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RESEARCH ARTICLE

Effect of Student-Lecturing Teaching Model on Eighth Grade Students' Attitude towards Mathematics in Shaoguan, China

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ABSTRACT

Student-lecturing is an innovative teaching model which allows students to express their problem-solving strategies and ways of thinking using mathematical language. It not only allows students to demonstrate their thinking process, but also creates a relaxed classroom environment for students to overcome their fear of expressing mathematics, thus changing their attitude toward mathematics. However, the traditional teaching methods place students in a passive accepting position, causing them to believe that mathematics is difficult and dull, leading to a loss of interest in Mathematics. This study analyzed the effect of the student-lecturing teaching model on student attitude toward mathematics through a one-and -half-year controlled-experiment with eighth-grade students in Shaoguan, China. The result of this study shows that the student-lecturing teaching model not only helps to develop students' problem-solving and communication skills, but also gives students the opportunity to express themselves with mathematical language, which in turn enhances their attitude toward learning mathematics.

Keywords: student lecturing, teaching model, attitude towards mathematics, communication skills

1. INTRODUCTION

The dialogic approach proposed by Socrates (Wilberding, 2021) is the beginning of Mathematical communication, which is the capacity to utilize mathematical language to accurately communicate mathematical ideas to friends, teachers, and others as well as to critique and evaluate the mathematical thinking and methods of others (Rohid & Rusmawati, 2019). In 1989, the National Council of Teachers of Mathematics (Frye, 1989) first proposed mathematical communication as a goal of school mathematics education, which has led to reforms in mathematics classrooms in various countries. For example, the latest revision of the Compulsory Mathematics Curriculum Standards has put forward three aspects of developing students' core literacy, one of which requires students to be able to express the real world in the language of mathematics, that is, mathematical communication. N. Ellerton and P. Clarkson discussed one type of mathematical communication in Chapter 27 of the International Handbook of Mathematics Education (Bishop et al., 1996) is classroom communication. Some

Chinese scholars (Gao & Zuo, 2019; Yin, 2011; Zhou, 2019) have proposed a model for classroom communication, in particular, the student-lecturing teaching model, which refers to a mathematical communication activity in which students use mathematical language to express their problem-solving strategies and thought processes (Li, 2020). However, such model is mainly used in problem-solving lessons. Combined the researcher's teaching experience and the concept of student-lecturing teaching model proposed by Yin (2011), the researcher adjusted Yin's teaching model and extended the application scope of this model, such as applying it to inquiry lessons.

Studies have revealed that researchers' operational conceptions of student-lecturing teaching models might vary. For example, according to Yang (2012), the procedure for student-lecturing model is generally four steps, while Yin (2011) proposed three stages of student-lecturing process based on students' learning receptivity. Based on Yin's research (2011), the operational concept of student lecturing model was divided into three stages. (i) Teacher-student interaction lecturing - Due to their inexperience, pupils are reluctant to try when they are asked to do lecturing for the first time. At this time, teachers would guide students by asking questions. This stage is the teacher-student interaction lecturing, which is to give students an initial experience of what and how to lecture; (ii) Student-student interaction lecturing - Student-student interaction lecturing is when students discuss questions in groups before selecting a representative to present the group's methods and thinking, whereas the teacher gives some comments. This stage aims at providing opportunities to some group members to practice the lecturing skills on their own first, further to inspire other students to learn and participate; and (iii) Individual student lecturing - Individual student lecturing is characterized by the individual taking control of the classroom throughout the presentation as a teacher. The purpose of this stage is to allow students to practice the student-lecturing model and make more students participant in the process, thereby increasing their interest and self-confidence in learning. In addition, this teaching model can create a relaxed classroom environment for students to overcome their fear of mathematical expression, thus stimulating their interest in learning mathematics and increasing their motivation and initiative in learning it (Ye, 2022), which also realizes the mathematical communication (Guo, 2017). That is to say, there is a relation between the innovative teaching model of student lecturing and students' attitudes toward mathematics.

