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EXAMINING SELF REGULATED LEARNING IN RELATION TO CERTAIN SELECTED VARIABLES

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Abstract. Self-regulation is the controlling of a process or activity by the students who are involved in Problem solving in Physics rather than by an external agency (Johnson, 2011). Self-regulated learning consists of three main components: cognition, metacognition, and motivation. Cognition includes skills necessary to encode, memorise, and recall information. Metacognition includes skills that enable learners to understand and monitor their cognitive processes. Motivation includes beliefs and attitudes that affect the use and development of cognitive and metacognitive skills. The present study made its sincere attempt to develop self-regulatory strategies that are integrated into Physics problem solving. It also took cognizance of cognition as a thinking component, Metacognitive awareness among the students as a chief component of self-regulatory strategies and multimedia as a component of motivation. The present investigation was carried out in S.R.V.S Higher Secondary school, Karaikal. A sample of 90 XII students was taken for the study. Out of 90 students, 45 students belong to computer Science and 45 students belong to Biology group. Both of the groups have Physics as the compulsory subject. The students are divided into two groups namely control and experimental group based on the mathematical ability and Physics achievement score. Experimental research method with control design was adopted for the study. The major findings of the study reveal that there exists marked difference between Post-test1 and post-test2 for the following variables of experimental group in Physics problem solving ability, self regulatory awareness, knowledge of ICT and students attitude towards learning Physics. It is also noted that self-regulatory strategies with interactive multimedia effective for enhancing problem solving ability in physics among higher secondary students.

Key words: self-regulation, problem solving ability, ICT, students attitude.

Introduction

Science has been and will continue to be of tremendous importance to humanity for its ability to explain many of the everyday occurrences in life, as well as playing a very significant role in the technological development of both developing and developed nations of the world.

While delivering the convocation address of Allahabad University in 1946, Nehru said, It is science alone that can solve the problems of hunger and poverty, of insanitation and malnutrition, of illiteracy and obscurantism of superstition and deadening customs, of rigid traditions and blind beliefs, of vast resources going to waste of a rich country inhabited by starving millions. Nehru (1946) stated, Who indeed can afford to ignore science today? At every turn, we have to seek it's aid and the whole fabric of the world is of it's making. (Pursuit and Promotion of Science, 2001)

In cognizance with Pandit Jawaharlal Nehru opinion, Atal Behari Vajpayee, has also rightly pointed out that, "We must overhaul the system of science education in the country to base it on knowledge and creativity and not on memorizing and examinations". (Pursuit and Promotion of Science, 2001)

Physics - widely recognized to be the most fundamental of all the Sciences - has also been recognized as the foundation of our society (Pravica, 2005). Physics is not only important to a country's economic progress; it is also important to individuals to be able to cope up with the rapidly changing society as a result of advances in technology. Goodstein (1999, P.186) believes that "a solid education in Physics is the best conceivable preparation for the lifetime of rapid technological and social change that our young people must expect to face". Abdus Salam (in Ford and Wilde, 1999, p.215), a Nobel Prize

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winner in Physics in 1979, wrote in a book: “If a nation wants to become wealthy, it must acquire a high degree of expertise in Physics, both pure and applied”.

Indeed it is imperative to take cognizance of UNESCO recommendations. UNESCO Planning Mission (in Aman Rao, 1993, p.6) made important recommendations and they are summarized as follows:

- Learning of Physics be made compulsory.
- More time be devoted to impart elementary knowledge of modern areas of Physics like atomic Physics, nuclear Physics, solid state physics, electronics etc.
- More emphasis be put on the practical applications of physics.
- Learning activities be built into the teaching of physics.
- The teaching of physics should start as a part of general science from class VI
- Physics be taught as a separate subject from class XI

Interactive Multimedia can be used to develop active and mastery learning. In this learning situation, there is active participation on the part of the learner as opposed to passive learning, listening to lectures and demonstrations. It can stimulate the students’ mind and encourage learning through all sense because multimedia can combine so many media together. Psychologists acknowledge the important of interactive process for knowledge retention. Interactive Multimedia generates a lot of excitement as a learning tool. It crosses traditional boundaries of school, work place, and home, and enabling learners to choose their learning materials, in their own time and at their own pace.

