application in the teaching and learning process is e-content. This may be computer-based, including text, video, audio, animation and graphics.

The e-content is mainly viewed as a way to preserve and carry forward the cultural or historical heritage, disseminate lifestyle, scientific, educational and business information in a digitalised format, or provide user-interactive service. The e-content is valuable to the learners, and helping to all individualised instructional systems teachers. E-learning is a process, and e-content is a product. This teaching approach has become an answer to the complicated modern, social, and economic conditions, and an

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exploding population. An e-content package can be used as a teacher in a virtual classroom situation. Using e-content, time and money can be minimised required in the teaching process. Facilitating individualised learning, creating interest and maintaining it among the students is a significant concern for the science teaching-learning process.

Need of the Study

An effective science teacher should know that not only their subject but also the learning experiences of the students so that they can employ a new technique to produce the desired and improved achievement. Experiences of seeing something new leave a long-lasting impression on students. The traditional teacher-centred teaching method does not allow the participation of students in the process. The idea of digital education is a significant innovation in the learning platform. The e-content package plays a vital role in imparting education. It gives self-paced, self-supporting, self-study, self-evaluation, and self-corrections opportunities and suggests remedial measures. The students could understand the concepts quickly and take as much time as they wanted to learn. They will approach learning with a critical view. In the lecture-oriented method, the learners are passive, becoming boring within a few hours. It increases curiosity in students and makes learning more enjoyable. It ensures the active involvement of students. It creates a more prosperous and efficient diverse environment for learning. As students are more interested in e-content-based learning, the methodology can make learning more active and interactive. The interactions between the students and the teacher create the learning environment. With these insights, the investigator has intended to attempt to study the developing e-content package for improving science process skills among secondary students.

Research Questions

- In what ways and means can science process skills be enhanced among secondary school students?
- Which are the appropriate strategies to identify the factors influencing science process skills?
- Can techno-pedagogy promote science process skills at the secondary level?

- How far will the e-content package be effective in enhancing the science process skills?

Methodology

The study was completed in two phases:

Phase 1—Development of E-content Package

The investigator developed e-content materials. Eight contents were selected from science subject of Grade 9. These contents were reviewed by the external experts and divided under 57 modules.

Phase 2—Experimental Design

The Science Process Skill Test (SPST), Science Achievement Test (SAT), and Strengths, Weakness, Opportunities, and Challenges (SWOC) analysis for the e-content package were prepared, and administered for the experimental part of the study. The development of the e-content package was tested using the pre-experimental design with single group pre-test and post-test in this study.

Tools and Techniques

The following tools and techniques were developed by the investigator:

Qualitative Techniques

- **Focus Group Discussion (FGD)**

  In the present study, the investigator conducted focus group discussions for 30 secondary school students. Out of 30 students, 15 were from high school, and 15 were from higher secondary school. The primary aim of focus group discussion, focused on students' perception about factors influencing science process skills.

- **The E-content Package Development**

  The investigator has constituted an expert committee comprising of science teachers from government secondary school, subject experts from the science departments, technology experts in developing the e-content materials and an expert member from NCERT, New Delhi to suggest and finalise the topics. With the expert committee's suggestions and recommendations, eight units were selected from science

of Grade 9 subjects. The selected eight units—Electric Charge and Electric Current, Magnetism and Electromagnetism, Light, Chemical Bonding, Acids, Bases and Salts, Organ Systems in Animals, Organ Systems in Animals and the World of Microbes from science of Grade 9 have been selected for preparing the e-content modules, after getting the experts' opinion, teachers' feedback and students' feedback in learning Grade 9 science. Then eight units were divided into 57 modules for three months of instruction through the WhatsApp platform using the e-content.

- **SWOC Analysis for E-content Package**

  In the present study, the investigator discussed with expert comments in the purpose of e-content package (SWOC) analysis. Totally, 15 expert members were selected, 2 experts from university staff, 3 experts from technology technical staff and 10 experts from science teachers. Investigator discussed e-content package analysis into four components, i.e., strength, weakness, opportunity and challenges. Based on the expert opinion, the investigator modifies the e-content package.

