AL-QALAM القلم

ISSN 2071-8683 E-ISSN 2707-0077
Volume 25, Issue, 1, 2020
Published by Institute of Islamic Studies,
University of the Punjab, Lahore, Pakistan.

Developing Metacognitive Skills among Secondary School Students using Instructional Models: An Experimental Study

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Abstract

Metacognition is the process of thinking about thinking. This is a process of developing self-awareness and self-assessment. Students with good metacognitive skills have flexibility in their learning skills. They have many strategies to best handle the information they need to interact with. The present study was conducted to compare the 5E instructional model and problem solving model for developing metacognitive skills in learning science at secondary school level. Objectives of the study included comparing the effect of 5E instructional model, problem solving model and traditional instructional model for developing metacognitive skills among secondary school students and finding the gender difference on developing metacognitive skills using 5E instructional model, problem solving model and traditional instructional model. True Experimental design was used for the study. All the secondary school students of class IX of District Rawalpindi formed the population of the study. Three sections of class IX of Govt. Boys High School Tehsil Kahuta and three sections of Govt. Girls High School Tehsil Kahuta were selected as sample for this study. The sample size consisted 180 students (90 boys and 90 girls). The duration of experiment was limited to eight weeks. There were four experimental and two control groups to conduct the experiment. Experimental groups were taught units of General Science through 5E instructional model and problem solving model while control groups were taught through traditional instructional model. Data were collected before and after experiment. Analysis of data was carried out, using both descriptive and inferential statistics. Analysis of variance (ANOVA), t-test, mean and standard deviation were used to analyze the data obtained from the subjects. The results indicated that both the 5E instructional model and problem solving model yielded better results in developing metacognitive skills among students. While, no difference was witnessed in the metacognition skills of male and female students. It is recommended to train the teachers to use the 5E instructional model and problem solving model.

Keywords: Metacognition, Metacognitive Skills, 5E Instructional Model, Problem Solving Model, Science Education.

Introduction

The twenty first century has brought about the concept of globalization in the world. The globalized world has affected the education system by producing a number of challenges from policy directions to teachers for instructional delivery while globalization demands achieving international standards. Globalization focuses critical internationalization based on local context and indigenous conditions. The former sets out goals and the later relevance to meet these challenges. It is pertinent to generate changes in the pedagogy and create new paradigm which suits the globalized generation. In the local context, the work of Shaheen and Kayani (2015) suggests that the new paradigm is likely to work on creating ways for lifelong learning for students and competing the challenges, contrasting the customary paradigm of education which focuses on providing knowledge and skills to a local community.

In connection to this, it is worth mentioning here that the science education is striving to develop the students who consider themselves the inhabitants of the world. According to Shaheen and Kayani (2015), the science education develops curiosity among the students by stimulating inquiry skills, to discover new horizons. Hence, they appear thoughtful about the scientific concepts (Shaheen, 2017).

In this connection the concepts of metacognition are of great importance. Flavell (1979) was the one who used the term ‘metacognition’ for the first time in literature. He and some of his followers considered three components of metacognition i.e. the knowledge, control and monitoring (Augustyn & Rosenbaum, 2005; Garner, 2009; Hacker et al., 2009; Halpern, 2014; Nelson, 1999; Tarricone, 2011).

It is noted in a local study that the traditional approaches to teaching are insufficient to meet the needs of individuals and their development to become productive members of the society (Chaudry & Ayyaz, 2016). Today’s teacher is considered as a designer who is responsible to take all the decisions of teaching and learning in a classroom. He/she decides what is to learn by the students, what should be the context of their learning, what strategies they should use for learning and how they are to be evaluated (Gros, 2002). In contrast, the constructivist framework does not emphasize teaching but it focuses on creating environment conducive for learning. Using this framework, the students try to create their own knowledge and use what they already know (Richardson, 2003). The role of teachers is to facilitate the learners in organizing their own stock of information that helps them to reflect what they have (Vighnarajah et al., 2008). The constructivist theory focuses on the use of different ways to learn a concept (von-Glassersfeld, 1996). In this connection, some of the students may use their cognitive thoughts to solve a scientific problem while others may not (Ericsson & Simon, 1993).