Problem-solving skill is highly valued. In the last five decades, many theorists and educational institutions have placed a heavy emphasis on this ability. For example, the movement of “discovery learning” (e.g., Bruner, 1961) was spawned, at least in part, by the perceived importance of fostering problem-solving skills.

It can be argued that Science in general, and Physics in Particular, has always played a key role in the development of our society in terms of the technological advances that brought to human existence many of our conveniences, and, at the same time, raised global-scale issues resulting from these advances. An example could be the development of automobile. The automobile has become a very important necessity in many people’s lives because of the convenience and the utility it provides when going places. However, there would be widespread agreement that it is also one of the key contributors to what has become a major global issue: that of Global Warming. There are many other technological advances which, through Physics, have enriched our modern society, and Physics, as a fundamental science, has made a big contribution to changing the way we live in the present time as compared to the way people lived, say, fifty years ago. Because of Physics we are now living in what others would call a technological society. Of all the sciences, Physics is at the heart of the technology driving our economy (National Research council, 2001) and is present in almost every facet of modern life. In other words, Physics is a very important science applied in engineering and in the design aspects of different technologies. That is, Physics can be seen as related to the fundamental understanding of phenomena and these ideas are then picked up and applied to technologies. Physics may also be considered the most fundamental of all the sciences because others like chemistry, Biology, Geology, etc., deal with systems that obey law of Physics. This is one of the reasons why Physics has become an essential part of being scientifically literate. Indeed Problem solving in Physics plays a key role in the conceptualization of the students at higher secondary level.

Self-regulated learning refers to our ability to understand and control our learning environments. To do so, we must set goals, select strategies that help us achieve these goals, implement those strategies, and monitor our progress towards our goals (Schunk, 1996). Few students are fully self-regulated; however, those with better self-regulation skills typically learn more with less effort and report higher levels of academic satisfaction (Pintrich, 2000; Zimmerman, 2000).

Self-regulated learning consists of three main components: cognition, metacognition, and motivation. Cognition includes skills necessary to encode, memorise, and recall information. Metacognition includes skills that enable learners to understand and monitor their cognitive processes. Motivation includes beliefs and attitudes that affect the use and development of cognitive and metacognitive skills.

Each of these three components is necessary, but not sufficient, for self-regulation. For example, those who possess cognitive skills but are unmotivated to use them do not achieve at the same level of performance as individuals who possess skills and are motivated to use them (Zimmerman, 2000). Similarly, those who are motivated, but do not possess the necessary cognitive and metacognitive skills, often fail to achieve high levels of self-regulation.

Rationale of the study

Higher Secondary is a crucial stage of school education because at this stage specialized, 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 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.

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.

In this perspective, the researcher attempts to empower the problem solving ability of higher secondary students in the rural area school through an innovative technique, self-regulatory strategies with interactive multimedia by the principle of “Reaching the Unreached”.

Research Questions

A research question is a question that is worth asking for a qualitative and quantitative analysis. A good research question requires more than looking something up. The following are the research questions formulated by the investigator which is summed up as follows:

Are self-regulatory strategies with interactive multimedia effective for enhancing problem solving ability in physics among higher secondary students?

Do these strategies help sustain problem solving ability of students in Physics over a period of time?

Do the variables self-regulatory awareness, knowledge of ICT among students and attitude towards physics problem solving contribute to problem solving ability of higher secondary students?

Sample, Method & Tools

A sample of 90 higher secondary school students from S.R.V.S, Karaikal was taken for the study. Experimental research method was adopted for the above 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 investigation. The investigator developed the following questionnaire for the study:

- Self-regulatory awareness Inventory for Physics students (SRA)
- Students Attitude Questionnaire in learning Physics (SAQ)
- Physics Problem solving ability Questionnaire (PPS)
- Checklist on Students Knowledge towards ICT (ICT)

Hypothesis 1

Students of control group and experimental group do not differ significantly for the following variables in the pre-test: Physics problem solving ability, self-regulatory awareness, knowledge of ICT; students Attitude in learning Physics; Mathematical ability.

