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Impact of Teacher's teaching Strategies on the Academic Achievements of Middle School Students in Mathematics

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Abstract: *The purpose of this study was to find out the impact of teachers' teaching strategies on the academic achievements of middle-section students, particularly in Mathematics. To achieve this, an experiment was carried out under the umbrella of quantitative study. Pre and post-test were taken. The experimental group participants were taught by implementing teaching strategies and controlled group participants were taught by lecture-based methods. The data was gathered from 7th-grade students at private high schools. There were 25 participants in each group. Hypotheses were being tested against the research questions, The descriptive and inferential statistics showed beyond doubt that learning through innovative strategies had a greater impact on the academic achievements of middle school students than learning through lecture-based methods.*

Key Words: Mathematics, Academic Achievements, Teaching Strategies, Middle Section Students

Introduction

Academically, middle school students are expected to build upon the skills they learned in elementary school, while also being introduced to more complex concepts and subjects. Even though Mathematics is one of the subjects that middle school students are expected to master, students lack interest and face hurdles to clear their concepts as well as to get decent grades.

To overcome these hurdles for middle school Mathematics' students, teachers must embed new breakthroughs to improve students' mathematical concepts such as by using

innovative teaching strategies. The development and implementation of Mathematics teaching strategies for middle school students is the main goal of this study. This was proved by Pakistani authors Ali, A., Ahmad, N., & Hussain, S. (2021) too by their research in "Mathematics teaching research journal" as they agreed that teaching Mathematics through the application of strategies is more productive than the lecture method.

In contrast, in Pakistan, Mathematics' teachers prefer lecture-based methods where students are passive learners. This method does

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not allow students to relate Mathematics to their daily life. Teachers in middle-section classrooms usually begin their lessons by asking students to take notes and memorize the written formulas on the board. Being part of a teacher-centred classroom, they do not relate Mathematics concepts with real life. Neither do they intend to describe the framework or history of the current concept.

Impacts of Mathematics teaching strategies on Students

Even though our nation has adopted mathematics as a filter for students into science, technology, engineering, and mathematics jobs at the university level, student performance in mathematics is at a low ebb when compared to high-achieving countries. A renewed interest in curricula and teaching methods that promote equity in math classrooms is necessary to stop this negative tendency in mathematics. By recognizing students' readiness, interests, and learning profiles during instruction and taking advantage of their opportunities for personal learning and development, equity in mathematics classrooms can be achieved.

Mathematics' teaching strategies are the various approaches and methods used by teachers to facilitate student learning. The most effective teaching strategies are based on sound educational research, are adaptable to meet the diverse needs of students and consider the learning goals and objectives of the class.

Teachers have a significant and far-reaching impact on students, as they play an important role in shaping their students' futures. According to Yasoda, R. (2009) effective Mathematics teaching can lead to higher academic achievement, increased engagement in learning, and positive attitudes toward education. According to Han, F. (2021), Mathematics teachers who are supportive and encouraging, who promote a growth mindset, and who foster a positive and inclusive classroom environment can positively impact their students' attitudes toward education and their overall academic achievement.

As Kagan, L. (2000) stated several reasons for teaching Mathematics by incorporating various strategies in their classrooms, will better prepare students for tomorrow's world. Instead of asking whether students are smart, teaching strategies questions how smart they are.

Enríquez, J. A. V., de Oliveira, A. M. P., & Valencia, H. G. (2018) discovered that all over the world, Mathematics' teachers use multiple teaching strategies to make the process of teaching and learning more fruitful. There is a lot of work already done on Mathematics' teaching strategies such as jigsaw strategy, group and pair work, differentiated instructions, teaching through technology and games, key point strategy, mental math strategy, teaching through math manipulatives, alike and different strategy, openness to student solution strategy, flip classroom strategy, CPA strategy, gallery walk strategy and whole class discussion strategy.