The concept of attitude toward mathematics (ATM) is derived from attitudes (Wang, 2017). Some scholars exclusively use emotion to describe ATM, i.e., a person's positive, neutral, or negative feelings about mathematics (Aiken Jr, 1970). As Daskalogianni and Simpson (2000) studied attitudes, they found that they were bidimensional, that is, comprised of two parts, emotion and mathematical concepts. Another definition proposes three components including emotional response, beliefs regarding Mathematics, and behaviors related to Mathematics (Kind et al., 2007). According to Tapia and Marsh (2004), one's attitude toward mathematics has four subscales: value is the belief that mathematics is useful or not, self-confidence refers to the belief that one is good at mathematics or not, enjoyment relates to the liking or disliking of mathematics, and lastly motivation is the tendency to engage in or avoid mathematics. This study follows Tapia and Marsh's definition of ATM.

Moreover, this study also intends to address the following issues in mathematics education. First, students have some problems in mastering mathematical knowledge. For example, they can understand in class through listening to the teachers, but they cannot solve problems by themselves, which was also mentioned by Cheng (2022). He pointed out that students are used to listening to the teacher and do not take the initiative to think and participate in the class by themselves. In other words, some students acquire knowledge only by listening to the teacher and seldom do mathematical communication in class, which makes it difficult for them to master the mathematics. One of the reasons is that their attitudes towards mathematics are not positive, not active, they lack interest, and so on; thus they have little success in learning

mathematics (Guo & Li, 2019; Wang, 2021). Yan (2017) also believed that the first task to solve this issue is to change student attitude towards mathematics. Consequently, improving students' attitudes towards mathematics can to a certain extent, address the issue of students struggling to learn mathematics. Cheng (2022) stated that the student-lecturing model may foster an environment for students to express themselves, which completely mobilizes the class's passion, initiative, and interest in learning. Zhou (2019) found that the student-lecturing teaching model is an effective strategy to enhance student self-confidence, enjoyment, value, motivation, and so forth in learning mathematics. In other words, there is a connection between students' attitude towards and student-lecturing model. Therefore, this study aims at examining the effect of student lecturing on 8th graders' attitudes toward mathematics, so it has practical relevance to solving students' problems in mastering mathematics.

The second crucial matter is that the implementation of student-centered reforms in mathematics education is hindered. Zhong (2017) noted that although the reform of "student-centered" has been implemented for some time, the results are not immediately apparent. He also pointed out that one of the reasons is the inflexible teaching methods. The majority of mathematics teachers presently use the traditional teaching approach, which makes mathematics boring to students and cannot realize students' subjectivity in learning (Zhang, 2018). As a result, some scholars proposed an innovative pedagogy to implement the student-centered reform Zhou (2019), so that the student-lecturing teaching model has emerged. Some teachers, however, believe that such an innovative teaching model not only wastes classroom time but also is not conducive to improving students' academic achievement. Some educators are hesitant to allow pupils to express themselves out of concern that they lack related skills (Wu, 2019). These phenomena indicate that mathematics teachers rarely implement student-centered reform in the real classroom, which to some extent hinders the implementation of education reform policies. Therefore, this study has contributed to provide some suggestions and references for implementing student-centered reform.

Two issues can be found by reviewing past related literature. On the one hand, the majority of researches on student lecturing depend on practical experience or literature of "mathematical communication" as the article's support without more cutting-edge authoritative theory, so that the conclusions lack cutting-edge (Cheng, 2020). On the other hand, "student-lecturing" is necessarily and importantly related to psychology (Gao, 2022), but few articles have been written or analyzed from a psychological perspective. Therefore, this study aimed at filling this gap by investigating the effect of student-lecturing teaching model on eighth graders' attitudes towards mathematics in Shaoguan, China.

Given the above issues, the purpose of this research was to investigate the effect of "student-lecturing" teaching model on eighth grade students' attitude towards mathematics in Shaoguan, China, which can not only provide a reference for future related research but also provide some effective strategies or suggestions for students and teachers. Furthermore, it can promote the implementation of student-centered mathematics education. In the study, the following null hypotheses were examined; (H0) There is no difference in attitudes towards mathematics of eighth-graders between the experimental group and the control group before the treatment; (H0) There is no difference in attitudes towards mathematics of eighth-graders in the experimental group before and after the treatment; and (H0) There is no difference in attitudes towards mathematics between experimental and control groups of 8th graders after the treatment.