Table 1. Comparison of mean scores of control group and Experimental group in the pre-test

Max: PPS-30; SRA-240; ICT- 30; SAQ-80; MA-15

Variables	Control group		Experimental group		t value	P value
	Mean	SD	Mean	SD		
PPS	3.69	2.54	3.07	2.13	1.261	0.211
SRA	110.27	21.50	105.44	18.30	1.146	0.255
ICT	21.87	3.09	21.80	2.26	0.117	0.907
SAQ	46.64	6.54	44.42	6.35	1.636	0.106
MA	11.82	1.89	11.89	1.95	0.165	0.869

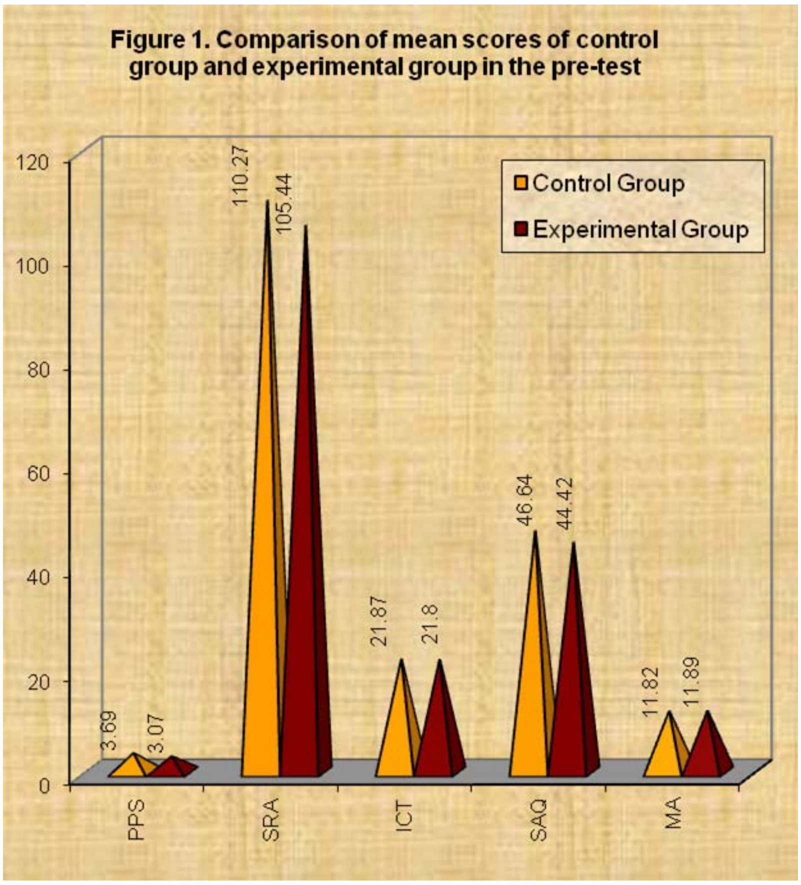

Figure 1. Comparison of mean scores of control gourp and experimental group in the pre-test

It can be seen from the Table 1 that the control group and experimental group students do not differ significantly in Physics Problem solving, Self-regulatory awareness, Knowledge of ICT, Students Attitude in learning Physics and Mathematical ability at 0.01 level of significance ($P<0.01$) in the pre-test. Since the t-value for the above mentioned variables were found insignificant.

The values of mean and standard deviation of control group and experimental group were found almost same which indicates that students of both groups have same level of problem solving ability in Physics, although they do not have average level of such ability.

As far as self- regulatory awareness is concerned, although there is no marked difference in the scores of Mean and Standard Deviation it is found that the mean score of control group is slightly greater than that of experimental group. Hence students of Control group and experimental group have almost similar level of Self-regulatory awareness.

For the variable knowledge of ICT, the values of mean and standard deviation of control group and experimental group were found almost same .This indicates that students of both groups have same level of Knowledge of ICT, although some students are from computer science group.

As far as students' attitude in learning Physics is concerned, although there is no marked difference in the scores of mean and Standard deviation it is found that the mean score of control group is slightly greater than that of experimental group. Hence students of Control group might be treated to have same level of attitude in learning Physics.

For the variable Mathematical ability, the values of mean and standard deviation of control group and experimental group were found almost same .This indicates that students of both groups have same level of Mathematical ability.

