An Investigation into the Effectiveness of Metacognitive Skills Development Training at University Level

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Abstract: *This was an experimental study that has been conducted while taking BS Physics students from a Public sector university based in Lahore. The independent variable for the study was the Metacognitive skills development strategy (Thinking Aloud) enhanced with Cooperative Learning whereas the students' Metacognitive skills were the dependent variable. The sample (two groups, comprising 35 students in each) for the study has been selected with the help of Convenient Sampling. One of them was the experimental whereas the other was a controlled group. The Quasi-Experimental nonequivalent pretest-posttest control group design was used for the conduction of this research. The researcher used a performance test named "Metacognitive Skills Assessment Tool" (MSAT) adapted from (Ali, Siddiqui, & Tatlah, 2020) for the data collection. The results show that the intervention has a considerable impact on the development of university students' metacognitive abilities.*

Key Words: Metacognitive Skills, Metacognition, University Students

Introduction

In 1979, John H. Flavell introduced the idea of metacognition. Since then, studies have focused on metacognition and metacognitive skills. However, the researchers have looked at these skills in the context of learning. However, these aren't just academic talents; they're also life skills (Eskandari, 2020). It is necessary to use the knowledge one has gained and sound judgment while finishing either an academic or non-academic job (Amzil, 2013). Metacognition led to the two behaviours mentioned above. Making wise judgments, however, relies on how well one employs metacognitive skills (Ali, 2020).

One has to have a fundamental understanding of cognition in order to understand metacognition and metacognitive skills. Before discussing metacognition in this context, cognition is first defined. The Latin word "cognoscere" is the root word from which the English word "cognition" has been formed. In Latin, the word "cognoscere" means "to know" (Bayne, 2019).

But according to Cognifit (2019), it has been defined as a process that includes both understanding and awareness-seeking. Cognition is the ability to receive information, change it, codify it, store it, and then retrieve it. Metacognition is the next stage of cognitive

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development (Worley, 2018). Cognition is concerned with one's knowledge, as opposed to metacognition, which is concerned with how one uses information (Georghiades, 2012). Metacognition is, in other words, the excess of thought. The fact that the term "Metacognition" was originally used is to John H. Flavell's credit. He began investigating metacognition in the 1970s. Because he created metacognitive psychology, he has a right to it. The first person to explore metacognition was Plato in "Meno." According to acts and thoughts, one's inner self, which Plato discussed, assesses oneself. This assessment is the result of overanalyzing.

One's internal conversation has been described as such reflection (Worley, 2018; Plato, 385 BCE). In addition, Socrates called it "Silent Dialogue." He described it as an activity that entails conversing with oneself. As a result, in solitude when knowledge is attained, one's soul serves a variety of purposes (Vallin, 2019). One adopts the position of the interrogator and offers their replies. Aristotle, on the other hand, said that it was an action engaged in when one believed one's own idea to be superior to all others (Gama, 2004).

The conversation recounted above demonstrates that metacognition was a topic of discussion even during the time of Plato. However, Flavell deserves credit for coining the name "Metamemory" for this in the 1970s; the word "metacognition" was only adopted subsequently (Juma, 2017). This was clearly the proper beginning of metacognition.

One's awareness of one's thinking and learning processes is described as metacognition. It consists of two components: (Adnan & Bahri, 2018) (i) Metacognition Knowledge and (ii) Metacognition Regulation. In contrast to the latter, the former has six subfactors, including the following: declarative knowledge, procedural knowledge, and conditional knowledge (Azizah & Nasrudin, 2018). Planning, Information Management, Monitoring, Debugging, and Evaluation are included in the first of them. According to De Backer (2015), the components of metacognition regulation are referred to as metacognitive abilities.

According to the student's mother tongue and second language, there are differences in how metacognitive skills are used for learning, according to Cubukcu (2009). The findings showed that regardless of language, children apply the aforementioned competencies. They would much rather see their work done. Rahman (2010) examined how metacognitive abilities affected the academic success of secondary school pupils by using them as test subjects. Their abilities have been shown to have a significant favourable impact on their academic success.