The constructive approach uses instructional models which are based on inquiry and uses naturalistic ways to learn new things (Cavallo & Laubach, 2001). As these models are based on constructivism, they have been modified by the researchers over time. The literatures cite many versions of such instructional models (e.g. 3E, 4E and 5E etc). Settlage (2000) mentioned that irrespective of the number of stages, every model works on the construction of knowledge, skills and thoughts among students.

One of the instructional models which uses constructive approach, the 5E instructional model, has been used worldwide since its emergence in late 1980s (Bybee et al., 2006). Each step of the 5E instructional model has been crafted for the construction of knowledge, skills and thoughts among students. These steps of the 5E instructional model are in a proper sequence which provides opportunities for the learners to construct their knowledge.

Concurrently, another instructional model 'the problem solving model' allows active participation of the students to solve the educational problems (Malinowski & Johnson, 2001; Major, Baden & Mackinnon, 2000). The problem solving model creates critical thinking among students by providing them opportunity to inquire and find solution to the problems by using scientific process (Kemertaş, 2001). This is closely linking with creativity. In developing scientific thinking and conceptual understanding the problem solving ability enables the students to cope with problems that occur in our environment. It is linked with the scientific reasoning and making appropriate decision while solving scientific problems (Abdullah & Shariff, 2008). For teachers, the role is to provide proper feedback and guidance and introduce ways to stimulate the problem solving ability of the students (Collins, Brown & Newman, 1989; Asieba & Egbugara, 1993; Keith, 1993). It is necessary for them to spot the problem solving abilities of their students and guide them the ways to nurture their problem solving abilities (Jeon, Huffman & Noh, 2005).

Several experimental studies in Science level highlighted the importance of using instructional models to develop scientific concepts, reasoning skills, metacognition, scientific learning and achievements (Davis, 1978; Lawson & Thompson, 1995; Davidson, 1989; Shadburn, 1990; Scharmann, 1991; Cumo, 1992; Klindienst, 1993; Gang, 1995; Cavallo, 1996; Lord, 1997; Boddy et al., 2003; Akar, 2005; Garcia, 2005; Wilder & Shuttlewoth, 2005; Balcı et al., 2006; Mecit, 2006; Marek et al., 2008; Kaynar et. al., 2009; Bulbul, 2010; Shaheen & Kayani, 2015; Shaheen, 2017; Aziz & Hassan, 2018).

Aforementioned research studies also revealed that the metacognitive skills of students are severely affected due to the use of conventional pedagogical techniques at secondary level. In addition, effective use of metacognition by the students may enable them to enhance their conceptual learning. It is believed that the students need to use metacognitive skills as it may also affect their academic performance. The conceptual change among the students is likely to increase by using strategies which promote metacognition. Unfortunately, at secondary level, the students are unaware of using their metacognitive skills (Ormrod, 2000; Eluemuno & Azuka, 2013; Qureshi, Hassan & Akhtar, 2018). It is a fact that the science teachers lack sufficient teaching strategies and often use reading method in traditional classrooms. Hence, it becomes necessary for a secondary school teacher to practice those pedagogical techniques which may enhance students' metacognitive skills. This needs experimental evidence. In this perspective, this study was conducted to compare effects of traditional instructional model, problem solving model and 5E instructional model on students' metacognitive skills in General Science at secondary level.

Objectives of the Study

Following were the objectives of the study.

1. To compare the effects of problem solving model, traditional instructional model and 5E instructional model on students' metacognitive skills at secondary level.
2. To explore gender difference in developing metacognitive skills using 5E instructional model, problem solving model and traditional instructional model.

Hypotheses of the study

Following null hypotheses were developed for the study;

H_o1: There is no significant difference in the mean metacognitive scores of students taught through problem solving model, traditional instructional model and 5E instructional model.

H_o2: There is no significant difference in the mean metacognition scores of male and female students taught through 5E instructional model.