Figure 1 shows that there is no much difference in the values of mean between the control group and experimental group in the pre-test for the variables namely Physics Problem solving ability, Self regulatory awareness, Knowledge of ICT, Students attitude towards learning Physics and Mathematical ability. It is also noted that control group and experimental group are same in Physics Problem solving ability, Self regulatory awareness, Knowledge of ICT, Students attitude towards learning Physics and Mathematical ability.

Hypothesis 2

Students of Control group do not differ significantly between pre-test and post-test 1 of the following variables: Physics problem solving ability, self-regulatory awareness; knowledge of ICT, students' attitude in learning Physics.

Table 2. t-test for significant difference of control group between pre-test and post-test 1

Variables	Test	Mean	SD	t value	P value
PPS	Pre-test	3.69	2.54	1.261	0.211
	Post-test1	8.42	4.27		
SRA	Pre-test	110.27	21.51	0.404	0.688
	Post-test1	108.18	28.33		
ICT	Pre-test	21.87	3.09	5.978	0.000**
	Post-test1	22.36	3.28		
SAQ	Pre-test	46.64	6.54	1.058	0.296
	Post-test1	45.29	7.88		

Table 2. reveals that students of control group do not differ significantly between pre-test and post-test1 in their problem solving ability in Physics, Self regulatory awareness and students' attitude towards learning Physics and they differ significantly in their knowledge on ICT at 0.01 level of significance ($P<0.01$).

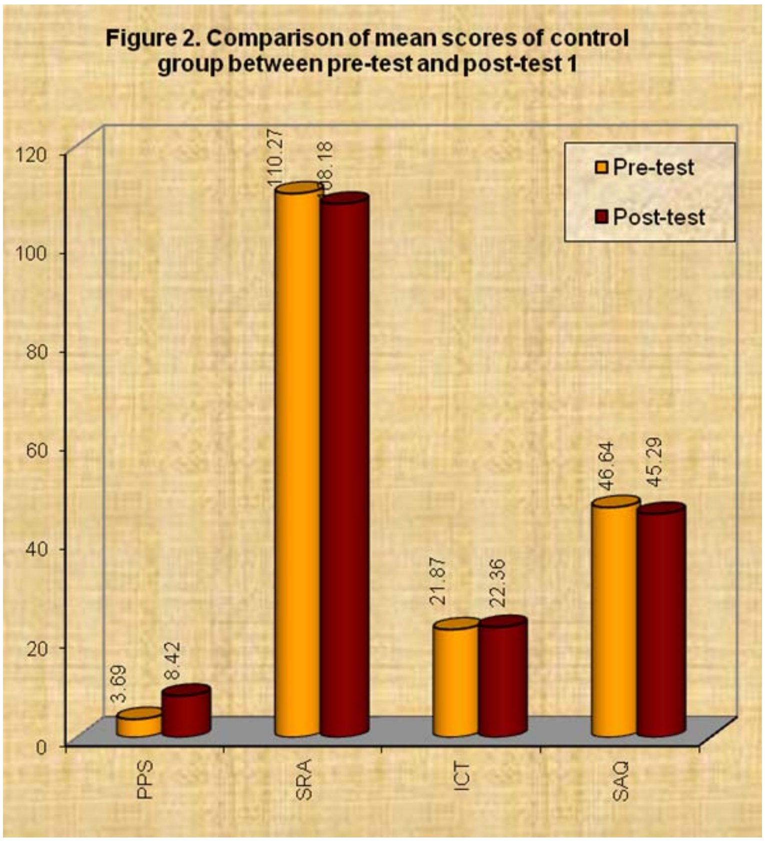

Figure 2. Comparison of mean scores of control group between pre-test and post-test 1

It is interesting to note that the mean score of Physics problem solving ability and students attitude in the post-test1 is slightly greater than that of the pre-test which indicates the influence of conventional approach of teaching Physics. Also it was found that the post-test score in ICT knowledge was slightly greater than that of the pre-test. This might be due to the incorporation of computer science as a core subject in their curriculum. As there is no marked difference in the scores of Standard deviation for all the variable, the performance of students for all the variables were found likely to be same between the pre-test and post-test1.

It can also be observed from Figure 2 that there is no increase of mean scores of control group between pre-test and post-test 1 for the variables namely Physics problem solving ability, self regulatory awareness, knowledge of ICT and Students attitude towards learning Physics.