Akturk & Sahin (2011) looked into how students' metacognitive abilities affected their performance. The findings indicated that students who utilized their abilities while completing the test had greater performance levels than students who did not use metacognitive skills while completing the activity. Rahman (2011) drew the conclusion from the study that instructors' knowledge and use of metacognitive abilities have a substantial impact on their students' academic achievement. It has been noted that kids who had teachers who were aware of their abilities and utilised them in the classroom performed better than those whose professors were not.

Ozturk (2015) looked at how participants' reading abilities were affected by their metacognitive abilities. The researcher implemented scaffolding as an intervention to foster the growth of the aforementioned talents. It has been determined that the participants' skills improved as a result of the intervention, and they began to employ these skills when reading the prescribed content.

Additionally, Evangeline (2016) found that metacognitive abilities aid in improving students' academic performance. Consider teaching students how to use their metacognitive talents when they are studying and getting ready for exams. In comparison to individuals who do not receive such instruction to apply their aforementioned skills, they demonstrate strong academic success. Erdogan (2017) recruited sixth graders to work on their metacognitive abilities.

Literature Review

The review of the related literature has been stated here in this section and stated as under:

Cognition

It is a mental process with significant implications for both teaching and learning. Therefore, it is important for educational stakeholders to comprehend it as well (Woolfolk, 2009). One may

grasp objects and concepts through this approach. By actively participating in the cognitive process, one can also gain knowledge. At the start, sensory perception is involved in this process. Following the transformation and retrieval, it is time to store the information (Cherry, 2020).

This is what the brain is for. The cognitive process is what produces one's knowledge. With the use of the cognitive process, one may ponder, recollect, and evaluate ideas or phenomena (Ashman & Conway, 2002). It is a comprehensive process that involves taking in sensory input, turning it into useful information, and then retrieving it. Cognition helps one comprehend the knowledge acquired. One sign that someone's mind isn't working properly is trouble thinking and comprehending the phenomena (Bayne, 2019).

Metacognition

It is essentially a process of self-reflection. One actively engages in thinking about one's own thoughts. The term "metacognition" is derived from the Greek word "Meta." This is code for "beyond." Metacognition is so thinking, although it differs from regular thinking. Instead, it goes beyond the normal modes of thought. While meta-thinking, one goes back and forth in thought (Ali et al., 2020). It is the process of reflecting on one's own thoughts, choices, and actions. The way one thinks reflects the way one thinks. Why is that what one thinks? How is it conceived? How one could conceive of things differently (Cubukcu, 2009). Before performing any particular work, one plans the items or activities they will accomplish. The information that has been obtained and is essential for carrying out any task is then managed. The same person continues to keep an eye on the work after that. Debugging is done after monitoring if an error occurs while the job is being performed. The last term of the evaluation is how the person ultimately assesses the work, its execution, and its completion (Akturk & Sahin, 2011).

The awareness of one's own thinking and learning is called metacognition. One ponders the concepts and content they have learned as well. If one engages in metacognition, one will always be thinking over thinking when they are merely thinking or performing any work (Cherry, 2020). According to some, metacognition is a process

that has a positive focus. This procedure forces one to reflect on overthinking and address the faults that are found (Erdoan & Engül, 2017).

Even though Aristotle stated that metacognition is a process by which one thinks at a higher level, he explored it in his "On the Soul" and the "Parva Naturalia" and "On the Soul." The soul serves two purposes at this level. One position is that of a doer, while the other is that of an assessor. However, Flavell coined the correct word "Metacognition" in 1976. be a result, he is referred to be the founder of metacognitive psychology (Veenman et al., 2013).

Difference between Cognition and Metacognition

Given that both cognition and metacognition entail thinking, they may sometimes be confusing. So let's examine how these two vary from one another. Thinking about many objects, occurrences, processes, etc. is a process known as cognition. Information is gathered for this reason with the aid of one's sensory organs. Following the transformation or coding of the information, it is understood and stored (Ozturk, 2015).