Quantitative Tools

- **Semi-Structured Interview Schedule (SSIS)**

  The investigator conducted a SSIS with 15 science teachers in the present study. Out of 15 teachers, 2 professors were from university, 4 from high school, and 9 from higher secondary school. The primary aim of SSIS focused on teachers' perception about the ways and means for enhancing Science Process Skills. The experience of teachers in teaching in a particular method were from 1 year to 15 years, in the science teaching field.

  The researcher has framed semi-structured interview schedule with 42 items to teachers' perception about the ways and means for enhancing Science Process Skills in draft tool, and finalised the tool with 35 items selected. The reliability of the semi-structured interview schedule was 0.692 using Spearman-Brown Formula.

- **Science Process Skill Test (SPST)**

  Items were arranged according to their expected difficulty level, the questions were arranged from easy to difficult to

sustain the students' motivation. Items having a difficulty level between 0.4 and 0.8 with a discriminating power above 0.5 were selected for the final test.

- **Science Achievement Test (SAT)**

  Items were arranged according to their expected difficulty level, the questions were arranged from easy to difficult to sustain the students' motivation. Items having a difficulty level between 0.3 and 0.7 with a discriminating power above 0.4 were selected for the final test.

Major Findings

- It is found that teachers' perception of imparts of a digital learning environment enhances observation skills (86.66 per cent), online classes improve communication skills (93.33 per cent), and live experimentation enhances classification skills (93.33 per cent). Digital equipment enhances measurement skills (86.66 per cent), provides innovative experiment activities to enhance prediction skills (93.33 per cent), experimentation videos to enhance inference skills (86.66 per cent), and online simulation to strengthen the understanding of cause-and-effect relationships skills (80 per cent).
- In the perception of students, the observation skill is highly influenced by the use of a demonstration kit (93.33 per cent), communication skills by responding to the question (90 per cent), classification skills by mind map (93.33 per cent), measurement skills by virtual science labs (96.66 per cent), prediction skill by predicting the events (86.66 per cent), inference skill by using real-life scenarios (93.33 per cent), cause-and-effect relationship skill by act out with role-play (90 per cent).
- It is found that student responses about techno-pedagogy skills to promote Science Process Skills are based on observation skills (99.04 per cent), inference skills (96.19 per cent), measurement skills (95.23 per cent), prediction skills (95.04 per cent), communication skills (94.28 per cent), classification skills (90 per cent), and understanding the cause-and-effect relationship (89.04 per cent). The techno-pedagogy is the best method for developing Science Process Skills. In this type of teaching process, all the students develop more or less, 90 per cent of all the skills.

- It is found that the e-content package enhancing the Science Process Skills shows a statistically significant difference in their pre-test and post-test science achievement test scores (t = 7.286), and the e-content package improving the Science Process Skills shows a statistically significant difference in their post-test and delayed post-test science achievement test score (t = 8.188).
- It is found that the e-content package enhancing the Science Process Skills shows a statistically significant difference in their pre-test and post-test in Science Process Skills Test (t = 5.343), and the e-content package improving the Science Process Skills shows a statistically significant difference in their post-test and delayed post-test in Science Process Skills Test (t = 6.963).

Educational Implications of the Study

- The e-content modules in learning science stimulate each student's individual or self-learning interest.
- The e-content modules provide an enjoyable learning environment and develop Science Process Skills at the secondary level.
- The e-content modules developed in learning science help each student to clarify their doubts in learning science concepts.
- The e-content modules developed in learning science offer an opportunity to exchange learners' knowledge with each other.
- The e-content modules developed in learning science make students actively participate in the learning process.
- The e-content modules developed in learning science encourage cooperation and active learning, and promote a scientific attitude among the learners.
- The e-content modules developed in learning science provide opportunities for peer tutoring to both high and low achievers.

Conclusion

Teaching with the help of e-content is more effective than the traditional way of teaching. We need innovative work in e-content material as a form of digital literacy in educational settings, particularly to investigate the implications of new forms of social networking, knowledge sharing and knowledge building. This is due to the pervasive nature of e-content as digital technology, the commercial interest invested in it and the largely unregulated content of internet-based sources, we also need to begin to sketch out what a critical digital literacy might look like.