2. MATERIALS AND METHODS

A quantitative and quasi-experimental research design was used in this study to investigate whether the student-lecturing teaching model has an impact on 8th grade students'

ATM in Shaoguan, China. Based on the hypothesis, a control experiment approach was used, including two groups and two tests (pre-test and post-test) in this study. And ATMI was used by the researchers to gather data twice, and it is reliable with a high Cronbach's alpha score of 0.97 and a standard deviation of 5.67 (Tapia & Marsh, 2004). In addition, this study concentrated on analyzing the difference in students' ATM under various teaching approaches in order to answer the research questions. That is, this study will describe the changes in students' ATM under different teaching approaches and analyze the differences. Therefore, the researchers used SPSS 23.0 to perform descriptive and difference analysis on the collected data.

2.1. Participant

Samples are selected from a private school with the largest number of students and a geographically diverse student body in Shaoguan, China. Moreover, the group-based learning and management system used in each class at this school, along with the four blackboards put up in the front and back of the classroom, created the ideal situation for the experiment. Therefore, the students from this school would be more representative and the research results would be generalizable. Two classes with matching overall results were chosen during the second semester of the seventh grade, totalling 92 students， and instructed by the same teacher. In this research, the first six months were the adaptation period for teachers and students to reduce the impact of students' ATM. And then a year-long formal experiment was conducted in the eighth-grade level in which students have certain expression and thinking abilities, and which is also a transitional period for students' psychological state(Yang, 2019). A total of 92 questionnaires were distributed, among which some students took only one test in the pre-test and post-test experiments, so the final valid questionnaire was 89, with an effective response rate of 96.7%.

2.2. Instrument

To investigate the impact of the student-teaching model on eighth graders' attitudes toward mathematics, the researchers focused on three points. First, it is necessary to take into account that it is a complex construct with four components based on the definition of ATM in this research. Besides, the researcher took into account the instrument's briefness. In fact, the scale's briefness makes it a good addition to a battery of tools used to assess math attitudes (Primi et al., 2020). The inventory consists of 40 items: value (10 items), self-confidence (15 items), enjoyment (10 items), and motivation (5 items) (Cerbito, 2020). The psychometric properties of the questionnaire were good, with a reliability coefficient of 0.97 (Tapia & Marsh, 2004). It will take the participants 10 to 20 minutes to finish the questionnaire with only 40 elements. Thirdly, this instrument is reliable to investigate secondary school students' ATM. According to Tapia and Marsh (2004), ATMI showed strong internal consistency with a high Cronbach's alpha of 0.97 and a standard error of measurement of 5.67. Other researchers also found short forms of ATMI, and their Cronbach's alpha coefficients ranged from 0.81 to 0.96.

For example, Yaşar 's research had an overall Cronbach's alpha reliability estimate of 0.956(2014), Lin and Huang's research had an overall Cronbach's alpha reliability estimate of.89(2016), and so on. In sum, this study employed the Attitudes Towards Mathematics Inventory, ATMI (Tapia & Marsh, 2004) to measure eight grade students' attitudes toward mathematics. In addition, a five-point Likert scale was used to score the 40 items, with positive questions scored from Strongly Disagree (1) to Strongly Agree (5) and reversing items received the opposite numbers (Kalder & Lesik, 2011). The final scores were standardized to the mean value, i.e., each question was assigned a score based on the student's answer, and then the mean scores for both the total mathematical attitude and each dimension were calculated. Participants'

mean scores (both overall and subscales) above 3.0 were interpreted as positive, while those below 3.0 were seen as negative (Ali, 2019).