Hypothesis 3

Students of experimental group do differ significantly between pre-test and post-test 1 of the following variables: Physics problem solving ability, self-regulatory awareness; knowledge of ICT, students' attitude in learning Physics.

Table 3. Comparison of mean scores of experimental group between pre-test and post-test 1

Variables	Test	Mean	SD	t value	P value
PPS	Pre-test	3.07	2.13	82.906	0.000**
	Post-test1	27.96	1.67		
SRA	Pre-test	105.44	18.30	32.711	0.000**
	Post-test1	172.22	9.99		
ICT	Pre-test	21.80	2.26	21.139	0.000**
	Post-test1	28.09	1.43		
SAQ	Pre-test	44.42	6.35	13.844	0.000**
	Post-test1	55.67	3.50		

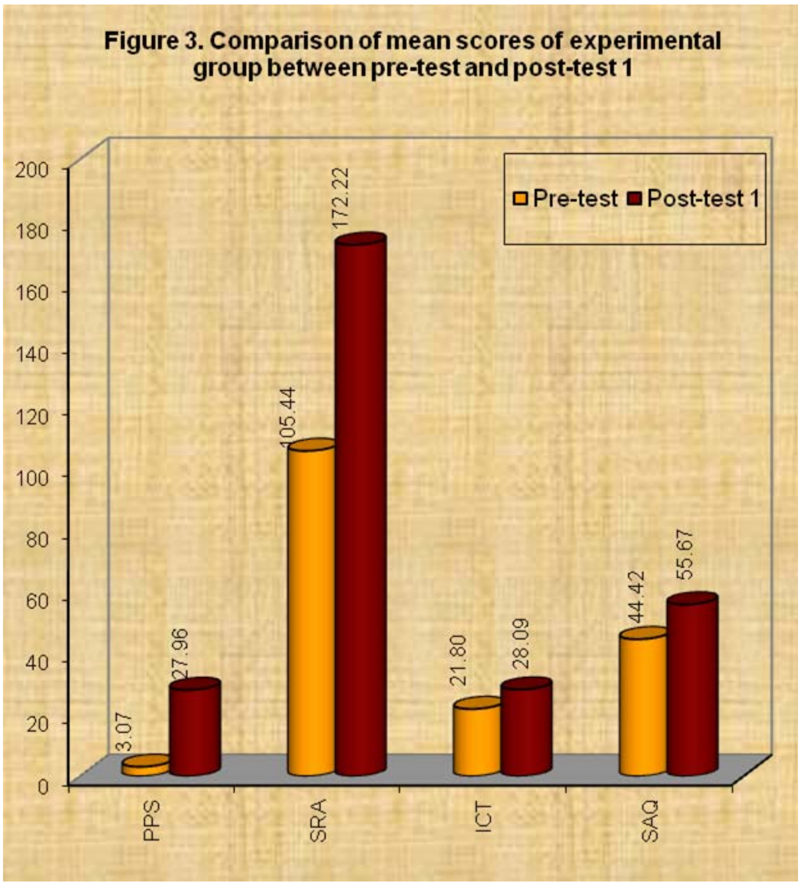

Figure 3. Comparison of mean scores of experimental group between pre-test and post-test 1

Table 3 indicates that experimental group differs significantly between pre-test and post-test 1 in the Physics problem solving ability, self-regulatory awareness, knowledge of ICT and students' attitude in learning physics at 0.01 level of significance. As performance in the post-test1 is significantly greater than that of pre-test compared to control group and experimental group, the orientation on self regulatory strategies with interactive multimedia is proved to be more effective. Hence orientation on self regulatory strategies not only strengthens self regulatory awareness of higher secondary students but also their Physics problem solving ability, students' attitude towards learning physics and knowledge of ICT.

Significant increase of scores in the post-test 1 in Physics problem solving ability, self regulatory awareness, knowledge of ICT, students' attitude in learning physics from the pre-test is noticed from the Figure 3. This increase is comparatively more than that of the control group.

Hypothesis 4

There is no significant difference between post-test1 and post-test2 for the following variables of the control group: Physics problem solving ability; self-regulatory awareness; knowledge of ICT; students attitude in learning Physics.

