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IMPACT OF METACOGNITIVE SKILLS INTERVENTION PROGRAM ON ACADEMIC ACHIEVEMENT OF PHYSICAL SCIENCE STUDENTS OF SECONDARY SCHOOL

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ABSTRACT

This study is mainly focused about the development of metacognitive skills and its impact on academic achievement of students. Keeping this purpose in view an interventional package based on metacognitive skills in physical science is developed. The pre-test, post-test equivalent, experimental and control group design is used in this study. In this study, ninth standard private school students were selected as the sample of the study. Raven's progressive matrices intelligent test was used for equating the groups. Seventy students were divided in two groups i.e. experimental and control group. Interventional package encompassed with strategies namely; structured teaching, Self-directed learning and Group discussion, developed on the line of sub components of Metacognitive skills. Achievement test was constructed on four units of physical science which were used for developing interventional package. Pre-test was administered for both experimental and control group on academic achievement. Forty-three days of teaching (treatment) was done for experimental group and conventional method was used for control group. Achievement test was administered as post-test for both the groups. The difference between the scores of pre-test and post-test of both the groups were calculated by applying t- test. The obtained data was analysed and interpreted in tabular form. The result shows that, there is a significant difference between the achievements of students of experimental and control group. This indicates that interventional program was more effective than the conventional method of teaching to enhance the academic performance in physical science.

KEY WORDS: *Metacognitive Skills, Interventional Package, Structured Teaching, Self-directed Learning, Group Discussion, Achievement Test.*

INTRODUCTION

Academic achievement of students at secondary level is influenced by many factors. Cognitive Constructivism emphasizes more on knowledge construction by the Individuals. The metacognition-thinking about thinking determines the performance of the learner and recognised as a most suitable strategy of learning (Veenman & Elshout, 1995, Wang et al., 1990, 1993). The development of Metacognitive skills among the students is a challenging task. It should be developed on proper structuring and sequence. The present study focuses on the development of Metacognitive skills which led to the academic development. Proven Intervention strategies are necessary to develop the Metacognitive skills. It is observed from the studies (Barouche, 1997) that higher order thinking skills are the means of development of Metacognitive abilities among the learners. Hence, the researcher has developed the interventional package encompass structured teaching, self-directed learning, and group discussion. However, structured and conducive

learning environment that support specific skills relevant to learn science are much needed. In this regard, there is also a growing emphasis on developing higher order thinking skills of secondary school students (Barouche, 1997; Sleet et al, 1996; Bucat & Shand, 1996). Essentially in learning science the ability to plan, monitor, and cognitive strategies to analyse and create awareness about the way they are learning is important. It is observed that, the horizon of the students' knowledge in science is expanding during secondary level. School education offers, student learning experiences that helps in exploring their hidden abilities and acquisition of higher order thinking skills needed for their learning (McLoughling & Luca, 2000; McLoughling & Oliver, 1998). In this study, the researcher has developed intervention program based on Metacognitive skills to find out the effectiveness on the academic achievement of secondary school students in physical science.

NEED AND SIGNIFICANCE OF THE STUDY

The main purpose of the study was to equip the learners with Metacognitive skills in order to develop them to learn effectively and enhance their academic achievement. The literature review provided some insights into the importance of Metacognitive skills in developing students as able and efficient learner to increase academic achievement. It is obvious that developing expert learner needs a deliberate effort designed towards creating awareness and procedural and declarative knowledge on how to implement and manage learning activities in the learning process. Thus, the purpose of this study is to find out the impact of Metacognitive Skills based interventional strategies to develop academic achievement of students.

THEORETICAL BACKGROUND OF THE STUDY

METACOGNITION

Metacognition is knowledge and understanding of our own cognitive process and abilities and those of others as well as regulation of these processes. Most definitions of Metacognition include both knowledge and strategy components; however, there are many problems associated with using such definition. One major issue involves separating what is cognitive from what is Metacognitive. Knowledge is considered to be Metacognitive if it is actively used in strategic manner to ensure that a goal is met. For example, a student may use knowledge in planning as how to approach a science exam.

Initially concept of Metacognition was introduced in early 1970s by John Flavell, Brown and others (Flavell, Brown, Branford, Ferrara, & Campione, 1983, Miller and Miller, 1993; Schinder& Pressley, 1997). Since its inception it was broadly defined as any knowledge or cognitive activity that takes as its cognitive objects or regulates any aspect of cognitive activity (Flavell et. al., 1993). Obviously, it refers to the knowledge of their own information-processing skills.