3. RESULTS AND DISCUSSION

In this study, eighth grade students' attitudes toward mathematics were determined through ATMI. According to the research questions, the researcher used SPSS 23.0 to analyze the data as follows. First, the ATM in the control and experimental groups before the experiment was analyzed. The results in Table 1 show that there were 44 participants in both the experimental and control groups. Students' attitudes towards mathematics in the experimental group (M = 138.59, SD = 27.68) was very close to those in the control group (M = 138.54, SD = 22.84) at the beginning. To examine whether there existed any differences in eighth graders' ATM before the treatment, Independent-Sample *t*-test was conducted.

Table 1. ATM of 8th graders before the experiment

	Groups	N	Mean	Std. Deviation
Students' ATM	Control group	44	138.5909	27.68369
	Experimental group	44	138.5455	22.83760

Table 2 shows the mean score of students' ATM in the experimental group was 0.45, 95% CI [-10.71 to 10.80], similar to the mean score of ATM in the control group, which means there was no difference between means ($p > .05$) before the treatment. A Paired-Sample t-test, on the other hand, was utilized to determine if there was a statistically significant mean difference in the students' ATM of the experimental group between pre- and post-tests. Tables 3 and 4 show the respondents' descriptive statistics for students' ATM between pre- and post-tests in the experimental group. Table 3 presents that after employing the student-lecturing teaching method, students' ATM (M= 149.05, SD = 21.36) had a significant improvement (M= 138.55, SD = 22.84).

Table 2. The difference of 8th graders' ATM before the treatment

	Sig.	Mean difference	95% confidence interval of the difference	
			Lower	Upper
Students' ATM	.528	.04545	-10.70988	10.80079
		.04545	-10.71543	10.80634

Table 3. Mean of students' ATM between pre- and post- tests in the experimental group

Tests	N	Mean	Std. Deviation
Post test	44	149.0455	21.36064
Pre test	44	138.5455	22.83760

Table 4. Differences of ATM between pre- and post- tests in the experimental group

Post test-Pre test	95% confidence interval of the difference					
	Mean	Lower	Upper	t	df	Sig. (2-tailed)
	10.50000	1.33344	19.66656	2.310	43	.026

It can also be highlighted in Table 4 that students achieved a mean increase in ATM after receiving the student-lecturing teaching model, M= 10.50, 95% CI [1.33, 19.67], t (43) = 2.310, $p < .05$ which indicates there was a statistically significant difference between means in the experimental group before and after treatment. The following table shows the data related to the test of significant difference on eighth graders' ATM between the experimental and

control groups one year after the experiment was conducted. Table 5 shows that there were 44 participants in the experimental group with a higher mean score (M = 149.05, SD = 21.36) than that of the control group (M = 138.48, SD = 20.23), indicating an increase in the mean score. After one year in terms of the student lecturing mode of instruction, the researcher used an independent sample t-test to determine if there was a difference in ATM between the experimental and control groups. As presented in Table 6, there was a statistically significant difference in the mean score of students' ATM between the experimental and control groups, with the control group scoring lower than the experimental group, M = -10.57, 95% CI [-19.38, -1.75], t (86) =- 2.383, p = .691.

Table 5. ATM in the experimental and control groups after the experiment

	Groups	N	Mean	Std. Deviation
Students' ATM	Control group	44	138.4773	20.22948
	Experimental group	44	149.0455	21.36064

Table 6. Difference analysis in ATM between the experimental and control group after the experiment

Post test-Pre test		95% confidence interval of the difference				
	Mean	Lower	Upper	t	df	Sig. (2-tailed)
	-10.56818	-19.38499	-1.75137	-2.383	86	.691

Two important contributions are made by this work. First of all, it is the first field study to examine whether the student-lecturing teaching model affects 8th grade students' ATM in Shaoguan. Second, this research can inform suggestions for students' problems in mastering the Mathematical knowledge problem and the implementation of student-centered education reform. Our data showed that students using one year of student-lecturing teaching model exhibited a significant improvement in ATM ($p < 0.05$), with the mean score from 138.55 to 149.05, while students' ATM employed the traditional teaching model had no improvement with the mean score from 138.59 to 138.49. The results gave preliminary evidence to suggest that the student-lecturing teaching model can improve 8th grade students' ATM, in particular, in Shaoguan. Why then do students receiving the student-lecturing teaching model have better ATM than those who are taught in the traditional method? It is our speculation that the student-lecturing teaching model has some influence on non-intellectual factors such as interest, value, enjoyment, and motivation. For example, Li (2020) pointed out that the student-lecturing approach for secondary school students fosters a strong interest and motivation for learning mathematics. Similarly, Liu (2018) also believed that the student-lecturing model can stimulate student interest and improve learning initiatives.