Table 4. Comparison of mean scores of control group between Post-test1 and Post-test2

Variables	Control group	Mean	SD	t value	P value
PPS	Post-test1	8.42	4.27	1.055	0.297
	Post-test2	8.22	4.23		

SRA	Post-test1	108.18	28.33	0.561	0.578
	Post-test2	112.11	32.48		
ICT	Post-test1	22.36	3.28	4.195	0.000**
	Post-test2	21.69	3.19		
SAQ	Post-test1	45.29	7.88	0.845	0.407
	Post-test2	46.73	8.25		

**Denotes significant at 1% level

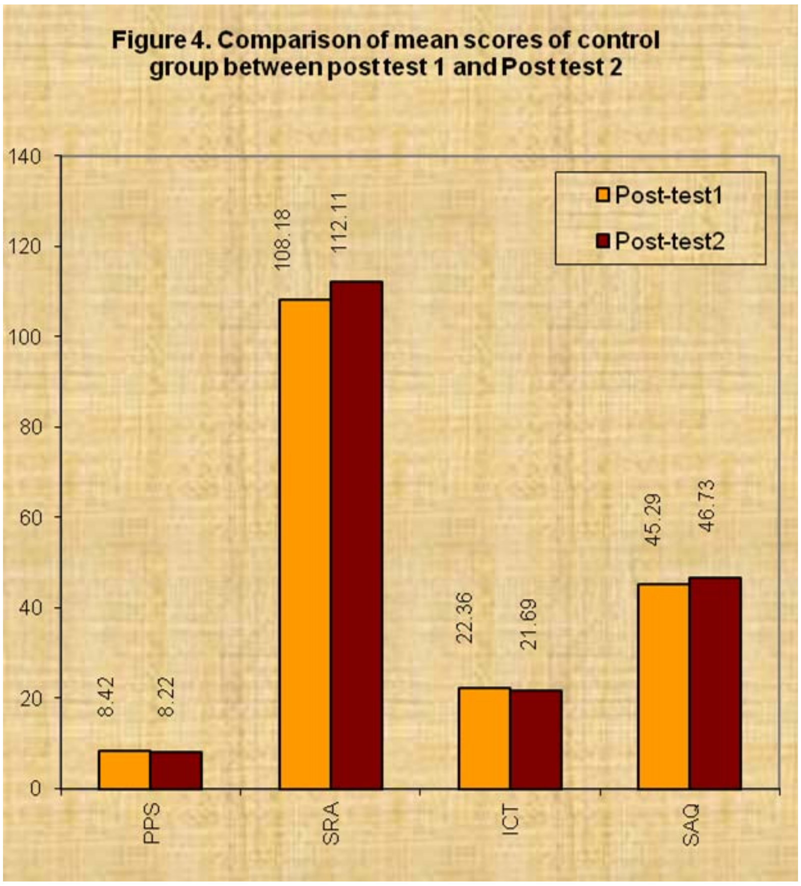

Figure 4. Comparison of mean scores of control group between post-test 1 and post-test 2

It was found from the table T.4 in Knowledge of ICT that the mean score of post-test1(M=22.36) is greater than the post-test2 mean score (M=21.69).This clearly indicates that Knowledge of ICT decreased gradually from post-test1 to post-test2 and the control group students should be given hands on experience in the knowledge of ICT and a suitable orientation classes shall be arranged in enhancing the Knowledge of ICT of higher secondary students. Since P value is less than 0.01, null hypothesis is rejected at 1% level of significance with regard to Knowledge of ICT of Post-test1 and Post-test2. Hence there is significant difference between post-test1 and post-test2 in Knowledge of ICT of higher secondary students in Physics.

It can be seen from the Table 4 in Physics Problem solving that the mean score of post-test1(M=8.42) is greater than the post-test2 mean score (M=8.22).This clearly indicates that Physics Problem solving decreased gradually from post-test1 to post-test2 and the control group is lagging behind the experimental group in physics problem solving. Since P value is greater than 0.05, null hypothesis is accepted at 5% level of significance with regard to Physics Problem solving of Post-test1 and Post-test2. Hence there was no significant difference between post-test1 and post-test2 in Physics Problem solving ability of higher secondary students of the control group.

