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RESEARCH ARTICLE

EFFECT OF SELF-REGULATORY STRATEGY WITH INTERACTIVE MULTIMEDIA ON PROBLEM SOLVING ABILITY OF HIGHER SECONDARY STUDENTS IN PHYSICS

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ABSTRACT

The importance of teaching problem solving to students has been widely recognized by teachers, administrators, and other educational stakeholders. The advent of computer technology, particularly multimedia learning, has changed the landscape of problem-solving instruction. Computer-based problem simulations, for example, begin to replace the traditional paper and pencil approach with more vivid, interactive approach that provides both auditory and visual information to problem solving. The psychological and cognitive benefits of using multimedia to teach problem solving are palpable: the multimedia motivates students to learn, promotes deep understanding, and engages them in problem solving. 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).Problem solving is an evergreen topic in science education research. Here students do not get an opportunity to think independently and conceptualize the process involved in problem solving. In fact the present state of teaching problem solving in science by innovative methods like using interactive multimedia in the majority of educational institutions at all levels needs a lot of overhauling. It is in this assumption that the present study aims to find out the effectiveness of an innovative strategy with modern technological tools known as interactive multimedia with a self regulatory strategy in solving physics problems of higher secondary students. This study attempts to empower the Problem solving ability of students in the rural areas through an innovative technique, interactive multimedia with a Self regulatory strategy by the principle of "Reaching the Unreached". The present study examined the self-regulatory awareness of higher secondary students. The sample of the study consisted of 90 higher secondary school students. Self-regulation of students was measured using Self-regulatory awareness inventory (SAI). Results further indicated male and female students do not differ in their Self-regulatory awareness during their problem solving action in the pre-test, Post-test1 and post-test2. The Self-regulatory awareness of students of science in rural areas in Karaikal district during their problem solving action is comparatively less in the pre-test. Post-test1, Post-test2, mean and SD scores revealed that students of science could improve their Problem solving, ability using Self-regulatory strategies with multimedia learning materials. The orientation on Self-regulatory strategies with multimedia learning materials is effective for solving problem in Physics.

INTRODUCTION

Science was made a compulsory subject for all children in India up to class X after Independence (Rajput, 2000). Everybody had the benefit of several commissions and committees on education since then. The report of the Secondary Education [Mudaliar Commission Report, (1952)] recommended the study of general science at the Junior Secondary stage, i.e., from standards 6 to 8. At the higher secondary stage, i.e., from standards 9 to 12, a diversified curriculum was to be followed. However, the commission recommended that a common, core group of subjects that includes science, be taught to all students irrespective of their diversified courses of study (Report of the Secondary Education, 1952). According to Schunk and Zimmerman (1994), Self-regulated learning as "the process whereby students activate and sustain cognitions and affects that are systematically oriented toward attainment of their goals". SRL is viewed as proactive processes that students use to acquire academic skill, such as setting goals, selecting and deploying strategies, and self-monitoring one's effectiveness, rather than as a reactive event that happens to students due to impersonal forces (Zimmerman, 2008). Self-regulation is the controlling

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of a process or activity by the students who are involved in it rather than by an external agency (Johnson *et al.,* 2009).

Rationale of the study

The Kothari commission report (1960) states, "If science is poorly taught and badly learnt, it is little more than burdening the mind with dead information and it could degenerate even into new superstitions". It is necessary to identify the problems of the learners and plan the learning activities before teaching and using innovative strategies for effective dissemination of instruction. So there is a growing need for appropriate science education. The most important purpose of the teaching of science is the development of the problem solving ability in the pupils as well as the ability to meet and solve problems in daily life. Presenting a problem and developing the skills needed to solve that problem are more motivational than teaching the skills without content. Such motivation gives problem solving special values as vehicle for learning new concepts, skills and the reinforcement of skills already acquired (Stanic and Kilpatrick, 1989). Problem solving is of paramount importance in learning science. The objectives of the study were to:

1. Find difference between self-regulatory awareness of higher secondary students between control and experimental group.
2. Find difference between Physics Problem solving of higher secondary students between control and experimental group.
3. Examine the gender differences in self-regulatory awareness of higher secondary students.
4. Examine the subject group differences in self-regulatory awareness of higher secondary students.

