

Effect of Self-regulatory Strategies with Interactive Multimedia on Problem solving ability of Higher secondary students in Physics

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Brief description on the state of the art of the research topic Higher

Secondary is a crucial stage of school education because at this stage specialised, discipline based, content oriented courses are introduced. Students who reach this stage after 10 years of general education choose subjects that would enable them to pursue their career. "The Physics students of today are tomorrow's scientists, engineers, medical doctors and teachers at the secondary and tertiary levels." (UNESCO, 2005). The National Curriculum Framework 2005 recommends that theoretical component of Higher Secondary stage should emphasize on problem solving methods and that the awareness of historical development of key concepts be judiciously integrated into the content.

The special aim of applying interactive multimedia to science is to enable students to make their thinking visible, to state arguments for difficult concepts in science and to crack the problem in science with interest and ease. This process is seen significant for learning Self-regulatory skills and it is supported with interactive multimedia environment. The interactive multimedia technology and self-regulation not only enable the students to review their thought processes but also to get them exposed of modern techniques and hence students may be helped regulate their thinking processes and enhance their problem solving in science. Problem solving has been identified as an important aspect of student learning in science and technology and in the development of scientific literacy (National Research Council, 1996).

In this perspective, the researcher attempts to empower the Problem solving ability of students in the rural areas through an innovative technique, Self-regulatory strategy with interactive multimedia by the principle of "Reaching the Unreached".

Definition of the problem

There has been considerable interest in Self-regulated learning in recent years (Zimmerman and Schunk 2001). Learning to be self-regulating is seen as an essential skill for "life- long learning", which in turn is seen to be an important disposition for living in a post- modern "Knowledge society". Zimmerman (2001) defines Self-regulation as the degree to which students are "metacognitively, motivationally and behaviourally active participants in their own learning process.

Semra Sungur et.al (2006) studied the effects of Problem based learning and traditional instruction on Self-regulated learning. Results revealed that Problem Based Learning (PBL) students had higher levels of intrinsic goal orientation, task value, use of elaboration learning strategies, Critical thinking, metacognitive self-regulation, effort regulation and peer learning compared with control group students. The above study gave an impetus to the investigator of selecting the research problem.

Though the importance of science is realized, the method of teaching of problems in physics is rather crude in most of the schools in India. The students in general are in the state of phobia in finding solution for a problem in science. As it is aware that problem solving is one of the processes of cognition, Self-regulation can be an instrumental for the problem solving action. Physics instructors generally accept problem solving as the way to learn Physics (Maloney, 1994), Many studies revealed that self-regulation aims at attaining success in problem solving.. (Marjorie Montague, 2008; Nathalie Nadar Grosbois, 2011). Hence the present study made an attempt to explore self-regulatory strategies for developing Physics Problem solving ability among the higher secondary students. Furthermore, the pivotal role of self-regulation in using multimedia recognized by Lehman

(2000) provided an insight to the investigator in integrating interactive multimedia with self-regulatory strategies. Moreover, Physics N- dimensional and multidimensional figures and concepts are involved in it. Interactive multimedia can facilitate learner's multi-sensory experience in their problem solving action. It is in this line of thinking the present study aims to find out the effectiveness of an innovative strategy known as Self- regulatory strategy in solving Physics problems at higher secondary level using interactive Multimedia. In that way, the research problem has been selected and stated as, "Effect of Self- regulatory strategies with Interactive multimedia on problem solving ability of Higher Secondary Students in Physics". Based on the aim of the present study the following objectives are to be accomplished:

- To examine rural school Students' Self-regulatory awareness in Physics Problem solving.
- To design and develop a model on Self-regulatory orientation to enhance Physics problem solving ability among the students.
- To design and develop Self-regulatory strategies for the selected lessons in Physics for empowering rural school students Problem solving ability.
- To develop and validate Multimedia package in Physics at Higher Secondary school level.
- To characterize what kind of Self-regulatory processes do appear in multimedia learning environment while students learn Physics Problem solving.
- To find out the effectiveness of Self-regulatory strategy with multimedia learning materials among the students on the following variables:
 - o Physics Problem solving
 - o Self-regulatory Awareness
 - o Information and Communication Technology
 - o Students Attitude in learning Physics
- To evolve recommendations on the basis of the findings of the study for future policy and planning of Science Education.

Scope of research work

The present study believes that Self-regulatory orientation helps students to exhibit cognitive processes, to analyze, and manage their own thinking in pursuit of knowledge acquisition in order to gain insight and creativity to become critical thinkers. If students, the future citizens are trained with the innovative approaches, then they will be independent in their problem solving in Physics.

Self-regulation has been suggested as an important factor in Physics Problem solving. Higher secondary students can get to integrate self-regulatory skills such as Planning, Information Management strategy, comprehension Monitoring, Debugging strategies, Evaluation, Declarative knowledge, Conditional knowledge and Procedural knowledge in their problem solving in Physics. The study helps students to promote the cognitive process which builds the structured knowledge develop desirable habits of mind to guide students through the stages of cognitive development.