The importance of it is given by its role in the learning process. Research indicates that students who are involved in and self-regulation training score higher on school tests than students who do not participate in such training (Wilburne, 1997). These students are more active and independent learners than their peers who weren't explicitly trained in self regulation skills (Gott, Lesgold & Kane, 1996)

Thus, it has become crucial to teach students how to learn new information along with the information itself to enable them to become successful learners. The researcher has developed Metacognitive skills strategies to find its impact on academic achievement of students.

INTERVENTIONAL STRATEGIES

The researcher has implemented the following three strategies for the experimental group.

1. STRUCTURED TEACHING: It is a strategic approach by the teacher to teach concepts in a systematic manner which involves the structure, sequencing and pattern, arrangement of concepts to make a proper and complete meaning for its comprehension. Structured teaching is an intervention philosophy developed by the teacher for the treatment and education of learners. It is an approach in instructing children who

need Metacognitive skills development. It has the following sub components namely, instructional communications, scaffolding, questioning and feedback strategies.

2. SELF-DIRECTED LEARNING: Self-directed learning is an instructional strategy where the students with guidance from the teacher, decide what and how they will learn. It can be done individually or in group learning. Students take ownership of their learning (Malcolm Knowles, 1975). Knowles (1975), Winne & Hadwin (1998) identified 4 key phases of self-directed learning in academic learning situations; Defining tasks, Setting goals and planning, Enacting study tactics & strategy, Mata cognitively adopting study.

The following are the components of the cycle of Self-directed learning (Ambrose et al., 2010), 1) Assess the task, 2) Evaluate strategies and weaknesses, 3) Plan, 4) Applying strategies, 5) Monitor performance, and 6) Reflect and adjust.

3. GROUP DISCUSSION: It is an important activity in education. It is a systematic and purposeful interactive oral process. Here, the exchange of ideas, thoughts, and feelings takes place through oral communication. The exchange of ideas takes place in a systemic and structured way.

In an educational setting small group learning is an instructional arrangement for teaching academic and collaborative skills to small heterogeneous groups of students. They are popularly known as cooperative learning strategies. Cooperation is working together to accomplish shared goals. Students worked in a mixed ability groups and rewarded on the basis of the success of the group. Students work together to maximise their own and each other learning. In the present study, Think-pair-share technique of group discussion is followed.

The result of this study is expected to recommend appropriate strategies that can be used by teachers to promote students Metacognitive skills in their classroom and develop academic achievement.

OBJECTIVES OF THE STUDY

- To find out the impact of metacognitive skills based intervention program on academic achievement of 9^{th} standard physical science students of secondary school.
- To find out the difference between the effect of metacognitive skills based intervention and conventional/formal method of teaching on the academic achievement of 9^{th} standard physical science students of secondary school.
- To find out the effect of metacognitive skills based intervention program on the retention of the concepts among 9^{th} standard physical science students of secondary school.
- To find out the difference between the academic achievement of Girls and Boys of 9^{th} standard physical science students of secondary school taught by the Metacognitive skills based intervention program.

HYPOTHESES

1. There is no significant difference between the pre-test mean scores of academic achievement of students of experiment and control group.
2. There is no significant difference between the post-test mean scores of academic achievement of students taught by metacognitive skills based intervention teaching (MSIT) and conventional/Traditional method of teaching.
3. There is no significant difference between the pre-test and post-test mean scores of academic achievement of students taught by metacognitive skills based intervention teaching (MSIT) for the experimental group**.**
4. There is no significant difference between the post test and Delayed post-test mean scores of academic achievement of students taught by metacognitive skills based intervention teaching (MSIT) for the experimental group.
5. There is no significant difference between the Girls and Boys post-test mean scores of academic achievement taught by metacognitive skills based intervention (MSIT) for the experimental group.

Sample

The population of the study composed of 9th standard secondary school students. The population consists of seventy students of 9th standard. Equivalent group design was followed. The following table gives the distribution of students for experimental group and control group gender wise based on the scores obtained in the RPM intelligent test.

