Relationship between Metastrategic Knowledge and Conceptual Change in Science

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Abstract

The current reform in science education emphasizes in fostering students' deep understanding and thinking skills. To developing this deep understanding with scientifically held concept clarity among the students in science concepts metastrategic knowledge based intervention is used as an effective intervention. Metastrategic knowledge is a subcomponent of metacognition defined as general explicit knowledge about thinking strategies. The present study assessed the relationship between metastrategic knowledge based intervention and conceptual change in science. 40 students of class 9th were taken as sample for the study purposefully. One group pre-test post-test quasi experimental design was opted for data collection. Achievement test in bioscience was conducted to find out the effectiveness of intervention. A correlational analysis was done to measure the strength and direction of the relationship between two variables. The finding of the study shows that there is a strong positive relationship between the metastrategic knowledge based intervention and conceptual change. The present study revealed that the metastrategic knowledge based intervention has enhanced the learning achievement of learners in science subject as well as the conceptual change in science concepts. The study may have implications to all the stakeholders like students, teachers, teacher educators and curriculum designers.

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KEYWORDS: - Metastrategic knowledge, Conceptual change, Secondary Schools, Bioscience Subject, High order thinking skills.

INTRODUCTION: -

With the changes in our social needs and the recent research in learning as well as cognition aspect there has emerged a new vision of education(Jones,1991). This new perspective emphasises the development of students' problem solving competence, higher order thinking skills and self regulated learning (Halpern ,19192). Metastrategic knowledge (MSK) considered as a component of metacognition that refers to the explicit knowledge regarding the thinking strategy being used during instruction. MSK is a general knowledge about the cognitive procedures which are comprised of higher order thinking skills and strategies. The application of MSK in the classroom explains when, why and how such a higher order thinking strategy should be used, when it should not be used, what are the disadvantages of not using appropriate strategies, and what task characteristics need for the use of the strategy (Zohar and Ben David 2009) .

THEORETICAL OVERVIEW

Metastrategic Knowledge(MSK): -MSK is a subcomponent of metacognitionthat is definedas general knowledge about higher-order thinking strategies (Zohar and Ben David,2009).Flavell (2002) divided metacognition into metacognitive knowledge and metacognitive monitoring and self-regulation. He then further divided metacognitive knowledge into three sub-categories: knowledge about persons, tasks and strategies. The latter two sub-categories are related to MSK because the task sub-category concerns the nature of the task demands and the strategy sub-category concerns the nature of the strategies that are likely to succeed in achieving specific cognitive goals.Schraw (1998) made the distinction between regulation of cognition and knowledge of cognition that is again further divided into declarative knowledge, procedural knowledge and conditional knowledge. MSK is related to the two latter sub-categories. Procedural knowledge has to do with effective use of strategies .Conditional knowledge refers, among other things to knowing when and why to use strategies. Meta-strategic knowledge may give the student advice about how to apply correct cognitive processes to specific, contextually-rich situations that are often "messy" in terms of their underlying logical structures (Zohar, 2004).

Conceptual Change

"The student is not a *tabula rasa* (blank slate)." --Edward. F. Redish

Conceptual change occurs every time when someone changes his or her mind, or learns something new about a certain issue or fact. But, simply altering a student's idea about some phenomenon is not what is meant by the term conceptual change.Phillips (1991) also believes that the exposure of misconceptions is essential to bringing about conceptual change. Conceptual change only occurs when students have begun to view the world and develop frameworks of knowledge based on "core" concepts that are scientific in nature. This position stands in opposition to the following inadequate but popular ideas about how misconceptions may be altered: (1) the extinction of old conceptions and their replacement with new conceptions, (2) the addition of new ideas, and (3) the rearrangement of ideas. For conceptual change there must be dissatisfaction with existing concepts. The new concept must be intelligible, plausible and fruitful in nature. Then only the conceptual change is possible.

METHODOLOGY

Research design & Variable: -In this present study one group pre-test post-test quasi experimental design was choosed by the researcher to measure the relationship. Two major variables are present in this study such as one is independent variable and another one is dependent variable. Independent variable is metastrategic knowledge based intervention and dependent variable is conceptual change in science and higher order thinking strategies like problem solving strategy, establishing causal relationship, constructing arguments, hypothesis formulation and drawing conclusions.

Sample: -The students of class 9th CBSE board were considered as sample for the present study. The sample consists of 40 participants. Purposive sampling was adopted to choose sample.