Hypotheses

1. There is no significant difference between Control and Experimental Group with respect to Self-Regulatory Awareness (SRA) of Pre-test, Post-test 1 and Post-test 2.
2. There is no significant difference between Control and Experimental Group with respect to Physics Problem Solving (PPS) of Pre-test, Post-test 1 and Post-test 2.
3. There is no significant difference between male and female with respect to SRA of Pre- test, Post-test 1 and Post-test2 of experimental group.
4. There is no significant difference between Biology and Computer Science group with respect to SRA of Pre- test, Post-test 1 and Post-test2 of experimental group.

METHODOLOGY

This was an experimental study. Self-regulation of students was measured using Self-regulatory awareness inventory (SAI). It was developed and validated by the investigator. SAI was designed after conceptualizing different components of self-regulation. The survey has 48 statements to ascertain the self-regulatory awareness of student-teachers in their *Planning, Information management strategy, Comprehension Monitoring, Debugging strategies, Evaluation, Declarative Knowledge, Conditional knowledge and Procedural knowledge* with three point scale i.e Yes, No, Uncertain. Pre-test was conducted to all the 90 higher secondary school science students to assess the entry behaviour of them. Theoretical orientation on Self-regulation with Science examples on problem solving was administered. Hands-on experience through Multimedia for the Experimental group on how to do Science problems at standard XII was provided. Finally, Post- test was conducted.

Sample

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. Experimental research method with control design was adopted for the study.

Hypothesis 1

Null hypothesis: There is no significant difference between Control and Experimental Group with respect to Self-Regulatory Awareness (SRA) of Pre-test, Post-test 1 and Post-test 2.

Table 1. t test for significant difference between Control and Experimental Group with respect to Self-Regulatory Awareness (SRA) of Pre-test, Post-test 1 and Post-test 2.

SRA	Group	Mean	SD	t value	P value
Pre-test	control	110.27	21.50	1.146	0.255
	Experiment	105.44	18.30		
Post-test1	control	108.18	28.33	14.300	0.000**
	Experiment	172.22	9.99		
Post-test2	control	112.11	32.48	12.519	0.000**
	Experiment	175.13	9.24		

Note: ** Denotes significant at 1% level

Since P value is less than 0.01, null hypothesis is rejected at 1% level of significance with regard to Self-Regulatory Awareness (SRA) of Post test 1 and post test 2. Hence there is significant difference between Control and Experimental Group with respect to Self-Regulatory Awareness (SRA) of Post-test 1 and Post-test 2. The mean score of the post-test 1(M=172.22), Post- test2 (M=175.13) is greater than that of pre-test (M= 105.44) for the experimental group. On comparison of the mean scores of the experimental and control group for post-test1 and post-test2, the mean scores of the experimental group are higher than that of the control group. This clearly depicts that the self regulatory awareness of students among the experimental group is higher than the control group. There is no significant difference between Control and Experimental Group with respect to Self-Regulatory Awareness (SRA) of Pre-test, since P value is greater than 0.05.

Hypothesis 2

Null hypothesis: There is no significant difference between Control and Experimental Group with respect to Physics Problem Solving (PPS) of Pre-test, Post-test 1 and Post-test 2. Since P value is less than 0.01, null hypothesis is rejected at 1% level of significance with regard to Physics Problem Solving (PPS) of Post test 1 and post test 2. Hence there is significant difference between Control and Experimental Group with respect to Physics Problem Solving (PPS) of Post-

test 1 and Post-test 2. The mean score of the post-test 1(M=27.96), Post- test2 (M=28.09) is greater than that of pre-test (M= 3.07) for the experimental group. This clearly indicates that the mean scores of experimental group is far more than the control group and the experimental group students physics problem solving mean score is higher than the control group. It clearly proves that the self-regulatory orientation with interactive multimedia enhances the Physics Problem solving ability of students.

Table 2. t test for significant difference between Control and Experimental Group with respect to Physics Problem Solving (PPS) of Pre-test, Post-test 1 and Post-test 2.