H_o3: There is no significant difference in the mean metacognition scores of male and female students taught through problem solving model.

H_o4: There is no significant difference in the mean metacognition scores of male and female students taught through traditional instructional model.

H_o5: There is no significant difference in the mean metacognitive scores of male and female students.

Review of the Related Literature

Constructivism

The main principles of constructivism often emphasize that students build their own knowledge rather than swallowing off-the-shelf knowledge from outside (Hatano, 1996). In general, constructivists agree that 1) knowledge is obtained above the limitations; 2) knowledge association reorganizes when new knowledge is acquired; 3) knowledge is acquired through construction, not just communication; 4) knowledge is controlled both internally and externally; and 5) Knowledge acquisition follows some well-defined criteria (Rysz, 2004).

In relation to science, students may begin to realize that general science may be useful for getting real-life knowledge. In this context social constructivism plays an important role. The students who believe in social constructivism apply the socially accepted concepts to organize their knowledge. Students use the established knowledge which may be considered by some experts as a fact to shape their understanding. In short, constructivism focuses on learning, not teaching (Verschaffel, Greer, & De Corte, 2000); it requires a critical reflection on the truths accepted by society. It is worth mentioning here that those students who use their metacognition for building knowledge need to four all four paradigms (von-Glassersfeld, 1996). The students are required to use good metacognitive skills which can be very useful in assisting the learning process (Rysz, 2004).

Metacognition

Taylor (1987) defines metacognition as an understanding of known things, combining the correct understanding of learning tasks, the knowledge and skills required, and the application of one's strategic knowledge to ensure the correctness of specific content. If the student wants to review, he/she needs to re-read, think and take some psychological action or ask questions to deal with conditions. Hence, this internal guide will take action to help the student to do all that (Lester, 1994).

Metacognition has been researched extensively during last four decades ever since Flavell's (1979) pioneering article. Van Overschelde (2008) argues that metacognition has been used by the researchers of educational psychology as it allows them to follow scientific rules to monitor and control the power of mind, or, in other words, to study the ability of understanding the knowledge. In this connection Halpern (2014) and Tarricone (2011) proposed a three-way model of metacognition. The components of this model included knowledge, control, and monitoring. Furthermore, building levels of taxonomy of metacognition, Tarricone (2011) points out that controlling, monitoring and adjusting strategy to achieve the learning goals are considered as main connection between metacognition and self-regulation. Hacker *et al*. (2009) argued that students' intellectual skills were focused in past metacognitive studies, and there was a great deal of research on metacognition in the educational achievements. However, Augustyn and Rosenbaum (2005) challenged this very approach of metacognitive researcher by explaining whether intelligence and perceived motor skills depend on metacognition or not. The world expects metacognition to be applied in developing perceptual motor skills, just like knowledge and skills (Weil et al., 2013; Palmer et al., 2013).

Development of Metacognition

Research in the field of metacognitive development proposes a conceptual map that evolves with age and is related to psychological theory (Flavell, 2004). However, different aspects appear to develop at different times and it is unclear how each aspect affects the development of others (Veenman et al., 2006).

Wimmer and Perner (1983) argue that the theory of mind states that pupils' mental state usually lasts for three to five years and they also recognize their own mental state is dissimilar from other people's mental state. Children gradually realize that others see things in different ways and that certain things are real and there is no guarantee that they are real. To understand that others can see the world in different ways, children must be aware that their own views can represent their views of the world. Lockl and Schneider (2006) argue that there are evidences which suggest that there is a strong relation between the theory of mind and metacognition, as both are concerned with the age-linked attributes that change with phase and familiarity. This development trajectory persists in childhood and adulthood. In addition to the initial development of psychology, metacognitive awareness is also evident in young children and increases with age (e.g., Flavell, 1979).