Interactive multimedia package are prepared in such a way that they will provide multi-sensory experience to the students. Also the students will be able to visualize the entire content and attain mastery over the Physics problems. It is understood that the development of interactive multimedia are of their first kind prepared for students of science which explained how to solve problems in Physics using self-regulatory strategies. It activates the students in solving Physics problems at ease using self-regulatory strategies. It removes the phobia towards solving physics problems and makes problem solving a joyful experience.

Sample & Methodology

A sample of 90 high school students from standard XII of S.R.V.S National higher secondary school, Karaikal was taken for the study. This study targets on the student of Physics at higher secondary level in the rural area. Experimental research method is adopted for the present study which enables the researcher to go beyond description, Prediction, and identification of relationship to partial determination of what causes them. Based on the above advantages of experimental research, the investigator adopted 'Experimental Method' with two parallel groups with pre-test, post-test1 and post-test2 design for the present investigation.

Original Contribution

The present study has attempted to develop and validate the interactive multimedia package on how to solve problems in Physics. This interactive multimedia is first of its kind which is programmed for students of Physics to learn problem solving technique using self-regulatory strategy. Students can learn the interactive multimedia package at their own pace.

Synthesis of Review of related literature

Ramganesh (2009) explored on Self-monitoring strategy on problem solving in mathematics. Mehran Farjaollahi (2010) compared self regulated learning strategies between computer based and print based learning students. Chia-Wen Tsai (2009) examined the effects of applying web-based self regulated learning (SRL). Web-based problem learning (PBL) with initiation to involve low achieving students in learning. Marjorie Montague (2008), Madhavi Williams (2008), Nadar Grosbois et.al (2011) investigated on the self regulation strategies to improve problem solving for students with learning disabilities. E.Yerushalmi (2001) examined the teacher's approaches to promoting self-monitoring in physics problem solving by their students. Serap Caliskan et.al (2010) explored on Pre-service teachers' use of self-regulation strategies in physics problem solving. Henk J. Pol et.al (2008) studied the effect of the timing of instructional support in a computer supported problem solving program for students in secondary physics education. Edward F.Redish (2005) insisted on problem solving and the use of math in physics courses. Anthony R. Artino Jr (2009) investigated academic motivation and self-regulation of undergraduate and graduate students learning online. Singaravelu.G (2008) studied on the effectivity of self-regulated learning in Psychology at master of education. Jon-chao Hong (2011) developed physics concepts through hands on problem solving. Shen P.D et.al (2007) attempted a study on Applying Web-Enabled Problem-Based Learning and Self-regulated Learning to Enhance Computing Skills of Taiwan's Vocational Students. Ramganesh (2003) investigated on the effect of metacognitive orientation on enhancing problem solving competency in mathematics among B.Ed trainees. Ramganesh.E (2011) explored on the Empowerment of teaching competence of mathematics teachers in the rural schools through Metacognitive strategies with Interactive Multimedia learning materials. Muniyappan et.al (2011) examines the effectiveness of self-regulated learning approach in enhancing academic achievement of secondary learners. Johnson,N and Ramganesh,E (2012) studied on critical thinking as a self regulatory process among B.Ed., & D.TEd., trainees. Johnson,N. and Ramganesh,E. (2012) explored on self-regulatory awareness in Physical Science Problem solving among the teacher trainees.

The above study gave an impetus to the investigator to study on the effectiveness of self regulation strategies with interactive multimedia on enhancing problem solving ability of higher secondary students. The investigator felt the need of self regulation strategies to improve physics problem solving among higher secondary students in rural areas. Various insights gained from the review of related literature incorporation of web enabled learning, on line learning, learning through interactive multimedia. The investigator chose interactive multimedia to find out the effectiveness of self regulation strategies on physics problem solving. This study is unique in determining the effectiveness of self regulation strategies on physics problem solving ability of higher secondary Students.

Tools developed

Self-regulatory Awareness Inventory for Physics students (SRAI)

The Self-regulatory awareness Inventory for Physics students (SRAI) designed after conceptualizing different components of Self-regulation by number of reviews by the investigator provided a reliable test of Self-regulatory awareness. The survey has 48 statements to ascertain the Self-regulatory awareness of students in their *Planning, Information management strategy, Comprehension Monitoring, Debugging strategies, Evaluation, Declarative Knowledge, Conditional knowledge and Procedural knowledge* with five point scale i.e I never do this, I do this occasionally, sometimes do this, I usually do this, and I always do almost do this. There are five items in the tool which represent 'Planning' of students for their delivery; nine items represent 'Information management Strategy' of contents to be delivered; three items for 'Comprehension Monitoring' aspects; four items for ascertaining the 'Debugging Strategies'; Five items for 'Evaluation'; six items for ascertaining their 'Declarative Knowledge'; and six items represent their

'Conditional knowledge' and four items to ascertain the 'Procedural knowledge' of the students.