To explore the impact of student lecturing mode on students' ATM, we asked participants to test their ATM under different teaching situations. The results of this research only revealed the overall significant improvement in ATM, but it did not analyze the influence on the four subscales of ATM. Surprisingly, the researchers found that some students failed to show any significant improvement in terms of value based on the interview of some students and the participant teacher. Studies have only shown that student-lecturing model affects student interest, enjoyment, and motivation. However, the subscale of value is not covered in some studies. We believe that this lack of significance should be considered in the context of secondary school, which was not sufficiently empowered due to the small sample size and professional skills of the participant teacher, because the value of ATM has influence on students’ choices in university studies and future careers (Shi, 2018). Further studies could do some in-depth research on the value dimension in ATM.

4. CONCLUSION

This research aimed at examining the impact of the student-lecturing teaching model on 8th grade students' ATM in Shaoguan. Based on a quantitative analysis of the questionnaire survey on ATM, it can be concluded that students' ATM can be influenced by different teaching methods, such as student-lecturing model. According to the research purpose, three research hypotheses were proposed according to the research purpose in this study. Combined with the results of the data analysis, the main findings of this study are as follows, (1) The results of the pretest between the experimental and control groups were very similar in their ATM, which indicated that both groups had the same attitudes toward mathematics before the experiment, which allowed the experiment to continue; (2) The results exhibit a difference in the ATM in the experimental group after using the student-lecturing teaching model than before the treatment, and (3) The results revealed that the participants' ATM using the student-lecturing model had a significantly improvement than the students in the traditional approach. In conclusion, the results indicated that the student-lecturing model has a positive effect on 8th grade students' ATM. Therefore, secondary school mathematics teachers should take every possible measure, such as applying the student-lecturing mode to implement student-centered education and enhance student attitudes toward mathematics.

Declaration of Interest
I declare that there is no conflict of interest.

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REFERENCES

Aiken Jr LR. (1970). Attitudes toward mathematics. *Review of Educational Research*, 40(4), 551-596.
Ali MM. (2019). A study on the relationship between perceived mathematics classroom learning environment and academic achievement and attitudes of high school students. Master Dissertation, Northeast Normal University.
Bishop A, Clements K, Keitel C, Kilpatrick J, Laborde C. (1996). International Handbook of Mathematics Education. Kluwer International Handbooks of Education.
Cerbito AF. (2020). Comparative analysis of Mathematics proficiency and attitudes toward Mathematics of senior high school student. *International Journal of Scientific and Research Publications*, 10(5), 211-222.
Cheng LM. (2020). The experiment and thinking of teaching "students talking about problems" in junior high school mathematics classroom. *Mathematics and Physics for Middle School Students (Teaching and Learning)*, 1(2), Page?
Cheng M. (2022). Study on the Causes and transformation strategies of eighth-grade math students with difficulty. *Chinese Science and Technology Journal Database Education Science*, 2, 46-49.
Daskalogianni K, Simpson A. (2000). Towards a definition of attitude: The relationship between the affective and the cognitive in pre-university students. Proceedings of the 24th conference of the international group for the psychology of mathematics education.
Frye SM. (1989). The NCTM Standards - Challenges for All Classrooms. *The Mathematics Teacher*, 82(5), 312-317.
Gao J. (2022). A study of mathematics teaching activities based on standards in junior high school mathematics classrooms. *Secondary School Mathematics: Middle School Edition,* 3, 92-93.
Gao JY, Zuo M. (2019). The cultivation of thinking ability begins with "speaking" mathematics. *Education in Sichuan*, 1(6), 20-21.
Guo CY, Li XQ. (2019). A practical research on the effect of learning attitude on the improvement of junior middle school Mathematics Literacy. *Examination weekly*, 1(55), 88-88.
Guo SF. (2017). A study of secondary school students' attitudes towards learning mathematics. PhD Disssertation,