Background of the Research

Much research is already conducted by Zikra Hayati, Khairatul Ulya (2019); Das, K (2019); Cevikbas et.al (2020); Delgado-Rebolledo, R., & Zakaryan, D. (2020) & Kellems, et.al (2019) on various teaching strategies utilized by Primary or Junior Mathematics teachers in their classrooms. As the teachers prefer primary and junior sections to teach through innovative teaching strategies. But, when the students become part of the middle section, due to the extensive syllabus and workload, teachers choose to teach by lecture method which is why students don't take much interest in the subject and consequently, their academic achievements suffer. It was the need of an hour to develop and implement mathematical teaching strategies for middle school students. Teaching itself is two-way traffic. Teachers learn as they teach so, Finally, for this reason, it's important to assess how these strategies affect students' academic performance, especially in Mathematics classes. If we keep on ignoring the fact that different teaching strategies impact students differently in Mathematics, there is much possibility that

middle school students will lose interest in Mathematics as they will spend much of their Mathematics' lesson time with their learning needs unrecognized and unfulfilled. Hence, they will suffer more with low grades in Mathematics and obscurity of Mathematics concepts. Ultimately, it will affect their career in future. This paper also wants to determine the difference between the academic achievements of the participants of the experimental group as well as to observe the effects of teaching Mathematics through the lecture-based method and their attitudes towards Mathematics classes.

This study focuses on the development and implementation of five engaging and practical main Mathematics' teaching strategies which are Expert strategy, Give and take strategy, Think, turn, talk strategy, Diverse teaching strategy and Physical material strategy.

Expert Strategy

Expert strategy is a cooperative learning tool invented by Elliot Aronson and his colleagues in the early 1970s. The "Expert strategy" is among Cooperative teaching strategies. It entails breaking down a large point into smaller, more manageable pieces and then letting students collaborate in small groups to sort out the data. Each student is responsible for working out a certain portion of the assignment. They move to their original teams and transfer their knowledge to other team members. Teams learn the subtopic after rearranging themselves. (Ronfeldt, M., Farmer, S. O., McQueen, K., & Grissom, J. A., [2015](#)). With the use of this strategy, students learn to comprehend and find the solution to the problem while strengthening their collaborative abilities. (Nusrath et.al, [2019](#))

Cooper, J. L., & Robinson, P. ([2000](#)) agreed that the Expert teaching strategy is a powerful and engaging strategy for a large number of students as they work in teams according to their expertise. This was acknowledged by Chang, W. L., & Benson, V. ([2022](#)) too as they shared their findings on expert teaching strategy by saying that "by allowing students to focus on specific aspects of

the subject, educators can ensure that everyone is working on something appropriate for their level of expertise. It promotes dynamic learning, develops cooperation and coordinated effort skills, and addresses individual learning differences". The educators agree that the Expert teaching strategy can be effectively implemented only if learners are informed about the objectives before using it. It is recommended that educators dedicate sufficient time to achieve major positive results. (Kasim et al., [2019](#)).

Give and Take Strategy

Social interaction expands the procedure of development. This declaration was affirmed by Vygotsky who was a Russian psychologist of the early 20th century and has been a major influence for educators to teach through collaboration. For Mathematics, significant studies in this field proved that teaching through social interaction through small groups for a variety of tasks and exercises produces positive results for student learning. (Sofroniou A, Poutos K, [2016](#))

As every individual is born with unique abilities, for the application of give and take strategy, students are merged in such a manner that they get the opportunity to learn from each other by interacting with different skill sets and a variety of information. Theobald, et.al ([2020](#)) admitted that students learn deeper when they interact with each other as collaboration makes them more confident and empathetic team players. This is evident from Yadgarovna, M. F., & Husenovich, R. T. ([2020](#)) research on "Advantages and disadvantages of working in small groups" as the authors agreed that give and take strategy help them to learn social skills as well as they learn the art of listening which is equally important for their life. Each group member learns that they cannot thrive on their own unless the others do. As a result, the accomplishment is handled collectively with the contributions of each member. The feedback given by teachers is crucial at the end of this activity as a dialogue between teacher and student increases their morale and consequently, escalates students'

academic achievements (Howe et.al, [2019](#)). Another author Ainiyah ([2022](#)) gave voice to Howe by declaring that the role of a facilitator is crucial. The teacher should serve "as both an academic specialist and as a classroom manager" during group tasks. (Ainiyah et.al, [2022](#)).