Lockl and Schneider (2006) argue that in order to understand children's own cognition in the form of metacognitive knowledge, they first need a representative understanding of the state of mind. In other words, they must implement the theory of mind. They believe that theory of mind can predict metacognitive knowledge in the next few years. To test this hypothesis, Lockl and Schneider (2006) tested the theory of mental capacity of children aged 4 and 6 months. A year later, they tested children's metacognitive knowledge. The results of the study showed that children who acquired psychology early had a deeper understanding of these factors when they determined their commemorative ability after 18 months. This developmental trajectory persists in childhood and adulthood. In addition to the initial development of psychology, metacognitive awareness is also evident in young children and increases with age (e.g. Flavell, 1979).

The next section provides details of the models used in science teaching for the development of metacognition and enhancement of students' achievement in general science.

Instructional Models of Teaching Science

Odom and Kelly (2001) state that adopting a scientific results-oriented teaching strategy to improve scientific outcomes; promoting the role of students and teachers as active participants and facilitators is an important area of interest for science educators. Consequently, Bülbül (2010) states that instructional has gained the attention of many researchers and educators as well. Following is the a brief description of the models used in this research.

Traditional Instructional Model

Teachers in the traditional learning environment adhere to the central map, followed by the traditional learning model (Vighnarajah, et al., 2008). Although it has witnessed some learning (Ertmer & Newby, 1993). Aronson (2005) argues that traditional education shows a unique flow of information from teachers to students. Learning from memory is a hallmark of this teaching method. Classroom teaching with chalk and dialogue is a form of information circulation. Teachers often talk for an hour without making the students' reactions and reactions meaningful. The materials provided are entirely dependent on the teacher's notes and textbooks. Further, the traditional learning environment makes students a passive learner, providing them with the opportunity to retain and master information (Shaheen and Kayani, 2015).

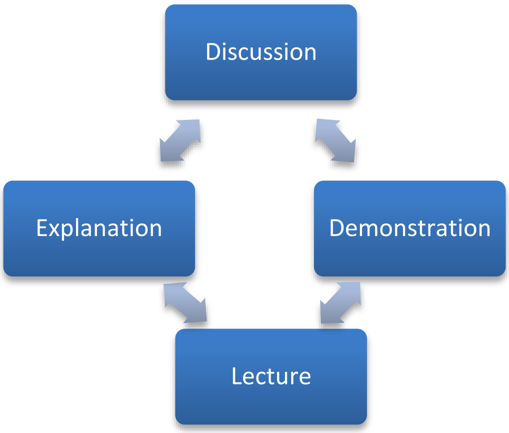

***Figure 1*. Traditional Instructional Model (Shaheen & Kayani, 2015)**

The 5E instructional model

Over time, different studies have been carried out due to the widespread use of learning models, which has led to revisions and additions to the new phase. Therefore, a five-stage model called 5E teaching model was developed, namely participation, exploration, interpretation, elaboration and evaluation (Bybee et al., 2006).

Table 1

BSCS 5E Instructional Model: A Brief Description

Stage	Brief Description
Engaging	Teachers or core course assignments attempt to acquire prior knowledge of the student. Therefore, they look into small activities to inspire their curiosity and recall their previous information. Therefore, these activities must bridge the gap between past and present learning.
Exploring	The exploration process involves the concepts of the past to establish the concepts acquired by the tasks currently completed. Participation in the exploration phase provides students with a common starting point at which to build existing ideas, procedures and expertise. Completing lab activities supports the use of prior knowledge to generate new concepts, extend queries and possible options to design and communicate initial search levels.
Explaining	The phase emphasizes that students focus on the specific characteristics of the experience gained during the exploration process. It also provides an opportunity to know about understanding based on concepts, planning expertise and performance. This stage also provides opportunities for teachers to publicly present concepts, procedures or expertise. Here, students are free to express their understanding.
Elaborating	The interpretation of the teacher or core curriculum can also prove its value in a deep understanding, because this is the relevant step at this stage. Teachers are also testing and expanding the theoretical foundations of student knowledge and expertise. Therefore, the development of new skills has given people a deep and broad understanding of other facts and important expertise. The learner understands this idea by taking on additional tasks.

