RESEARCH REVIEW JOURNALS
Volume-03
Issue-10
October-2018

ISSN: 2455-3085 (Online)
RESEARCH REVIEW International Journal of Multidisciplinary
www.rrjournals.com [UGC Listed Journal]

Effectiveness of Metacognitive Intervention on Achievement in Mathematics among Secondary School Students in relation to Intelligence

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ARTICLE DETAILS

Article History
Published Online: 10 October 2018

Keywords
Metacognitive Intervention, Intelligence and Achievement in Mathematics

ABSTRACT

Today in the age of information and technology, 21st century smart classroom learners are very active and energetic. They are interested in learning mathematics by nature, but the teachers teach them, leads a big failure in learning outcomes. So there is need to be realized to explore new strategies and skills to improve achievement of mathematics. So the present study aims to find out the effectiveness of metacognitive intervention on learning in mathematics among secondary school students in relation to Intelligence. The research was carried out on a sample of 120 IX standard students of district Sangrur in Punjab. The data was analysised with the help of t-test and analysis of variance. The results revealed that there is a significant positive effect of metacognitive intervention on achievement in mathematics. In the other intelligence also effects the achievement in mathematics, but there is no interactional effect of intelligence and metacognitive intervention on achievement in mathematics.

1. Introduction

Metacognition is defined as “Cognition about cognition” or “knowing about knowing”. It can take many forms; it includes knowledge about when and how to use strategies for learning and problem solving.

J.H. Flavell: first used the word “Metacognition” in 1976. He describes, “Metacognition refers to one's knowledge concerning one's own cognitive processes or anything related to them, e.g. the learning relevant properties of information or data."

More specifically Taylor (1999): defines Metacognition as “an appreciation of what one already knows, together with a correct apprehension of the learning task and what knowledge and skills it requires, combined with the ability to make correct inferences about how to apply one's strategic knowledge to a particular situation and to do so efficiently and reliably.”

Metacognition is defined as “cognition about cognition” or “knowing about knowing”. It can take many forms, it includes knowledge about when and how to use or strategies for learning and problem solving. Intervention is a kind of engagement, involvement and participation. It also means a set of metacognitive skills and metacognitive strategies practised in learning. So Metacognitive Intervention include all the components of metacognition, skills of and strategies of metacognition.

Mathematics is an accepted science which deals with the quantitative aspect of our life and knowledge. It helps us drawing necessary conclusions and interperating various ideas with useful meanings. In fact mathematics is taken as a chest filled up with so many valuable tools concerning with the operations like measuring weighing, counting etc and helps in proper understanding of the nature’s work and complicated problems of life by converting them into its language of signs and symbols. Courrent and Robbins once tried to define mathematics as “Mathematics as an expression of the human mind reflects the active will, the contemplative reason and the desire for aesthetic perfection, its basic elements are logic and intuition, analysis and construction, generality and individuality.”

Bacon has rightly said, “Mathematics is the gate and key of all sciences”.

It is acknowledged by all teachers that one of the most important single variable which affects schooling, is the quality of behavior called intelligence; in ancient India our great rishis and seers named it viveka. In psychological literature, intelligence has been treated as a construct; no one knows what intelligence is? According to Woodworth and Marquis (1948) "Intelligence is the ability to acquire knowledge."

- Jean Paiget’s view (1952) "Intelligence is the ability to adapt one’s surroundings.”
- David Wechsler (1944) "Intelligence is the aggregate or global capacity of the individual to act purposefully, to think rationally and to deal effectively with the environment."

Metacognition or the ability to control one’s cognitive process has been linked to intelligence. Sternberg refers to these executive processes as “Meta Components” in his triarchic theory of intelligence. Meta components are executive of these components. According to Sternberg, Meta components are responsible for “figuring out how to do a particular task or set of tasks, and then making sure that the task or set of tasks are done correctly”. These executive

processes involve planning, evaluating and monitoring problem-solving activities. Strenberg maintain that the ability to appropriately allocate cognitive resources, such as deciding how and when a given task should be accomplished, is central to intelligence.

2. Statement of the problem

EFFECTIVENESS OF METACOGNITIVE INTERVENTION ON ACHIEVEMENT IN MATHEMATICS AMONG SECONDARY SCHOOL STUDENTS IN RELATION TO INTELLIGENCE

3. Objectives of the study

The present study will be undertaken with the following objectives in view:

1. To study the metacognition level of secondary school students.
2. To find out the effect of metacognitive interventions on achievement in mathematics among secondary school students.
3. To access the interactional effect of intelligence and metacognitive intervention on achievement in mathematics.

4. Hypotheses of the study

1. There will be no significant effect of metacognitive intervention on achievement in mathematics of secondary school students.
2. There will be no significant interactional effect of metacognitive intervention and intelligence on achievement in mathematics of secondary school students.