For the variable Self-regulatory awareness the mean score of post-test1(M=108.18) is less than the post-test2 mean score (M=112.11).The value of standard deviation in the post-test2 is little bit higher than that of post-test1, which shows a bit of deviation in Self-regulatory awareness. Since P value is greater than 0.05, null hypothesis is accepted at 5% level of significance with regard to Self-regulatory awareness of Post-test1 and Post-test2. Hence there was no significant difference between post-test1 and post-test2 in Self-regulatory awareness of higher secondary students in Physics.

As far as Student attitude in learning Physics is concerned, the mean score of post-test1 (M=45.29) is less than the post-test2 mean score (M=46.73). This clearly indicates that Student attitude in learning Physics increased gradually from post-test1 to post-test2 which is not at the expected level. In order to enhance the attitude of students in learning Physics Self-regulatory awareness, Knowledge of ICT should be incorporated in the curriculum. The value of standard deviation in the post-test2 is little bit higher than that of post-test1, which shows a bit of deviation in Student attitude in learning Physics. Since P value is greater than 0.05, null hypothesis is accepted at 5% level of significance with regard to Student attitude in learning Physics of Post-test1 and Post-test2. Hence there was no significant difference between post-test1 and post-test2 in Student attitude learning Physics of higher secondary students in Physics.

It can also be observed from the Figure 4 that there is no increase of mean scores of control group between Post-test1 and Post-test2 for the variables namely Physics Problem solving ability, Self regulatory awareness, Knowledge of ICT and Students attitude towards learning Physics.

Hypothesis 5

There is no significant difference between post-test1 and post-test2 for the following variables of the experimental group: Physics problem solving ability; self-regulatory awareness; knowledge of ICT; students attitude in learning Physics.

Table 5. Comparison of mean scores of experimental group between post-test 1 and post-test 2

Variables	Experimental group	Mean	SD	t value	P value
PPS	Post-test1	27.96	1.67	0.903	0.372
	Post-test2	28.09	1.41		
SRA	Post-test1	172.22	9.99	12.977	0.000**
	Post-test2	175.13	9.24		
ICT	Post-test1	28.09	1.43	10.074	0.000**
	Post-test2	28.93	1.14		
SAQ	Post-test1	55.67	3.50	6.673	0.000**
	Post-test2	57.87	3.01		

**Denotes significant at 1% level

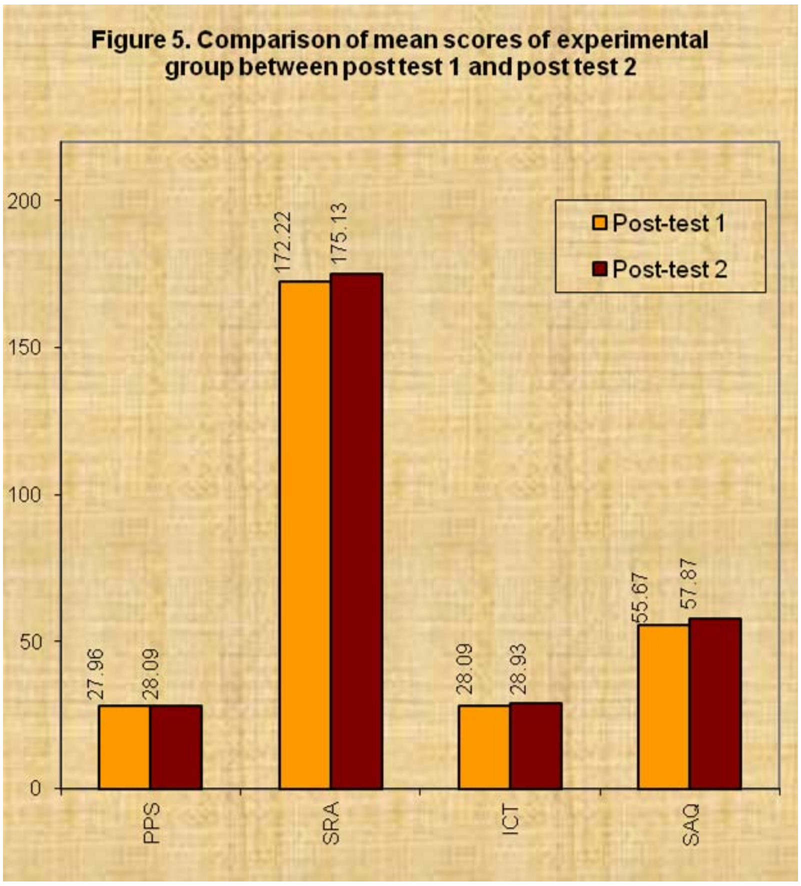

Figure 5. Comparison of mean scores of experimental group between post-test 1 and post-test 2