Procedure for data collection: - For data collection researcher conducted achievement test which includes four chapters of Class 9th NCERT Science Book. The achievement test items include five major parameters of higher order thinking (HOT) strategies like problem solving strategy, establishing causal relationship, constructing arguments, formulation of hypothesis and drawing conclusions. As one group pre-test post –test quasi-experimental design was used both pre-test and post-test were administered for the same group. Pre- test was done before the intervention whereas post-test was done after the intervention. Both data were collected and analysed to measure the relationship between the two variables.

RESULT AND DISCUSSION

To measure the strength as well as direction of the relationship between two variables the researcher has used correlational analysis. Here the researcher has used individual correlational analysis for different parameters as shown below,

Table 1: - Correlation between MSK Intervention and Problem solving strategy

		Total Post-test Score	Problem Solving Post-test
Total Post-test Score	Pearson Correlation	1	.831**
	Sig. (2-tailed)		.000
	N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

From the table it was found that there was a strong positive correlation between the total post-test score and problem solving post test score which is statistically significant. **(r = .831, p <.001)**. This shows that an increase in problem solving strategy would lead to increase in total achievement score of class 9th students in bioscience subject.

Table 2:- Correlation between MSK Intervention and Establishing Causal relationship Strategy

		Total Post-testScore	Establishing Causal Relationship Post-test
Total Post test Score	Pearson Correlation	1	.718**
	Sig. (2-tailed)		.000
	N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

The table 2 shows the statistically significant high positive correlation between the total post test score and establishing causal relationship post-test score **(where r = .718, p < .001).** It means an increase in establishing causal relationship strategy would lead to increase intotal achievement score of class 9th students in bioscience subject.

Table 3:- Correlation between MSK Intervention and Constructing Argument Strategy

		Total Post-test Score	Constructing Arguments Post-test
TotalPost-test Score	Pearson Correlation	1	.901**
	Sig. (2-tailed)		.000
	N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

The Pearson Product moment correlation of total post test score and constructing argument post test score was found to be very high positive correlation and statistically significant **(r = .901, p < .001).** This shows that an increase in constructing argument strategy would increase in total achievement score of class 9th students in bioscience subject.

Table 4:- Correlation between MSK Intervention and Formulating Hypothesis Strategy

		Total Post-test Score	Formulating Hypothesis Post-test
Total Post test Score	Pearson Correlation	1	.516**
	Sig. (2-tailed)		.000
	N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

From the table 4 it was found that the correlation between total post test score and formulating hypothesis post test score shows moderately positive correlation and also

statistically significant **($r_{=}$ .516, p <.001).** It means an increase in formulating hypothesis strategy would increase in total achievement score of class 9th students in bioscience subject.

Table 5:- Correlation between MSK Intervention and Drawing conclusion Strategy

		Total Post-test Score	Drawing Conclusion Post-test
Total Post test Score	Pearson Correlation	1	.829**
	Sig. (2-tailed)		.000
	N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

Finally, the Pearson product moment correlation of total post-test score and drawing conclusion post test score was found to be high positive correlation and statistically significant **($r_{=}$ .829, p < .001).** This shows that an increase in drawing conclusion strategy will result increase in total achievement score of class 9th students in bioscience subject.

From the above result it was found that there is a strong positive correlation between metastrategic knowledge based intervention and conceptual change in Science. This result relates to the literature review reported earlier because as explained in the literature review (p.18) Kuhn (1999; 2000b; 2001a) argues that general metastrategic knowledge plays an important role in the developmental process, leading to sound choices among available thinking strategies. From this research, we can conclude that explicit teaching of MSK is an extremely valuable teaching strategy for students with low academic achievements. This conclusion is in line with prior research in both science and mathematics education showing that metacognitive instruction was highly beneficial for low achieving students (Kramarski, Mevarech& Arami, 2002; Mevarech & Fridkin, 2006; Teong, 2003; White & Fredericksen, 1998; 2000).

IMPLICATION

The study may have implications to all the stakeholders like students, teachers, policy makers and curriculum designers. At secondary level the students need deep understanding in science concepts to plan, monitor and execute different scientific activities in their day to day life. So conceptual change in scientific concepts help the students to do their scientific activities in better way. This can give scope to the pre service as well as in service teachers to apply the metastrategic knowledge based intervention with higher order thinking skills in real classroom situation. Policy makers at different levels can help in maximize the number of learners that benefit from the metastrategic knowledge based strategy. Curriculum developers can incorporate this new strategy in curriculum to enhance students understanding in different higher order thinking strategies.

CONCLUSION

From this study Metastrategic Knowledge(MSK) was found as a promising and fruitful means for bringing about changes in students' strategic and meta-strategic levels of scientific thinking. In particular, explicit teaching of MSK was identified as

an invaluable instructional "tool" for helping low achievements students to overcome their difficulties with scientific thinking strategies and therefore for supporting the progress of conceptual change in the science classroom.

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