Evaluating	The evaluation phase motivates students to assess comprehension skills. It also provides opportunities for teachers to assess students' improvements in achieving their guiding goals.

Problem Solving Model

The essential elements of problem solving models are found in the experimental psychological work of Woolfolk (1998). He describes a general problem-solving strategy as a starting point, an outline. There are usually five stages in such a strategy. Bransford and Stein (1984) use the acronym IDEAL to determine five steps:

- I = Identification of opportunities and problems
- D = Defining goals and representing the problem
- E = Exploring possible strategies
- A = Anticipating outcomes and acting upon the procedure
- L = Looking back to learn.

Methodology

A brief description of the methods and procedures of the study is discussed below.

Research design

The study was experimental in nature. According to Gay (2009) 'true experimental design' provides an opportunity to the researchers to randomly select the participants of the study. Hence, the researcher chose true experimental design for this study (Afridi, 2015). Furthermore, to be precise, a type the true experimental design named 'pretest posttest control group design' was used to conduct the study.

Population

The population of the study consisted of all students of 9th class, studying General Science as elective subject at secondary level in the District Rawalpindi.

Sample

For the selection of sample, two schools named Government Boys High School Kahuta and Government Girls High School Kahuta were selected as a sample frame using purposive sampling technique. Further, the researcher selected 180 students (90 boys and 90 girls) from aforementioned schools for the conduction of experiment using random sampling technique. These 180 students were further assigned in two control and four experimental groups. Each group had 30 students.

Research instrument

Metacognitive Awareness Inventory developed by Schraw and Dennison (1994) was used in this study as a research instrument for the collection of data.

Data collection

For the collection of data the Metacognitive Awareness Inventory was applied as pre and post tests. All the participants (90 boys and 90 girls) attempted the pre and post tests, hence, the response rate was hundred percent.

Conceptual Framework

The purpose of conceptual framework of the study is to explain relationship between the study variables. Figure 1.1 clearly describes that the independent variables i.e. traditional instructional model, problem solving model and 5 E instructional model might affect the dependent variable i.e. Students' metacognitive skills.

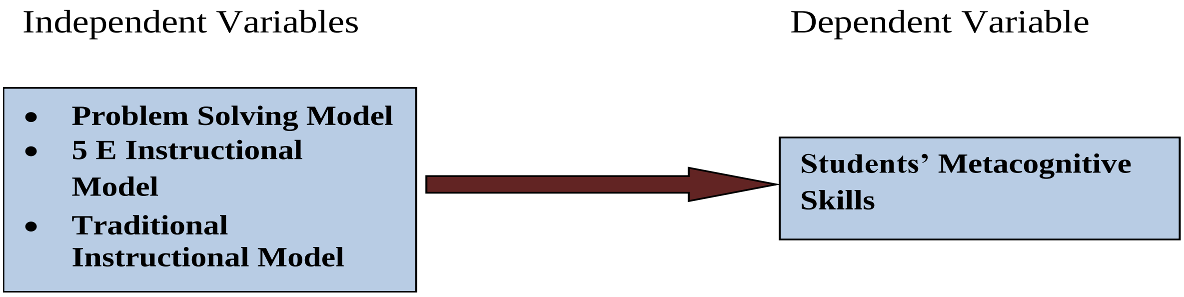

***Figure 2*. Conceptual Framework of the Study**

Results

This portion describes results of the basis of analysis and interpretation of data. For this both descriptive and inferential statistical techniques were used.

Table 2

Descriptive Statistics on Pre-Metacognition Scores

Groups	N	Mean	SD
Problem Solving Model	60	217.68	35.245
5E Instructional Model	60	217.85	34.796
Traditional Instructional Model	60	220.02	35.233

Table 2 indicated that there was a slight difference in the mean scores of students taught by traditional instructional model (M=220.02, SD=35.233), 5E Model (M=217.85, SD=34.796) and Problem solving model (M=217.68, SD=35.245). This means all the students in the groups were almost equally distributed.

