

Metacognitive skills and Learning Styles enhance the achievement in mathematics of secondary school students.

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Abstract - The present study was conducted to find out the relationship between achievement in mathematics and metacognitive skills and achievement in mathematics and learning style of secondary school students. A total of 600 secondary school students were selected from various schools of Prayagraj District. A self-constructed tool for achievement in mathematics, Learning Style Inventory tool by K.S. Mishra (2012) and Metacognitive Skills Scale by Madhu Gupta and Suman (2017) were used to conduct the study. The coefficient of correlation was used to find the relationship between achievement in mathematics and metacognitive skills and achievement in mathematics and learning style. The study concludes that there is a positive strong correlation between achievement in mathematics, metacognitive skills and achievement in mathematics and learning style of secondary school students.

Key- Words: - Achievement in Mathematics, Metacognition, Metacognitive Skills, Learning Styles, Secondary school students.

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Education is a process that aims to enlighten and empower people in order to improve and elevate their quality of life. It cultivates the attitudes, aptitudes, and cognitive capacities that make life worthwhile. The degree to which a student, instructor, or institution has met their immediate or long-term learning objectives is known as achievement or performance in education. To improve students' mathematics performance, teachers should support the students for the development of self-efficacy and attitudes towards mathematics. (Appiah J. B. et al. 2022). Students can gain proficiency in mathematics and can learn skills and concepts by practicing mathematics. (Grouws D. A. & Cebulla K. G. 2000).

Flavell (1979) viewed metacognition as a learners' knowledge of their own cognition, defining it as 'knowledge and cognition about cognitive phenomena'. Metacognition may be defined as 'thinking about one's own thinking' or 'Cognitions about cognitions.' Students that possess strong metacognitive abilities will be capable of learning efficiently. Therefore, teachers should encourage students to think about the "metacognitive reflection" activities in the classroom as this will help them become efficient learners by fostering metacognitive development in the classroom. (Rahman S. et al. 2010). The four dimensions of Metacognitive skills are: Planning Skills, Implementation Skills, Monitoring Skills, and Evaluation Skills. (Madhu Gupta and Suman 2017). As metacognitive skills are closely linked with self-regulation and the use of metacognitive process in achievement in mathematics can provide insights into effective problem-solving technique.

A learner's perception, interaction, and response to the learning environment can be determined by a variety of cognitive, emotional, and psychological elements that make up their learning style. These indicators are often consistent. Everybody combines different learning methods in different ways. (Singh L. et al. 2015). The five dimensions of learning styles are: Enactive reproducing (ER), Enactive constructive (EC), Figural reproducing (FR), Figural Constructive (FC), Verbal reproducing (VR) and Verbal Constructive (VC). (K. S. Mishra, 2012). Studying the use of learning styles in relation to achievement in mathematics is important for several reasons. Learning styles refer to the preferred ways individuals process information, and understanding how they learn best can have implications for teaching and learning.

Research Question

- (1) How do metacognitive skills influence the achievement in mathematics of secondary school students?
- (2) How do learning styles enhance the achievement in mathematics of secondary school students?

I. Research methodology

Study Area: The research was confined to 600 secondary school students of Prayagraj District.

(1) **Relationship between achievement in mathematics and metacognitive skills.** The study was conducted to find out the relationship between achievement in mathematics and metacognitive skills. Coefficient of correlation was used to conduct the research, the same is shown in table no. 1.

Table1 showing Coefficient of Correlation (r) between Metacognitive skills and Achievement in Mathematics

S. No.	Coefficient of Correlation (r) for	
	Metacognitive Skills	Achievement in Mathematics
1	Planning Skill	0.821*
2	Implementation Skill	0.677*
3	Monitoring Skill	0.779*
4	Evaluation Skill	0.659*
5	Overall Metacognitive Skills	0.907*

*Correlation is significant at the 0.05 level (2-tailed).

The coefficients in table1 indicate the strength and direction of the correlation between various dimensions of metacognitive skills and achievement in mathematics and shows that there is a very strong positive correlation between metacognitive skills and achievement in mathematics (0.907). The various dimensions of metacognitive skills also show a positive correlation with achievement in mathematics, with planning skills showing a strong positive correlation (0.821), followed by Monitoring skill (0.779), Implementation skill (0.677) and Evaluation skill (0.659) showing that use of metacognitive skills can greatly help the students to perform better in education.

In summary, these results suggest that higher levels of metacognitive skills, including planning, implementation, monitoring, and evaluation, are associated with higher achievement in mathematics. Additionally, the overall metacognitive skills show the strongest positive correlation with achievement in mathematics among the specific skills measured. The same is reflected in figure 1.