Diverse Teaching Strategy

Smale-Jacobse ([2019](#)) believed that when students are taught without keeping their individual differences in mind, they suffer. Many teachers use the same instruction and method termed a one-size-fits-all instructional approach (Bondie, R. S., Dahnke, C., & Zusho, A, [2019](#)) which should not be the case as every individual is different. Diverse instruction in Mathematics can take many forms, including adjusting the level of difficulty of tasks, employing different teaching methods, and providing students with alternative assessments. A diverse teaching strategy is an adaptable and responsive approach that tailors instruction and assessment to each student's specific learning needs. Before the execution of the lesson plan, teachers consider each student individually to make sure that their ability to learn, their way to comprehend, and their strong and weak areas of learning and interests are considered. By considering these factors, the instructor differentiates the learning material, process and product (Awofala, A. O., & Lawani, A. O. ([2020](#))).

A diverse teaching strategy offers a framework for modifying the curriculum and instructional techniques to better suit each student's individual level of interest, different learning behaviour and unique knowledge readiness (Tomlinson, C. A, [2001](#)). It contributes to the closing of the achievement gap between high- and low-performing students. It encourages students to take charge of their own education. Diverse instruction can help students succeed in Mathematics and develop essential problem-solving skills by providing personalized instruction and encouraging student engagement. Furthermore, research has shown that when students have the flexibility to design their own

strategies to solve questions, they are better equipped to apply mathematical operations to numerical information. (Growvs, D. A., & Cebulla, K. J, [2000](#)). Mulder, M. ([2014](#)) disagreed with this statement and perceived that there was no significant effect on students' mathematics achievements when they were taught by diverse teaching strategies, however, the positive relationship between students' achievements and diverse teaching strategies could be seen easily which meant that the more the teacher had diverse instructions, the higher the Mathematics achievement of the students was.

Think-Turn-Talk Strategy

The concept of the Think-Turn-Talk strategy was first developed at the University of Maryland by Frank Lyman. They defined it as "thinking individually and having a discussion with partners is among cooperative learning designed to influence student interaction". Harmer ([2002](#)) states that Think-Turn-Talk Strategy is an essential way to alter the pattern of class discussion as the process used in this strategy provides additional time for students to think, find partners by turning, and assist each other. He further affirmed that students enjoy the way teachers teach something new from a variety of sources. Sampsel, A. ([2013](#)) stated that Students can practice evaluating the logic of others and developing their own cases during class discussions or in small groups. These are critical abilities for students to develop because they are beneficial for their academics as well as extracurricular. Over the passage of time, this strategy was used by many other researchers in their study and Firdausah ([2020](#)) acknowledged that learning in pairs is a strategy which makes teaching easier, more fruitful, easy to apply and easy to understand for the students and allows students to work jointly in small groups with phases of thinking, turning, and talking.

This strategy is an effective way to improve students' thinking ability. Cooper & Robinson ([2000](#)) acknowledged that the "Think-Turn-Talk" strategy's formative evaluation is fruitful to the learning process. It is not that strategy

with only one stage as it combines several effective teaching strategies. From these findings (Cooper & Robinson, 2000; Harmer, 2002; Sampsel, A. 2013; Firdausah, 2020), we can conclude that the "Think-Turn-Talk" strategy promotes active learning, student engagement, collaboration, and critical thinking, making it a valuable tool for classroom instruction and discussion. This was revealed by Reinhart (2000) too as he stated that the application of this strategy has been proven to improve student participation in class discussions through action research.