Table 1: Sample of the Study

Gender	Experimental group	Control group
Girls	16	16
Boys	19	19
Total	35	35

Design

This study involves two group design namely Control-Experimental group with pre and post-test design was employed. In order to collect and analyse the data t- test was used for the independent variable and dependent variables viz., metacognitive skill based intervention package and academic achievement. The impact of intervention package was examined by conducting experiment. The main dependent variable was academic achievement.

Tools

Intervention package based on metacognitive skills was developed by the researcher by using three strategies, such as self-directed learning, structured teaching and group discussion. These strategies were designed in such a way that the components of metacognitive skills, were reflecting through two units in physics and two units in chemistry. The intervention package was validated by the Professors, Physical Science Pedagogy Teacher Educators from Colleges of Education, and Senior Subject Teachers at Secondary Schools. It was also validated by 10 hours pilot teaching carried out in a school based on physical science content, such as work and energy, sound, atoms and molecules, and structure of the atom by using all the three interventional strategies in the presence of subject teacher and physical science pedagogy associate professor of college of education.

Achievement Test was constructed by the researcher by following standardization procedure. The reliability value was 0.86.

Procedure

After the selection of the sample and allocation of students to the two instructional strategies, the experiment was conducted in four phases i.e., Firstly; a pre-test was administered by using Achievement test to the students of both the experimental and control group. Four units of physical science i.e., two units in physics and two units in chemistry of the state board syllabus were selected to prepare interventional package based on Metacognitive skills. Secondly, experimental group was taught through interventional package based on Metacognitive skills and control group was taught through conventional method with the same four units of physical science. Interventions such as Self-Directed Learning, Structured Teaching and group Discussion were followed for the experimental group. Thirdly, after the completion of the 43 days of treatment, the post-test based on achievement was administered to the students of both the groups. The scoring was done with the help of scoring key. Fourthly, after administering the post-achievement test, exactly three weeks later delayed post test was administered to the experimental group.

DATA ANALYSIS AND INTERPRETATION

Table 2: Paired Sample t-test Results Comparing Pre-Test Mean Scores of Academic Achievement of Experimental and Control Group Taught by Conventional Method of Teaching

GROUP/INTERVENTION Academic Achievement	N	M	SD	t-value	p-value	95% CI	
						LL	UL
Experimental Group Conventional Method Pre-Test	35	21.77	5.573	1.816	0.78^{NS}	-.218	3.875
Control Group Conventional Method Pre-Test	35	19.94	4.419				

NS-Not Significant.

From Table-2, the obtained p-value is (p>0.01) greater than the 0.01 level of significance. Hence, the hypothesis-1 is accepted. Thus there is no significant difference between pre-test scores of experimental group (M=21.77, SD=5.573) and control group (M=19.94, SD= 4.419) mean scores of academic achievement of students at 0.01 level of significance, t (35) = 1.816, P=0.783, 95% confidence interval of difference (CI) (-.816, 3.875). It can also be seen that the mean score of experimental group and control group of academic achievement are moderately similar.

Table 3: Paired Sample t-test Results Comparing Post-Test Mean Scores of Academic Achievement of Experimental and Control Group Taught by Metacognitive Skills Based Intervention Teaching (MIST) and Conventional Method of Teaching

GROUP/INTERVENTION Academic Achievement	N	M	SD	t-value	p-value	95% CI	
						LL	UL
Experimental Group MSIT Post Test	35	54.53	6.779	18.308	0.000**	21.7178	27.140
Control Group Conventional Method Post Test	35	30.00	3.918				

***Significant at 0.01 level (2-tailed).*

Table-3 depicts that the obtained p-value is (p<0.01) less than the 0.01 level of significance. Hence, the hypothesis-2 is rejected. Thus there is significant difference between post-test mean scores of academic achievement of students taught by MSIT approach ((M=54.43, SD=6.779) and conventional/traditional method of teaching (M=30.00, SD= 3.918) at 0.01 level of significance, t (35) = 18.308, P=0.000, 95% confidence interval of difference (CI) (21.717, 27.140). It can also be seen that the mean score favours experimental group than control group scores of academic achievement.