PPS	Group	Mean	SD	t value	P value
Pre-test	control	3.69	2.54	1.261	0.211
	Experiment	3.07	2.13		
Post-test1	control	8.42	4.27	28.580	0.000**
	Experiment	27.96	1.67		
Post-test2	control	8.22	4.23	29.912	0.000**
	Experiment	28.09	1.41		

Note: ** Denotes significant at 1% level

There is no significant difference between Control and Experimental Group with respect to Physics Problem Solving (PPS) of Pre-test, since P value is greater than 0.05.

Hypothesis 3

Null hypothesis: There is no significant difference between male and female with respect to SRAI of Pre- test, Post-test 1 and Post-test2 of experimental group.

Table 3. t test for significant difference between male and female with respect to SRA of Pre- test, Post-test 1 and Post-test2 of experimental group.

SRA	Sex	Mean	SD	t value	P value
Pre-test	Male	108.00	19.34	0.914	0.366
	Female	103.00	17.32		
Post-test1	Male	174.64	11.07	1.614	0.114
	Female	169.91	8.44		
Post-test2	Male	177.18	9.93	1.474	0.148
	Female	173.17	8.26		

Since P value is greater than 0.05, null hypothesis is accepted at 5% level of significance with regard to SRAI of Pre-test, Post test 1 and post test 2. Hence there is no significant difference between male and female with respect to SRAI of Pre- test, Post-test 1 and Post-test2 of experimental group. The mean score of Post-test1 (M=174.64), Post-test2 (177.18) for male with respect to SRAI is greater than the score of Post-test1 (M=169.91), Post-test2 (173.17) for female.

Hypothesis 4

Null hypothesis: There is no significant difference between Biology and Computer Science group with respect to SRAI of Pre- test, Post-test 1 and Post-test2 of experimental group. Since P value is greater than 0.05 for Post-test 1 and Post-test2 of Biology and Computer Science group with respect to SRAI of experimental group, the null hypothesis is accepted at 5% level of significance. Hence there is no significant difference between Biology and Computer Science group with respect to SRAI of Post-test1 and Post-test2 of experimental group.

Table 4. t test for significant difference between Biology and Computer Science group with respect to SRA of Pre- test, Post-test 1 and Post-test2 of experimental group

SRA	Group	Mean	SD	t value	P value
Pre-test	Biology	100.44	16.29	2.132	0.039*
	Computer Science	111.70	19.13		
Post-test1	Biology	171.52	8.49	0.523	0.604
	Computer Science	173.10	11.78		
Post-test2	Biology	174.60	7.92	0.429	0.670
	Computer Science	175.80	10.84		

Note: * Denotes significant at 5% level

There is a significant difference between Biology and Computer Science group with respect to SRAI of Pre-test, since P value is less than 0.05. The mean score of Post-test1 (M=173.10) for Computer Science is greater than the Biology mean score (M=171.52). The mean score of Post-test2 (M=175.80) for Computer Science is greater than the Biology mean score (M=174.60). This clearly indicates Computer Science group with respect to SRAI of experimental group is greater than the Biology group.

Findings

1. There is a significant difference between Control and Experimental Group with respect to Self-Regulatory Awareness (SRA) of Post-test 1 and Post-test 2.
2. There is a significant difference between Control and Experimental Group with respect to Physics Problem Solving (PPS) of Post-test 1 and Post-test 2.
3. There is no significant difference between male and female with respect to SRA of Pre- test, Post-test 1 and Post-test2 of experimental group.
4. There is no significant difference between Biology and Computer Science group with respect to SRA of Post-test 1 and Post-test2 of experimental group.

Conclusion

In this age of Globalization, Technology has become a powerful pedagogical tool in Education. Computer and Internet based technologies hold great promise both for increasing access to knowledge and as a means of promoting learning. Various technologies deliver different kinds of content and serve different purposes in the classroom. Each technology is likely to play a different role in students' learning. Self-regulation with interactive multimedia plays a major role in solving science problems. In the present scenario, Self-regulation has gained momentum and many studies are attempted to increase the achievement level of students.

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