Math Physical Materials

Piaget (1952) is among those several thinkers and theorists who laid the foundation for using physical materials in classroom learning, contemplated that students cannot understand abstract math through verbal explanations and lectures alone, but, for better understanding, they need hands-on experience with models, which is why physical materials are used in educational lessons to grasp the taught mathematical concepts. Physical materials are tangible or virtual objects (e.g., blocks) to demonstrate complex mathematical concepts (Lafay et.al, 2019). The first research on the use of physical materials applied to Mathematics learning was done by Sowell (1989). Sowell's research results declared that the students who used math physical materials in their classroom accomplished better than those who didn't.

Math physical materials are considered an effective way to teach and have been recommended by many educationists and researchers supported by empirical evidence for students identified with diverse learning patterns when used within the Math physical materials instructional framework. (Peltier et.al, 2020). Piaget (1952) believed that students need hands-on experience when it comes to those shapes or concepts which cannot be comprehended easily. Baroody (1989) disagreed with it and affirmed that Math physical materials are not necessary or adequate for purposeful learning but at the same time he suggested effective usage of math

physical materials as he believed that they are very helpful tools which make the lesson interactive and can alter the pattern of the classroom discussion. Baroody suggests that physical materials must be used thoughtfully as without them, they lose their effectiveness. For instance, they must be used at the initial stage of a topic. Likewise, Lafay et.al (2019) recommended the same that there is always a need to identify the situation that when and where to use math physical materials and most importantly how to use them because developing connections and linking them with the knowledge is a requirement of any lesson. He emphasized that for collaborative and meaningful lessons, teachers must make rules to use math physical materials.

Research Questions

The current study aimed to answer the following research questions considering existing literature to provide evidence based on experimental research.

1. To what extent do alternative teaching strategies affect students' academic achievement in Mathematics?
2. Which teaching method is more effective between Lecture-based teaching or strategy-based teaching?
3. Which strategy is best among expert, give and take think-turn-talk, diverse and physical materials?

Purpose of the Study

The significant features of the study are:

This study will help in exploring different teaching strategies specifically used in Mathematics' classes at middle school.

1. In this study, the researcher will focus on the teaching strategies and their impact on students' academic achievement.
2. Along with this, the possible best strategies for middle school Mathematics' students will also be examined.

Method

The researcher focused on the impact of alternative teaching strategies on the students'

academic achievements, specifically in Mathematics. Adaptation of the quantitative research approach made it easier to achieve the objective with experimental research by conducting pre-test, and post-test control group design. Students were divided randomly into two groups, named experimental and control groups. This was done by the researcher to avoid upsetting the students' regular classes. The variables gender and age were held constant so that these factors could not influence the outcomes of the study. The study was implemented on female 7th-grade students

(12-13 years old) who were the same in their calibre as the groups were equated statistically based on the pre-test. The study also aimed to investigate the effect and relationship of different variables. The "assessment" technique was used for it. After teaching the same topic to both groups with different methodologies (group 1 was taught by routine lecture method whereas group 2 was learning Mathematics by incorporating different strategies in their lessons). students completed the assessments provided to them. The confidentiality of participants was maintained as per ethics.

Table 1

Summary of Descriptive Statistics

	N	Min	Max	Mean	Std.Dev
Teaching Strategies	25	2.83	4.67	3.8267	0.44742
Lecture method final	25	1.00	5.00	2.6400	1.07548
V : N (listwise)	25				

Table 2

	N	Min	Max	Mean	Std. Dev
Physical Material Strategy	25	2.00	5.00	4.1600	0.94340
Diverse Teaching Strategy	25	3.00	5.00	4.1600	0.68799
Expert Strategy	25	2.00	5.00	4.1600	0.89815
Think, Turn and Talk Strategy	25	2.00	5.00	3.9600	0.93452
Give and Take Strategy	25	2.00	5.00	3.8800	0.97125