Table 4: Paired Sample t-test Results Comparing Pre-Test and Post-Test Mean Scores of Academic Achievement of Experimental Group Taught by MSIT

Experimental Group Academic Achievement	N	M	SD	t-value	p-value	95% CI	
						LL	UL
Pre-Test	35	21.77	5.573	-29.855	.000**	-34.880	-30.434
Post-Test	35	54.43	6.779				

***Significant at 0.01 level (2-tailed).*

From Table-4, the obtained p-value is (p<0.01) less than the 0.01 level of significance. Hence, the hypothesis-3 is rejected. Thus there is significant difference between pre-test (M=21.77, SD=5.573) and post-test (M=54.43, SD= 6.779) mean scores of academic achievement of students taught by MSIT with respect to experimental group at 0.01 level of significance, t(35) = -29.855, P=0.000, 95% confidence interval of difference (CI) (-34.880, -30.434). It can also be seen that the mean score favours post test, and indicates the impact of MSIT

Table 5: Paired Sample t-test Results Comparing Post-Test and Delayed Post-Test Mean Scores of Academic Achievement of Experimental Group Taught by MSIT

Experimental group Academic Achievement	N	M	SD	t-value	p-value	95% CI	
						LL	UL
Post-Test	35	54.43	6.779	-1.221	.231[NS]	-1.87	-0.456
Delayed Post-Test	35	55.11	6.574				

NS-Not Significant.

Table-5 reveals that the obtained p-value is (p>0.01) greater than the 0.01 level of significance. Hence, the hypothesis-4 is accepted. Thus there is no significant difference between post-test (M=54.43, SD=6.779) and Delayed post-test (M=55.11, SD= 6.574) mean scores of academic achievement of students taught by MSIT approach with respect to experimental group at 0.01 level of significance, t(35) = -1.221, P=0.231, 95% confidence interval of difference (CI) (-1.87, .456). It can also be seen that the mean scores of post test and delayed post test slightly differs.

Table 6: Paired Sample t-test Results Comparing Post-Test Mean Scores of Girls and Boys Academic Achievement of Experimental Group Taught by MSIT

Experimental Group Academic Achievement	Gender	N	M	SD	t-value	p-value	95% CI	
							LL	UL
Post-Test	Girls	16	56.5	2.72	1.704	0.097[NS]	-2.37	-0.647
Post-Test	Boys	19	52.62	2.29				

NS-Not Significant.

From Table-6, the obtained p-value is (p>0.01) greater than the 0.01 level of significance. Hence, the hypothesis-5 is accepted. Thus there is no significant difference between academic achievement, post-test scores of Girls (M=56.5, SD=3.502) and Boys (M=52.68, SD=8.34) mean scores of academic achievement of students taught by MSIT approach based on experimental group at 0.01 level of significance, t (33) = 1.705, P=0.098, 95% confidence interval of difference (CI) (8.370, -.738).

FINDINGS OF THE STUDY

- There is no significant difference between the pre-test mean scores of academic achievement of students of experiment and control group.
- There is significant difference between the post-test mean scores of academic achievement of students taught by metacognitive skills based intervention teaching (MSIT) and conventional/Traditional method of teaching.

- There is significant difference between the pre-test and post-test mean scores of academic achievement of students taught by metacognitive skills based intervention teaching (MSIT) for the experimental group.
- There is no significant difference between the post test and Delayed post test mean scores of academic achievement of students taught by metacognitive skills based intervention teaching (MSIT) for the experimental group.
- There is no significant difference between the Girls and Boys post-test mean scores of academic achievement taught by metacognitive skills based intervention (MSIT) for the experimental group.

RECOMMENDATIONS

- The physical science teachers must look in to the development of Metacognitive skills. So that each student will think of planning for his learning, monitoring his/her learning, applies different cognitive strategies, aware about what they are learning, and how they have to proceed. It will suitable for all type of learners which enhance the academic achievement.
- Teachers who are teaching science should integrate the three strategies such as; structured teaching, self directed learning and group discussion in their regular teaching so that the students' academic achievement improves and their learning retains for a longer time.
- By adopting the Metacognitive skills based teaching, irrespective of boys or girls, the academic achievement improves. Hence the teachers who are teaching co-educational institutions can conveniently use this technique.
- Government should take steps to train the teachers regarding Metacognitive skills approach which would in turn enhance the academic achievement of students.

CONCLUSION

The present study indicates that there is significant impact of metacognitive skills based intervention on the academic achievement of secondary school students in physical science. Hence, there is a need to train and insists the teachers to teach science using Metacognitive skills approach.

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