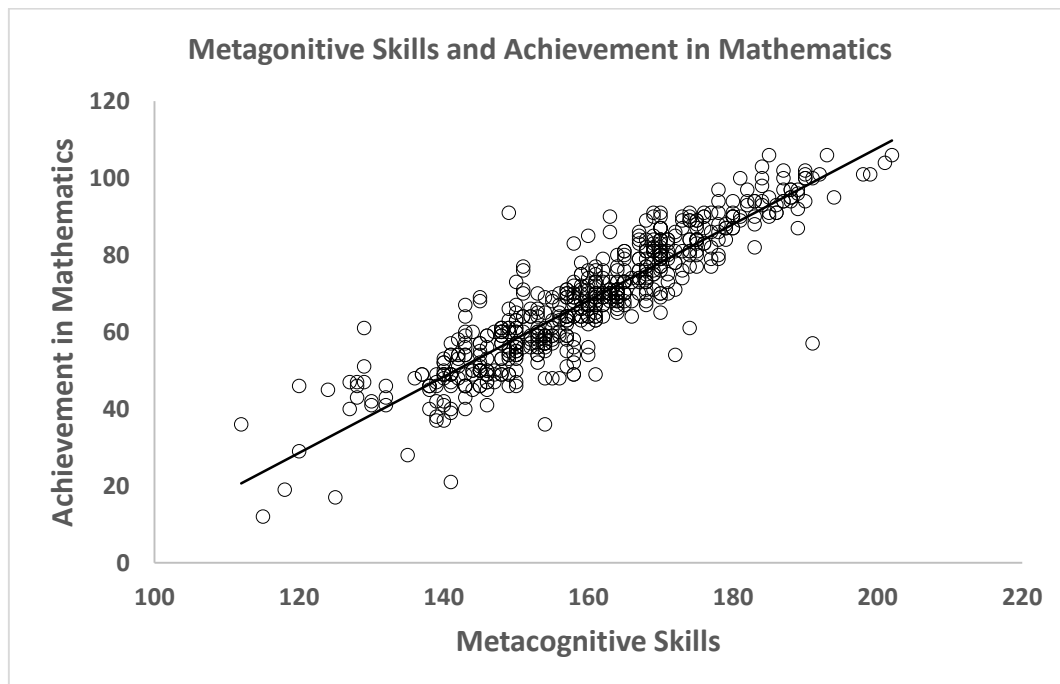


Fig. 1 showing relationship between Metacognitive skills and Achievement in Mathematics

In the scatter figure 1 it can be clearly seen that there is a strong correlation between achievement in mathematics and metacognitive skills and the line showing the relation is moving straight from left to right showing a strong relation. Kumar M. & Sharma A. (2019) and Ozsoy G. (2011) also found in their study that there is a strong relationship between metacognitive skills and achievement in mathematics. There are many studies that reports that teaching metacognitive skills to students may lead to some improvement in their academic achievement Cardelle-Elawar (1992). The study also found that there is a strong correlation between achievement in mathematics and metacognitive skills of students, as metacognitive skills enhance the ability of the students to perform well in mathematics.

(2) **Relationship between achievement in Mathematics and learning styles.** The purpose of the study was to investigate the relation between learning styles and achievement in mathematics. The research was conducted using the coefficient of correlation, as indicated in Table No. 2.

Table 2 showing Coefficient of Correlation (r) between Learning Style and Achievement in Mathematics

S. No.	Coefficient of Correlation (r) for	
	Learning Style	Achievement in Mathematics
1	Enactive reproducing (ER)	0.634*
2	Enactive constructive (EC)	0.603*
3	Figural reproducing (FR)	0.653*
4	Figural constructive (FC)	0.632*
5	Verbal reproducing (VR)	0.643*
6	Verbal Constructive (VC)	0.613*
7	Overall Learning Style	0.748*

**Correlation is significant at the 0.05 level (2-tailed).*

The intensity and direction of the link between each learning style and achievement in mathematics are indicated by the coefficients in Table 2. The result of achievement in mathematics and learning style (including its various dimensions) shows that there is a strong positive correlation between overall learning style and achievement in mathematics (0.748). The various dimensions of learning style also show a positive correlation with achievement in mathematics. The dimension, figural reproducing shows the highest correlation (0.653) with achievement in mathematics, followed by Verbal reproducing (0.643), Enactive reproducing (0.634), Figural Constructive (0.632), Verbal constructive (0.613) and Enactive constructive (0.603).