Table 3

Descriptive Statistics

		Expert Strategy	Give and Take Strategy	Think, Turn and Talk Strategy	Diverse Teaching Strategy	Physical Material Strategy
N	V	25	25	25	25	25
	M	0	0	0	0	0
Mean		4.1600	3.8800	3.9600	4.1600	4.1600
Median		3.96	4.00	4.02	4.05	3.99
Mode		5.00	4.00 ^a	4.00	4.00	5.00
Std. Dev		0.89815	0.97125	0.93452	0.68799	0.94340

Table 4

Summary of ANOVA

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Between Groups		0.124	3	0.041	0.045	0.02

ANOVA		Sum of Squares	df	Mean Square	F	Sig.
Expert Strategy	Within Groups	19.236	21	0.916	1.471	0.04
	Tot	19.360	24			
Give and Take Strategy	Between Groups	3.931	3	1.310	0.054	0.02
	Within Groups	18.709	21	0.891		
Think, Turn and Talk Strategy	Tot	22.640	24		2.570	0.04
	Between Groups	0.160	3	0.053		
Diverse Teaching Strategy	Within Groups	20.800	21	0.990	0.454	0.01
	Tot	20.960	24			
Physical Material Strategy	Between Groups	3.051	3	1.017		
	Within Groups	8.309	21	0.396		
	Tot	11.360	24			
	Between Groups	1.301	3	0.434		
	Within Groups	20.059	21	0.955		
	Tot	21.360	24			

Table 5
Summary of T-Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Diff	95% Confidence Interval	
					Low	Upp
Lecture method final Teaching Strategies	12.274	24	.000	2.64000	2.1961	3.0839
	42.764	24	.000	3.82667	3.6420	4.0114

Table 6
One-Sample Statistics

	N	Average Score	Std. Dev	Std. Err
Lecture method final	25	2.6400	1.07548	0.21510
Teaching Strategies	25	3.8267	0.44742	0.08948

Results

Descriptive Statistics, T-Test and Anova gave a clear insight into research questions tested against the null hypothesis. The results are summarized in Tables 1-3. Descriptive statistics in Table 1 show that effective teaching of Mathematics can be achieved through the application of teaching strategies. This is evident that the scores of the experimental group are superior to the control group. Table 2 shows that no strategy is less than any other. All strategies are equally effective, and the selection of strategy depends on the teacher, lesson, topic, grade and students' level of interest. Table 3 shows that for both groups,

the results of the t-test revealed that strategy-based teaching leaves a long-lasting and positive impact on students' academic achievements in Mathematics. All these three tables help to answer the research hypothesis.

Ho₁: Alternative teaching strategies do not affect students' academic achievement in Mathematics.

The results of Table 1(Descriptive statistics) show that the mean value for the lecture method = 2.6400 and the mean value for the strategy method= 3.8267, which rejected the null hypothesis and proved to teach through the application of strategies is more effective than teaching through lecture

method to students' academic achievement in Mathematics.

Ho₂: There is no difference in effectiveness between Lecture-based teaching and strategy-based teaching.

The results of Table 3(T-Test) show that the lecture method's value of $t = 12.274$, whereas, the teaching strategies' value of $t = 42.764$, their mean difference is 2.64000 and 3.82667 respectively, from these results, it is clearly evident that null hypothesis was rejected and learning through strategy-based method is more effective than lecture-based method.

Ho₃: No strategy is best among expert, give and take, think-turn-talk, diverse and physical materials

From Table 2 (ANOVA), we may conclude that every strategy is effective in terms of students' academic achievements. Teachers may incorporate strategies in their lessons according to topic, level of class and students' interest.

Discussion

The results of this study indicate that alternative teaching strategies have a significant and far-reaching impact on their students' academic achievements in Mathematics. Teachers who foster a positive and inclusive classroom environment can positively impact their students' attitudes toward education and their overall academic achievements. These results are harmonious with the research of Han, F. (2021) who emphasized teaching through innovative teaching methodologies as teachers can promote a growth mindset if they let students think out of the box and this is only possible if they adopt an openness to solution approach. Specifically, our results suggest that when students learn Mathematics through the application of different strategies, its impact is positive and long-lasting. This is consistent with the results of research of Fayetteville State University that show that performance in post-Mathematics assessment for students who experienced various strategies shows a

considerable increase when compared to those taught using the lecture-based method. Students' academic achievements can be enhanced if they learn through strategies-based methods (Douglas et.al, 2008).