5. Methodology

In the purposed study IX class students from one school of Sangrur District, selected for the study. For the selection of the sample, the purposive sampling technique was used. In all 120 students of class IX was selected for study. Two groups were matched on the basis of concept understanding in mathematics, Intelligence and metacoginition level. Then the students were randomly assigned into the groups: viz; experimental group and control group. Criterion Achievement pre test post test prepared for experiment and to know the effect of metacognitive intervention on learning in mathematics.

6. Design of the study

The purposed study is experimental in nature. The Quasi- Experimental Design Non Randomised Control Group Pre-test-Post-test design was employed because this design provide as much control as possible. There were two groups: experimental group and control group. Experimental group will be exposed to Metacognitive and Control group will be exposed to Traditional Method. Student were matched the basis of metacognitive level, intelligence and scores of pre test.

7. Sample of the study

In order to collect data, a sample of 120 students belonging to IX grade of Sangrur district were involved from one of the school of district Sangrur in Punjab.The sample was divided into two groups , the students were randomly assigned to experimental group and control group. Each group consists of 30 male students and 30 female students.

8. Tools employed

1. Group Test of Intelligence (GGTI) by G.C. Ahuja (2005).
2. Metacognitive Inventory (MCI) prepared by Punita Govil (2003).
3. Self made Six Modules for 9th class students of mathematics for experiment.

9. Statistical analysis

The following statistical techniques were used to analysis the data.

- Descriptive statistical mean, median, mode and standard deviation will be employed to study the nature of distribution of the sample.
- Inferential statistics i.e. t-test, ANOVA, product moment co-relational technique were employed to test the hypothesis.

10. Results and discussion

For testing the significance of difference in learning in mathematics of the groups treated with metacognitive strategies and treated without metacognitive strategies t-test was employed on gain scores (Post-test scores – Pre-test scores) of the groups.

Table 1 Significance of difference in Mean Gain Scores of Achievement in mathematics of the secondary school students provided with Metacognitive Intervention and secondary school students not provided with Metacognitive Intervention (N=120)

Groups	Variable	N	Mean	S.D.	SE_M	t-ratio	Sig/Not sig.
Experimental group	Achievement in Mathematics	60	13.78	7.27	0.94	7.20	Sig. at .01 level
Control Group		60	4.98	6.07	0.78		

As a significant difference was found between the group of secondary school students treated with and treated without metacognitive intervention in achievement in mathematics, therefore **Ho1** stating 'There will be no significant difference in the achievement in mathematics of secondary school students belonging to experimental and control group after metacognitive intervention' stands rejected. Thus the metacognitive intervention contribute significantly in achievement in mathematics of secondary school students.

Fig. 1 Mean Gain Scores of Achievement in mathematics of the secondary school students provided with Metacognitive Intervention and secondary school students not provided with Metacognitive Interventions (N=120)

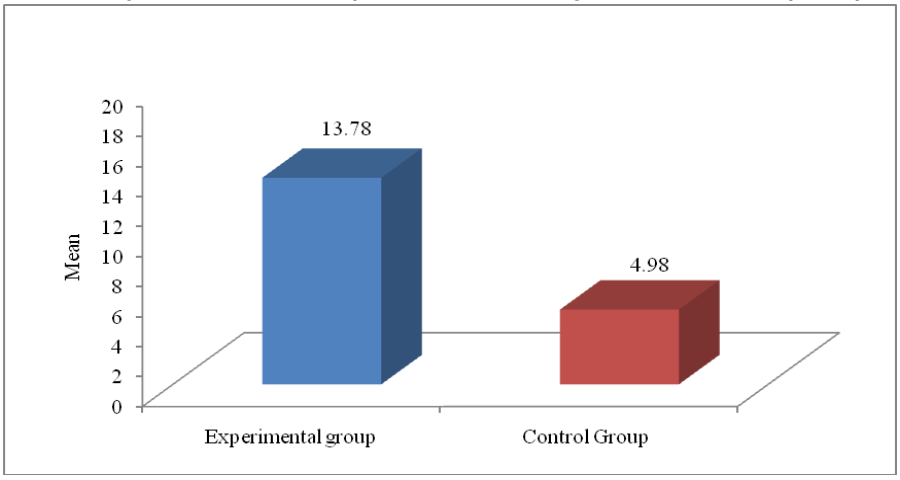


Table 2. Significance of difference in Mean Gain Scores of Achievement in mathematics of the groups of Secondary school students treated with Metacognitive Interventions and treated without Metacognitive Interventions in relation to Intelligence (N=120)

Variable	Source of Variance	SS	d_f	MS	F-Value
Achievement in mathematics	Metacognitive Intervention (A)	823.92	1	823.92	24.23**
	Intelligence (B)	773.04	3	257.68	7.58**
	Metacognitive Intervention X Intelligence (AXB)	66.12	3	22.04	0.65
	Within Group (Error)	3808.41	112	34.00	
	Total	7616.37	119		