For the variable Self-regulatory awareness the mean score of post-test1(M=172.22) is less than the post-test2 mean score (M=175.13).This clearly indicates that Self-regulatory awareness increased gradually from post-test1 to post-test2 and the experimentation is quite useful in enhancing the Self-regulatory awareness of higher secondary students. Since P value is less than 0.01, null hypothesis is rejected at 1% level of significance with regard to Self-regulatory awareness of Post-test1 and Post-test2. Hence there was significant difference between post-test1 and post-test2 in Self-regulatory awareness of higher secondary students in Physics.

It can be seen from the Table 5 in Knowledge of ICT that the mean score of post-test1(M=28.09) is less than the post-test2 mean score (M=28.93).This clearly indicates that Knowledge of ICT increased gradually from post-test1 to post-test2 and the experimentation is quite useful in enhancing the Knowledge of ICT of higher secondary students. Since P value is less than 0.01, null hypothesis is rejected at 1% level of significance with regard to Knowledge of ICT of Post-test1 and Post-test2. Hence there was significant difference between post-test1 and post-test2 in Knowledge of ICT of higher secondary students in Physics.

As far as Student attitude in learning Physics is concerned, the mean score of post-test1(M=55.67) is less than the post-test2 mean score (M=57.87).This clearly indicates that Student attitude in learning Physics increased gradually from post-test1 to post-test2 and the experimentation is quite useful in enhancing the Student attitude in learning Physics of higher secondary students. Since P value is less than 0.01, null hypothesis is rejected at 1% level of significance with regard to Student attitude in learning Physics of Post-test1 and Post-test2. Hence there was significant difference between post-test1 and post-test2 in Student attitude learning Physics of higher secondary students in Physics.

It was found from the Table 5 in Physics Problem solving that the mean score of post-test1(M=27.96) is less than the post-test2 mean score (M=28.09).This clearly indicates that Physics Problem solving increased gradually from post-test1 to post-test2 and the experimentation is quite useful in enhancing the physics problem solving of higher secondary students. Since P value is greater than 0.05, null hypothesis is accepted at 5% level of significance with regard to Physics Problem solving of Post-test1 and Post-test2. Hence there was no significant difference between post-test1 and post-test2 in Physics Problem solving ability of higher secondary students of the experimental group.

Figure 5 shows the increase of mean scores of experimental group between post-test1 and post-test2 for the variables namely Physics Problem solving ability, Self regulatory awareness, Knowledge of ICT and Students attitude towards learning Physics. It is also noted that there is slight increase of post-test2 scores than post-test1 scores for the variables namely Physics Problem solving ability, Self regulatory awareness, Knowledge of ICT and Students attitude towards learning Physics.

Findings

It was found that Control group and experimental group are same in Physics Problem solving ability, Self regulatory awareness, Knowledge of ICT, Students attitude towards learning Physics and Mathematical ability in the Pre-test.

It was found that there is no marked difference of mean scores of control group between pre-test and Post-test1 for the variables namely Physics Problem solving ability, Self regulatory awareness, Knowledge of ICT and Students attitude towards learning Physics.

It was found from the differential analysis that there exists marked difference between Pre-test and Post-test1 for the following variables of experimental group: Physics problem solving ability; self regulatory awareness; knowledge of ICT; students' attitude towards learning physics.

It was found from the differential analysis that there is no marked difference between post-test1 and post-test2 for the variables namely Physics problem solving ability, Self regulatory awareness, Knowledge of ICT and Students attitude towards learning Physics of control group.

It was found from the differential analysis that there exists marked difference between Post-test1 and post-test2 for the following variables of experimental group: Physics problem solving ability; self regulatory awareness; knowledge of ICT; students' attitude towards learning physics.

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.

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