Students Attitude Questionnaire in learning Physics (SAQ)

The Students Attitude questionnaire in learning Physics (SAQ) designed after conceptualizing different components of Students Attitude by number of review by the investigator. The survey has 16 statements to ascertain the Students attitude in learning Physics in their Real world connections, Personal Interest, Sense making Effort, Conceptual Connections, Problem solving general, Problem solving Confidence with Likert five point scale that is Strongly Agree, Agree, Undecided, Strongly disagree, Disagree. There are four items in the tool which represent 'Real world connections'; two items represent 'Personal Interest' of the students; three items indicate their 'Sense making Effort'; two items for 'Conceptual connections'; three items ascertaining the 'Problem solving general' aspects and two items represent 'Problem solving confidence' of students.

Physics Problem solving Questionnaire (PPSQ)

The Physics Problem solving Questionnaire (PPSQ) elicited students' retrospective reports on the self-regulatory strategies they had employed while working on a given Physics problem. The Questionnaire is based on an instrument used with BED trainees having choices Yes! No by Ramganes (2003). To make the questionnaire more appropriate for standard XII students, the original version was modified by deleting, rewording and including some items with the consultation of experts in the field of Education and Cognitive Psychology.

PPSQ was designed in order to find out the red alert of the students. There are 14 statements. Each statement has 2 options 'Yes' and 'No'. The students are given the PPSQ and their response is recorded. For each and every response they provide through PPSQ, the investigator ascertain it by the problem solving sheet provided to the students during Pre-test, Post-test1 and Post-test2. If there is a mismatch between the response in PPSQ and the Problem solving sheet, students get an error detection that is red alert.

Check list on students' knowledge towards Information and Communication Technology (ICT)

The investigator developed a Checklist on Students' knowledge towards ICT and Multimedia based on the ICT knowledge and skills questionnaire developed by Johnson and. Ramganes (2009) which consists of 30 questions pertaining to the operation of computer, about certain software and Multimedia components and how to use the interactive multimedia package. Since it is a checklist, only two alternatives are there 'Yes' or 'No'. The right answer carries one mark and the wrong answer carries zero. The checklist was circulated to the experts in the Department of Educational Technology, Tiruchirappalli, Department of Computer science, National Institute of Technical Teacher Training and Research, Chennai. Addition and deletion of items were done based on their opinion. In using ICTM, every effort is made to observe and evaluate student-knowledge about Information and communication technology and Multimedia. The Cronbach's alpha coefficient for ICTM was $r = 0.86$

Interview questionnaire on Interactive multimedia Package for experts in Educational Technology

This questionnaire is a structured one and was developed by the investigator. It is both open and closed ended, to obtain experts' opinion on the various aspects of e-content such as introduction of the topic, content, layout and text elements, delivery, use of multimedia, graphics, animation and music enhancements and technical production. Experts are requested to offer their remarks if any, for each of the above mentioned aspects of interactive multimedia package. The tool on Expert cum peer group rating scale on e-content developed by Ramganes (2009) was referred. Experts' opinion was obtained for the validity of the questionnaire. Based on their opinion, rewording, addition and deletion were made.

Interview questionnaire on Interactive multimedia Package for experts in Physics

This questionnaire is a structured one and was developed by the investigator. It is both open and closed ended, to obtain experts' opinion on the various aspects of interactive multimedia package such as introduction of the topic, content, text elements, delivery, use of multimedia, graphics and animation, technology and presentation with respect to the select topics in science. Experts are requested to offer their remarks if any for each of the above mentioned aspects of interactive multimedia package. Experts'

opinion was obtained for the validity of the questionnaire. Based on their opinion, rewording, addition and deletion were made.

Major Findings of the study

The following are the major findings of the study:

- Self-regulatory strategy with interactive multimedia was found effective on enhancing the problem solving ability of higher secondary students in Physics as experimental group outperformed control group in the post-tests.
- Self-regulatory strategies with multimedia were found to enhance self-regulatory awareness, Student Attitude towards learning Physics and knowledge towards Information and Communication Technology (ICT).
- As significant difference was found between post-test1 and post-test2 of Experimental group the strategies were proved to retain the problem solving ability among the higher secondary students.
- Self-regulatory strategies were found effective with multimedia in reducing 'Red Alerts' in Problem solving in Physics among the higher secondary students.
- Self-regulatory awareness, Student Attitude towards learning Physics, Mathematical ability and knowledge towards Information and Communication Technology (ICT) were found as predictors of problem solving ability in Physics among the higher secondary students.

Conclusion

21st century is characterized with the emergence of knowledge based society wherein ICT plays a pivotal role. The National curriculum framework 2005 (NCF 2005) has also highlighted the importance of ICT in school education. With this backdrop, major paradigm shift is imperative in education characterized by imparting instructions, collaborative learning, multidisciplinary problem-solving and promoting critical thinking skills.

In the light of the research findings it is felt that the present piece of research may contribute on alleviation of difficulties of students in approaching Physics Problems. It is hoped that appropriate training so called self-regulatory problem strategy training with interactive multimedia may be given for the needy students and the findings of the study may be taken into consideration for a better framework in developing Physics Problem solving ability of the students.