Huazhong Normal University.
Kalder RS, Lesik SA. (2011). A classification of attitudes and beliefs towards mathematics for secondary mathematics pre-service teachers and elementary pre-service teachers: an exploratory study using latent class analysis. *Issues in the Undergraduate Mathematics Preparation of School Teachers*, 5(1), 1-20.
Kind P, Jones K, Barmby P. (2007). Developing attitudes towards science measures. *International Journal of Science Education*, 29(7), 871-893.
Li WZ. (2020). A case study of the effect of "problem solving" on mathematical problem solving ability of junior high school students. PhD Disssertation, Xinjiang Normal University.
Lin SH, Huang YC. (2016). Development and application of a Chinese version of the short attitudes toward Mathematics inventory. *International Journal of Science and Mathematics Education*, 14(1), 193-216.
Liu WR. (2018). A practical study of students' "talking mathematics" activities in junior high school mathematics classroom. PhD Disssertation, Inner Mongolia Normal University.
Primi C, Bacherini A, Beccari C, Donati MA. (2020). Assessing math attitude through the attitude toward Mathematics inventory – Short form in introductory statistics course students. *Studies in Educational Evaluation*, 64(1), 100838.
Rohid N, Rusmawati RD. (2019). Students' Mathematical communication skills (MCS) in solving Mathematics problems: a case in Indonesian context. *Anatolian Journal of Education*, 4(2), 19-30.
Shi TC. (2018). Major choice and career planning of high school students from the perspective of college employment. *Chinese Youth*, 4, 223-233.
Tapia M, Marsh GE. (2004). The relationship of math anxiety and gender. *Academic Exchange Quarterly*, 8(2), 130-134.
Wang LY. (2017). A study of middle school students' attitudes towards Mathematics. PhD Disssertation, Ludong University.
Wang XF. (2021). Study and transformation strategies of mathematics students with difficulty in Eighth Grade-Take three middle schools in Quanzhou city as samples. *Fujian Basic Education Research*, 7, 60-65
Wilberding E. (2021). Teach like socrates: guiding socratic dialogues and discussions in the classroom (grades 7-12), Routledge.
Wu SJ. (2019). Deeply reflect on specific problems and specific solutions--The drawbacks of traditional middle school mathematics teaching and effective teaching strategies. *Secondary Course Tutoring (Teaching Research)*, 13(20), 33-33.
Yan HH. (2017). Strategies for transforming struggling students in middle school Mathematics. *West Quality Education*, 3(5), 69-71.
Yang JH. (2019). The smooth transition of the eighth grade "psychological weaning period" talking about family education countermeasures for eighth graders. *New Education Times e-magazine*, 2(39), 1-2.
Yang ZF. (2012). Example of the teaching attempt of "talking about the problem" in biology review class. *Teaching Biology to Secondary School Students*, 3(11), 24-25.
Yasar M. (2014). Mathematics attitude scale: its psychometric properties. *Pakistan Journal of Statistics*, 30(6), 1267-1277.
Ye WL. (2022). On the strategy and efficacy of problem solving in junior high school mathematics. *New Campus*, 1(10), 109-110.
Yin BH. (2017). A practical study of problem-speaking teaching for students in senior mathematics revision class. PhD Dissertation, Sichuan Normal University.
Yin WK. (2011). The principles and educational functions of teaching mathematical problem solving. *Educational Theory and Practice: Primary and Secondary Education Teaching Edition*, 31(5), 54-55.
Zhang JT. (2018). A study on the shortcomings of traditional mathematics education classroom model and the direction of reform. *Exam Weekly*, 1(29), 89-89.
Zhong Q. (2017). The current situation and improvement measures of middle school mathematics teaching. *West Quality Education*, 8, 241-241.
Zhou, X. Y. (2019). The experiment and thinking of teaching students talking about problems in junior high school mathematics classroom. *Mathematics Teaching Newsletter*, 1, 69-70.