Table 3

One Way ANOVA: Pre Metacognition

	df	*F*	Sig.
Between Groups	2	0.083	0.921
Within Groups	177		
Total	179		

Table 3 indicated the results of One Way ANOVA. It shows that there was no statistically significant difference in the mean scores of students' Metacognition using Traditional instructional model (M=220.02, SD=35.233), 5E Model (M=217.85, SD=34.796) and Problem solving model (M=217.68, SD=35.245), F (2, 177) = 0.083, p = 0.921) before the treatment carried out.

Table 2 and 3 indicated that all the groups were equal before the start of the treatment.

Table 4

Descriptive Statistics related to post Metacognition Scores

Groups	N	Mean	SD
Problem Solving Model	60	232.20	24.209
5E Instructional Model	60	234.73	37.664
Traditional Instructional Model	60	178.63	29.042

Tables 2 and 4 indicated that there was a 41.39 decrease in the mean scores of students taught by Traditional instructional model. While, the same tables indicated a 16.88 increase in the mean scores of students taught by 5E Model. Furthermore, a 14.52 increase in the mean scores of student taught by Problem Solving Model.

Table 5

One Way ANOVA: Post Metacognition

	df	*F*	Sig.

Between Groups	2	63.443	0.000
Within Groups	177		
Total	179		

The results indicated that there was a statistically significant difference between post mean scores of students' metacognition using traditional instructional model, 5E instructional model and problem solving model (F (2, 177) = 63.443, p= 0.000). So, the first null hypothesis was rejected. Hence, Post Hoc Tucky test was applied.

Table 6

Post Hoc Tucky test: Post Metacognition

(I) Type of Model	(J) Type of Model	Mean Difference (I-J)	Sig.
5E Model	**Problem Solving Model**	2.533	.894
	Traditional instructional model	56.100	.000
Problem Solving Model	**Traditional instructional model**	53.567	.000

Table 6 indicated results of Post Hoc Tucky test for checking difference between groups w.r.t. post mean scores of students' metacognition. It is clear from Table 6 that there was no significant difference in the mean metacognition scores of the students taught through 5E Model (N=60, M=234.73, SD=37.664) and Problem solving model (N=60, M=232.20, SD=24.209), as p=0.894>0.05. Furthermore, there was a significant difference in the mean metacognition scores of the students taught through Problem solving model (N=60, M=232.20, SD=24.209) and Traditional instructional model (N=60, M=178.63, SD=29.042), as p=0.000<0.05. While, there was a significant difference in the mean metacognition scores of the students taught through 5E Model (N=60, M=234.73, SD=37.664) and Traditional instructional model (N=60, M=178.63, SD=29.042), as p=0.000<0.05.

Table 7

t-tests: Post Metacognition of male and female students

Group	Category	N	Mean	SD	*t*	*df*	p
Overall	Male	90	213.39	39.442	-0.600	178	0.549
	Female	90	216.99	40.980			
5E Instructional Model	Male	30	229.33	37.967	-1.113	58	.270
	Female	30	240.13	37.207			
Problem Solving Model	Male	30	232.20	24.417	.000	58	1.000
	Female	30	232.20	24.417			
Traditional Instructional Model	Male	30	178.63	29.291	.000	58	1.000
	Female	30	178.63	29.291			

The results of this independent sample t-tests analyses indicated that there was no significant mean difference between male and female students' Metacognition in any group as p > 0.05 (Table 7). Hence, null hypotheses 2 to 5 were accepted. Moreover, the values of standard deviation showed that there was a slight difference in the dispersion from the mean scores of male and female students' metacognition scores.

Discussion and Conclusions

Powerful learning is essentially caused and the causing factors are grounded in three fold components: curriculum materials, teacher competencies, delivery and student assessment. Here delivery was considered in employing a set of instructional models; traditional, problem solving and 5E instructional models for gaining metacognitive skills in learning General Science in secondary schooling.