While cognition is the act of thinking about an idea or activity once again. One thinks about one's own thoughts in this (Azizah & Nasrudin, 2018). Cognition, put simply, is the process through which one becomes first involved before moving on to Meta-thinking or Meta-cognition. Gama (2004) has simplified this by saying that one should try to finish any given activity or cognitive issue. While metacognition encourages one to observe, troubleshoot, and then evaluate. The person engaged in metacognition assesses the method or approach used to complete the task.

Importance of Metacognition

The idea of metacognition has frequently been misunderstood since it is thought to be just useful and helpful for learning. It's not only a study or learning talent, though. Instead, it is a talent that is helpful for finishing any activity, regardless of its type. No matter what kind of businessperson you are, adopting metacognition will help you properly plan, monitor, debug, and assess the data and processes (Ali et al., 2020).

The knowledge of one's own thinking and learning is known as metacognition. However, it

is impossible to learn effectively if one is unconscious of their own thinking and learning. However, the instructors' efforts would not be as successful as they ought to be. However, if one is cognizant of their own thinking, they will also be conscious of their own learning. He would learn more effectively as a result (Rahman, 2011). When a student makes use of metacognition, their learning activities are organized. Therefore, the efforts wouldn't be in vain.

Similar to how the material would be organized, learning would take less time. One would continue to assess one's success while completing a task or learning, following the same pattern. This makes it easier to identify procedural or one's own flaws. This would enable one to troubleshoot the issues and keep moving on until the problematic task was finished. One's evaluation would prompt them to assess their own performance or progress. All of this contributes to the effectiveness of the learning process as a whole (Gama, 2004).

No matter what kind of work it is, using metacognition while doing it improves task performance. Learning would be enhanced if metacognition were used during learning. Likewise, if one applies these abilities to solve issues. One's ability to solve problems would increase and become more efficient (Chatzipantelia et al., 2013). One assesses one's own performance and how one completed the work. How successful was the chosen approach? Or perhaps another tactic would be more effective? Or how the job may be made better? One's ability to solve problems is enhanced while engaging in the metacognitive process. Problem-solving is a life skill that everyone requires.

Getting an education involves more than just getting a passing mark in class. Instead, the ultimate purpose of education is to provide a person with the skills necessary to both assimilate into society and find solutions to challenges they face in everyday life. Thanks to metacognitive abilities, this is feasible. One would be at ease to successfully handle challenges in real life if one employed metacognitive skills (Shen & Liu, 2011; Priya, 2012). The researcher aimed to enhance the prospective instructors' metacognitive abilities through cooperative learning while considering the significance of metacognition and metacognitive skills in one's life.

Metacognitive Skills

Planning, information management, monitoring, debugging, and evaluation are all metacognitive skills (Evangeline, 2016). Planning any activity, organizing the information related to the task, monitoring the task, troubleshooting the task execution process, and assessing are all examples of metacognitive abilities (Erdoan & Engül, 2017).

Methodology

This study has been conducted under the Positivist paradigm using the Quantitative approach. This was an experimental study that has been conducted while taking BS Physics students from a Public sector university based in Lahore. The independent variable for the study was the Metacognitive skills development strategy (Thinking Aloud) enhanced with Cooperative Learning whereas the students' Metacognitive skills were the dependent variable. The sample for the study has been selected with the help of Convenient Sampling because the random assignment of the students was not permitted by the university due to certain reasons. There were two groups (comprising 35 students in each) used in this study. One of them was the experimental whereas the other was a controlled group. The status of the Experimental or Controlled group was decided with the help of a coin. The Quasi-Experimental nonequivalent pretest-posttest control group design was used for the conduction of this research. The pre-test was given to both of the groups before the intervention. Then the intervention was given to the Experimental group and the Control group was given the usual treatment for the period of one semester. Then the posttest was given to the students. The "Planning" and "Information Management" skills were focused on during the first two weeks of each month whereas the rest of the skills "Monitoring, "Debugging" and "Evaluation" were focused during the last two weeks. While studying the given topic(s) with Metacognitive skills development strategy (Self-Assessment), the prospective teachers used to complete the given worksheet reflecting indicators of the above-mentioned skills so that their progress regarding skills development could be checked right after each session. These worksheets were assessed with the Worksheet Assessment Rubrics (WAR) developed by the researcher. The researcher used