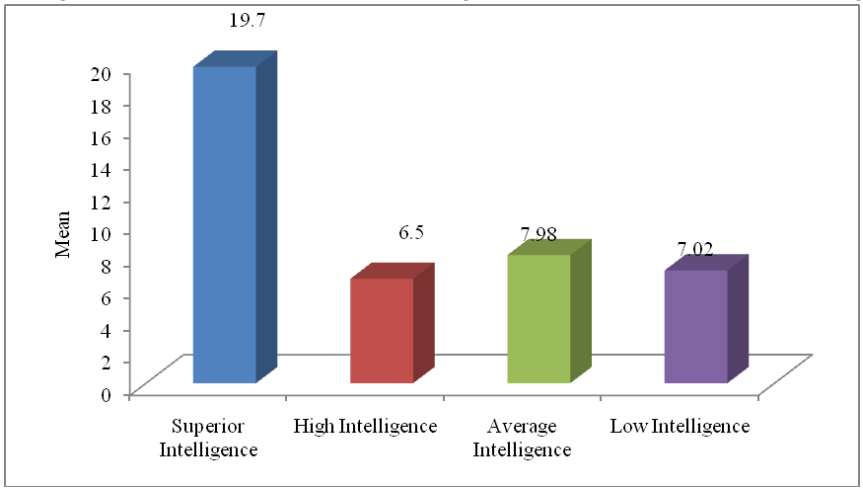
**Significant at 0.01 level*

F table value (1,119) at 0.01 and 0.05 level of significance is 6.82 and 3.95 respectively

The F-ratio for the difference in mean gain scores of achievement in mathematics of the group of secondary school students treated with and treated without metacognitive intervention indicates that the both groups differ significantly on the variable of achievement in mathematics. The above discussion indicates that secondary school students with superior, high, average, low levels of intelligence have different level of achievement in mathematics. This implies that intelligence influences achievement in mathematics of secondary school students.

The F-ratio for the difference in mean gain scores of achievement in mathematics of secondary school students due to interaction between metacognitive intervention and intelligence came out be 0.65 which is not significant. This reveals that there exists no significant interactional effect of metacognitive intervention and intelligence on achievement in mathematics of secondary school students. Therefore **Ho2** stating 'There will be no significant difference in the achievement in mathematics of secondary school students due to interaction between metacognitive intervention and intelligence' stands accepted.

Fig. 4.5 Mean Gain Scores of Achievement in Mathematics of Secondary School students with superior, high, average, low levels of intelligence with metacognitive intervention and without metacognitive intervention in relation to intelligence (N=120)



11. Discussion of results

The main findings of the study showed that there is a positive effect of metacognitive intervention on the achievement in mathematics. Many of the studies like Elawar (1995), S.K.Teong (2003), Dosoete and Annemie (2009), Metallidou (2010), Aydin (2010), Valerie (2010), Wolfgang Schneider (2010), Paravathi (2012), Moga (2012), Sekar and Annaraja (2013), Baten (2017), Khalid (2017), Julie M. Smith (2018), had supported this finding. One of the result of the study has found that Intelligence and Achievement in mathematics are positively co-related with the each other. The studies of Gakhar (1985), Viney (1992), Bajaj (1995), Aswal (2001), Parasad(2002), Taub (2008), and Kaur (2008) had supported this finding and showed that there is a positive and significant relationship between intelligence and achievement in mathematics.

The analysis of data has found that metacognition intervention effects the achievement in mathematics of secondary school students significantly. No interactional effect of metacognitive intervention and intelligence is found on achievement in mathematics. In the brief we can say that intelligence and metacognitive intervention effect the achievement in mathematics of secondary school students. So by using metacognitive strategies and techniques we can improve the achievement of secondary school students in mathematics.

The investigator could not find any study showing negative effect of metacognitive intervention on leaning in mathematics and other academic achievement. As, such a result is neither expected or desired.

12. Conclusion

After the analysis of data it is found that metacognitive intervention and intelligence effect the achievement and learning in mathematics of secondary school students significantly, but there is no interactional effect of intelligence and metacognitive intervention on achievement in mathematics. So by using metacognitive strategies and techniques we can improve the learning of secondary school students in mathematics. Teaching learning process in mathematics can be more innovative and effective by the use of metacognitive intervention.

13. Educational implications of the study

- Workshops and seminars can be arranged by the government from time to time to motivate the teachers for using innovative techniques based on metacognitive intervention in mathematics.
- Curriculum of mathematics should be based on metacognitive strategies.
- Students should be motivated to use their metacognition in solving the problems of mathematics.
- Metacognitive Intervention must be used in teaching and learning of academic subjects other subjects also.

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