The results of the current study answer Research Question 1 which was to know the extent to of teaching strategies affect students' academic achievements in Mathematics. The mean scores from descriptive statistics answer this question and these results are aligned with the results of a study by Pakistani authors Akhtar, Rashid and Hussain (2020) as they agreed that teaching Mathematics through the application of strategies is more productive than lecture method.

Strategy-based teaching is more effective than lecture-based teaching. The results of our study revealed that students' academic achievements improve when they learn through the application of different strategies. It clarifies Research Question 2 which was to identify a more effective way to teach among strategy-based teaching and lecture-based teaching. our results are consistent with the results of a study by Johnson (2018) and Cooper (1992) who emphasized the usage of Expert teaching strategy in Mathematics classrooms. From this study, it is proved that effective Mathematics teaching can lead to higher academic achievement, increased engagement in learning, and positive attitudes toward education. It is evident from Enríquez, De Oliveira, and Valencia's study too (2018) which suggested using innovative teaching strategies to make the subject trouble-free and compelling.

They further suggested that effective teaching, characterized by clear and concise explanations, hands-on activities, and a positive and inclusive classroom environment, can lead to improved academic achievement, increased engagement in learning, and positive attitudes toward education. (Enríquez, De Oliveira, and Valencia; 2018). Furthermore, the results of this study are comparable with the study of Indonesian authors Zikra Hayati, and Khairatul Ulya (2019) who suggested

having a strategy-based classroom rather than a lecture-based classroom to remove the fear of Mathematics from students. This is also reconcilable with the same results of research that show that there was a significant effect of teachers' teaching strategies on the academic achievements of middle school students in Mathematics. ANOVA table answers Research Question 3 and from the derived results we can conclude that every strategy is effective in terms of students' academic achievements. These results are in accordance with the results of research done by Pakistani authors Akhtar, Z. Rasheed, A., & Hussain, S., (2020).

Conclusion

Many strategies can be incorporated to improve students' academic achievements in Mathematics. The results of this study concluded that teaching through strategies-based methods was more effective in students' academic achievements than teaching through lecture-based methods. The teaching strategies used by educators can essentially affect students' academic achievements in Mathematics. The accomplishment of students in Mathematics is truly based on powerful instructing methodologies. Advanced decisive reasoning, critical thinking, and give clear and brief clarifications of numerical ideas can upgrade students' comprehension and execution in Mathematics. Insufficient showing procedures, addressing without understudy collaboration, giving repetition learning valuable open doors, and neglecting to address individual advancing necessities can prompt an

absence of understudy inspiration and underachievement in math.

To sum up, teachers' numerous teaching methods have a significant impact on how well their students perform in Mathematics classes. Effective teaching techniques can increase students' interest and engagement, enable them to comprehend mathematical concepts better, and aid in the growth of their brainstorming, reasoning and logical thinking abilities. On the other hand, ineffective teaching techniques can lead to poor academic achievement and a dislike of Mathematics. It is essential for educators to use various teaching approaches that make allowances for learning styles and incorporate group, pair and whole class work strategies.

Few advancements were observed with the application of teaching strategies in the current research; It improved the academic achievements of students as well as improved their overall attitude towards Mathematics. Hence, we may conclude that as compared to the lecture method, different and innovative teaching strategies increase students' academic achievements, particularly in Mathematics. The application of these strategies is crucial for their academic and emotional well-being. It is necessary to employ various teaching strategies in classrooms to fulfil the diverse needs of students in Mathematics. Margaret Mead, a remarkable archaeologist and scientist concluded, "If we are to achieve a richer culture, we must weave one in which each diverse human gift will find a fitting place."

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