a performance test named "Metacognitive Skills Assessment Tool" (MSAT) adapted from (Ali, Siddiqui, & Tatlah, 2020) comprising 14 items (representing Metacognitive skills) to measure the prospective teachers' skills. Furthermore, the Rubrics for Metacognitive Skills Assessment Tool (RMSAT) was used to rate the prospective teachers' performance taken on MSAT. These were also adopted by Ali, Siddiqui, & Tatlah, (2020).

Results

Descriptive Statistics (Mean Scores) and

Inferential Statistics (Independent Sample *t*-test) were applied to the quantitative data. Descriptive statistics were used to measure the Central tendency followed by the dispersion of the concerning data. The detail is as under:

Ho: There is no significant effect of the intervention on students' Metacognitive skills development.

The Independent Sample *t*-test has been used to find out the difference concerning mean scores between the Experimental and Controlled groups. The detail of the outcomes is as under:

Table 1

Comparison of Pre-test Scores Attained by Controlled and Experimental Group Participants

	Control Group N=30		Experimental Group N=30					
	M	SD	M	SD	df	t	p	d
Metacognitive Skills	18.68	2.44	18.74	2.99	68	0.08	0.42	0.02

The outcome of the Independent Sample *t*-test depicted in Table 1 shows that the Controlled group participants attained M=18.68, SD= 2.44 attained by the Controlled group against "Metacognitive Skills" is not statistically significantly different to the M= 18.74, SD= 2.99 scored by the Experimental group as *t*= 0.08, *p*=0.42 and d=0.02 (Small Effect Size).

Table 2

Comparison of Post-test Scores between Both Groups

	Control Group N=30		Experimental Group N=30					
	M	SD	M	SD	df	t	p	d
Metacognitive Skills	18.74	2.13	33.77	3.82	68	0.72	0.47	4.85

The outcome of the Independent Sample *t*-test depicted in Table 2 shows that the Controlled group participants attained M=18.74, SD= 2.13 attained by the Controlled group against "Metacognitive Skills" is statistically significantly lower than the M= 33.77, SD= 3.82 scored by the Experimental group as *t*= 0.72, *p*=0.47 and d=4.85 (Moderate Effect Size). Therefore, the *"Ho: There is no significant effect of the intervention on students' Metacognitive skills development."* Has been rejected based on the abovementioned results.

Conclusion

Finding out how the "Metacognitive skills development strategy" influenced the students' "Metacognitive skills" was the main objective of the current study. The inquiry was conducted using a quasi-experimental nonequivalent pretest-posttest control group design. The results show that the intervention has a considerable impact on the development of university students' metacognitive abilities.

Discussion

Based on the findings, it has been depicted that Metacognitive skills development training was found to be effective and developed Metacognitive skills in the prospective teachers. These results have supported (Chatzipanteli et al., 2013) who concluded that metacognitive skills can be developed as well as improved while teaching students with the self-check strategies of learning. The same has been concluded by the current study that Metacognitive skills can be developed while teaching with a Self-Assessment strategy. Similarly, Ellis et al., (2012) also concluded that metacognitive skills can be developed in the students as well as the teachers. They also referred that the success of the instruction lies in the phenomenon that the teachers should become active learners. They would be able to teach effectively only if they learn themselves how to learn which is possible through learning and using Metacognitive skills.

Recommendations

Based on the results, it is recommended that teachers should use Metacognitive development strategies to develop these skills in students.

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