In summary, these results suggest that there is a positive correlation between various learning styles (enactive reproducing, enactive constructive, figural reproducing, figural constructive, verbal reproducing, verbal constructive) and achievement in mathematics. The overall learning style shows the strongest positive correlation with achievement in mathematics among the specific learning styles measured. The same result is reflected below in figure no. 2.

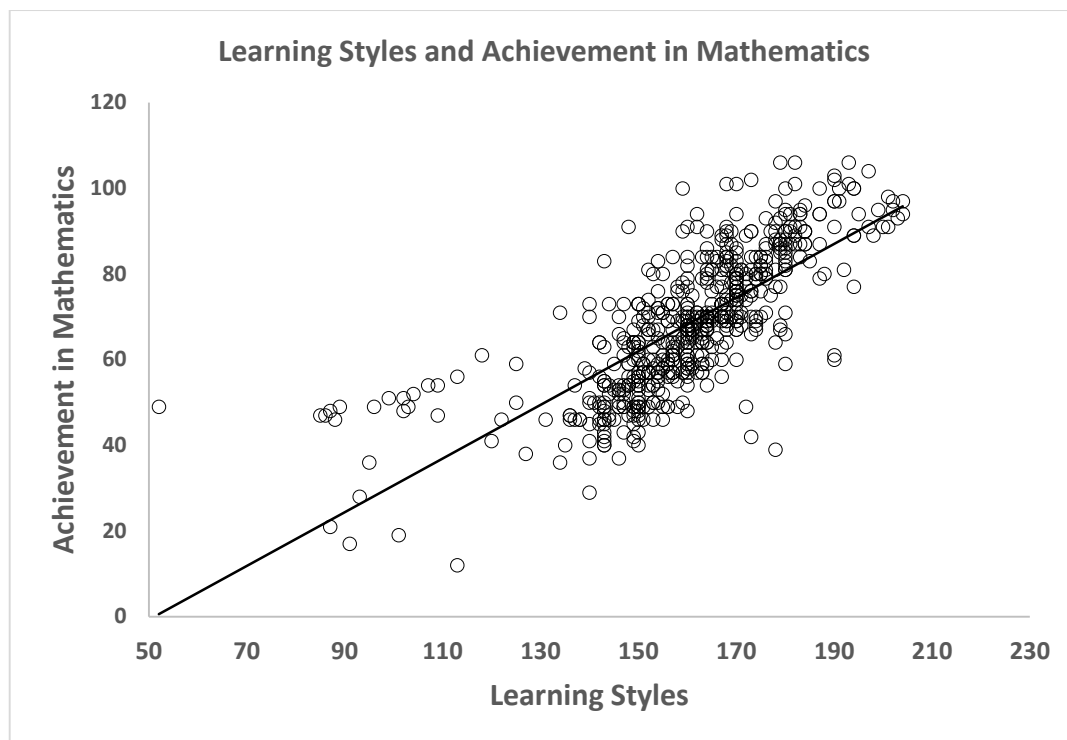


Fig. 2 showing relationship between Learning Styles and Achievement in Mathematics

It is evident from scatter diagram no. 2 that there is a strong relationship between achievement in mathematics and learning styles. The relationship is shown by a line that moves straight upwards, from left to right. Salome Schulze (2018) also suggested in his study that there is strong correlation between academic achievement in mathematics and learning styles. Similar study of learning style and academic achievement was conducted by Licin N. et al. (2018) and Grace G. and Dr. D. Kalpana (2022) also found a strong correlation between learning style and academic achievement of students.

II. Conclusion

It is concluded from the above study that there is a positive and high correlation between metacognitive skills and achievement in mathematics and learning style and achievement in mathematics. Both metacognitive skills and learning styles can be used as a useful tool to develop mathematical skills and to perform better in mathematics. The important result in the research is that all the dimensions of metacognitive skills and learning styles exhibit a positive correlation with achievement in mathematics. Though some dimensions show strong relationship while the others show moderate relationship, but the overall relationship of metacognitive skills and learning styles show a strong positive correlation with achievement in mathematics. Here the role of teachers become very important, as teachers should identify the metacognitive skills and learning styles of students and should guide the students to develop those skills and deliver their hundred percent to get the best results. The role of school management is equally important to provide good library, internet facility, to organize seminars/workshops, training facilities for teachers etc. Considering the importance of metacognitive skills and learning styles in the achievement in mathematics of students, it is suggested that these tools should be incorporated in our education system at all levels, this will give a boost to the achievement in mathematics of students and enhance their overall performance.

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