Three instructional models i.e. problem solving model, traditional instructional model and 5E instructional model were employed concurrently to the groups to measure metacognitive skills. Analysis of data yielded that 5E instructional model was more effective in developing metacognitive skills. The study results collaborate with a number of similarities that support work previously performed by other researchers (Seyhan & Morgil, 2007; Marek et al, 2008; Bevevino, Dengel & Adams, 1999; Lord, 1997; Sungur, Tekkaya & Geban, 2001).

The study conducted by Saglam (2006) concluded that the activities designed by keeping in view the 5E instructional model were more effective in developing scientific attitude in the students as compared to the activities designed by using traditional methods of teaching. Along the lines a study conducted by Saka and Akdeniz (2006) found effects of 5E instructional model accompanied with computer-aided materials on the subject of Genetics. The results of the study concluded that the classroom activities designed keeping in view the 5E instructional model were likely to decrease conceptual errors among the students. It was also found that the students felt themselves released from monotonous class environment by those activities. It also revealed that the teachers also felt an intensive experience to teach using 5E instructional model. Thus from wide range of studies a sample drawn here, it can be concluded that the 5E instructional model seemed more effective mode in developing metacognitive skills of students.

The results of the present study indicated that problem solving model was an effective way of instruction at secondary level as compared to traditional method of teaching. Many collaborative studies endorsed the finding of present study e.g. Nuzum (1991) and Ozsevgec et al., (2006). Review of related researches maintained that metacognition can be developed in the classroom. Several Studies undertaken in cross cultural environment support this proposition. They include: by Schraw et al. (2006), Haidar and Al Naqabi (2008), Joseph (2009), Wilson and Smetana (2010), Akyol, Sungur and Tekkaya (2010), Iiskala et al. (2011), Efklides (2011), Devaki and Pushpam (2011), Schofield (2012) and Papantoniou et al. (2012). All established that metacognition was important for the improvement of students' Academic Achievement, especially Achievement in Science. Hence, it was concluded that the problem solving model was fairly effective in developing metacognitive skills in General Science.

Gender differences have equally been observed in many conditions. It is generally found that the male students got more interest in General Science as compare to the female students, while no significant difference was witnessed between male and female students with respect to their metacognition scores. The results of the present study are also consistent with the studies conducted by Saka and Akdeniz (2006) and Seyhan and Morgil (2007). Contrary to this, the studies conducted by Shaheen (2017) and Shaheen and Kayani (2015) in local context also concluded that the gender had no effect on students' attitude while using instructional model. While, the study conducted by Haidar and Al Naqabi (2008) on 162 (80 boys and 82 girls) found that both the groups of gender used their metacognition equally. Furthermore, the study conducted by Akyol, Sungur and Tekkaya (2010) yielded a significant difference in metacognition and achievement of 7^{th} grade students in Science.

The discussion disclosed that the previous research studies showed a variety of results regarding gender difference. This might be due to demographic variations of learners' parental effects and school learning environment. Hence, it was concluded that the male students got more achievements in General Science as compared to the female students, while no significant difference was witnessed between male and female students with respect to their metacognition scores.

Recommendations

On the basis of conclusions following recommendations are suggested for endorsement of 5 E Instructional model and problem solving model in teacher training structures both at micro and macro levels.

1. As a classroom teacher, the role of a person becomes vital and it is prudent for a teacher to cause scientific learning students by choosing appropriate teaching strategies. Conclusions of the study yielded that both the 5E instructional model and problem solving model improved students' metacognition. Hence, designing forceful activities based on 5E instructional model and problem solving model attach a higher degree of vitality for a teacher. In addition, teachers training institutes may train novice teachers to develop such activities.
2. Transfer of learning is another important feature of students learning. Students may use their metacognition to develop a link between previous and new knowledge. In this respect, the 5E instructional model (stated by conclusions) may be helpful for them. The students may become aware of the effective use of their metacognition for the transfer of information and visualizing events occurring around them. In this connection, the teachers are recommended to use instructions based on 5E instructional model in their classrooms.
3. Metacognition skills bear productive ingredients to generate for better learning and enhance understanding the process of learning. In educational institutions metacognition skills may be introduced and applied both in professional and academic courses of study.

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