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From Chalk to Clicks: A Paradigm Shift in Mathematics Education for Chinese Ninth Graders through Computer-Aided Teaching

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Abstract: *With the increasing integration of information technology in education, this study examines how Grade-9 mathematics teachers in China use computers and how their teaching styles affect students' math performance. Utilizing quantitative research methods, including questionnaires and data analysis, the study explores the correlation between classroom computer usage and student grades. Descriptive analysis covers teachers' demographics and technology use, while difference and correlation analyses investigate the relationships between these factors and student performance. Key findings reveal a positive correlation between teachers' education levels and their training in subject pedagogy or textbooks, and negative correlations between favorite teaching methods and the use of teaching software, as well as between technology training and training in adolescent psychological development. By evaluating current computer use in classrooms and its impact on teaching and learning, this study aims to optimize teaching strategies and provide insights for future research.*

Keywords: *Use of computer assistance; Teaching styles; Teacher professional development; Students' mathematics academic achievements*

1. Introduction

Nowadays, the advancements in the field of science and technology greatly influence our lifestyles, impact our lives and cause changes in every aspect of them. These developments also affect the ways of teaching and learning. The National Council of Teachers of Mathematics (NCTM 2000) emphasized the importance of the use of technology in mathematics education, stating that “technology is essential in teaching and learning mathematics, it influences the mathematics that is taught and enhances students’ learning”.

Computer Assisted Instruction (CAI) provides one possible avenue for education leaders to overcome or address the problem of low achievement in mathematics[1][2]. There are a growing number of studies focusing on how Chinese mathematics teachers teach mathematics, since classroom teaching is a crucial influence on students’ mathematics learning outcomes[3]. From the students’ perspective, their success of learning mathematics has strong relationship about the teachers’ teaching skills[4].

Therefore, it is of great significance to analyze and study the current situation of computer use, and to find teaching strategies used by junior high school mathematics teachers to improve the quality of mathematics learning. This study will focus on the use of computers by Chinese junior high school mathematics teachers and their teaching methods. By conducting our proposal, we will try to get some methods to improve students' mathematics learning.

2. Problem Statement

Mathematics is one of the important subjects in school teaching. The quality of teachers' classroom teaching directly affects the students' mathematics learning ability and practical application ability. For students in the grade-9 of junior high school, mathematical knowledge is abstract and difficult for students to understand, so boring textbook knowledge and arithmetic formulas are not attractive to them. The new curriculum reform is an important basis for China's current education development, which contains new teaching concepts. Creating interesting classrooms is the top priority after the new curriculum reform, and it is also a direction of mathematics teaching reform in contemporary middle

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schools. Interesting and innovative practices are inseparable from the development of modern technology, and how to apply technology to improve mathematics education is also very important.

In the teaching process, the teacher should design interesting teaching situations based on the content of the teaching materials and the knowledge level and life experience of the students, so that students can feel the ease and fun of learning, understand mathematical knowledge in the situation, learn mathematical skills and master ideas Method. In the teaching process, the problems are brought into reality to explain in combination with the actual situation, and the situational teaching mode is designed to stimulate students' imagination and let them think independently. The use of various teaching methods requires the cooperation and mutual cooperation of the school education system to play a role. Therefore, in the process of implementation, teachers should adopt reasonable and effective teaching strategies to improve the quality of mathematics teaching in junior high schools and reduce the number of students with learning difficulties in mathematics.

3. Research Objectives and Questions

The objectives of this proposal are in three folds.

The first is to understand the use of computer-assisted classroom teaching by ninth grade mathematics teachers in my country (including the use of PPT lectures, the use of teaching software for research, and the use of the Internet in classrooms). Based on the data, we can clearly see the differences in the use of computers by Chinese junior high school mathematics teachers in the classroom.

The second is to understand the correlation between teachers' use of computers in the classroom and students' mathematics performance. The situation of using computer can cause negative or positive influence on students' grades.

The third is how different teaching styles affect student mathematics performance and identify which kind of teaching style has the most positive impact on student math performance.

Research Questions

(1) What kind of teaching style can cause a positive influence on mathematical grades?

(2) If the teacher applies the technology on students' mathematical classroom can help them improve the interests in mathematics study?

(3) What is the situation of classroom teacher's computer usage at present stage?

(4) What should we do to is the most efficient way of learning mathematics?

4. Literature Review

This study examines the use of computer-assisted teaching and various teaching styles in Chinese ninth-grade mathematics classrooms and their impact on students' academic achievements. A detailed literature review highlights the relevant aspects of these areas.

4.1. Use of Educational Technology in Mathematics Education

Demirbilek and Tamer (2010) emphasize the importance of professional development training for mathematics teachers in incorporating educational computer games[5]. Their study suggests that such training can positively shift teachers' attitudes towards using computer games in the classroom. However, several challenges arise, including issues with the technical operation of games and the hardware and software requirements. These factors significantly influence the effectiveness of integrating computer games into mathematics education, highlighting that while information technology holds great potential for teaching mathematics, it also brings practical difficulties. Drijvers(2014) stated that the integration of technology into mathematics education is related to three critical factors: the design of technology, learning activities and tasks; the role of the teacher; and the educational context[6].Kurniati, R., Sugiarto, S., Lestari (2023) conducted a literature review and reviewed the literature on the use of technology in mathematics learning over the past decade, arguing that in today's digital age, the use of technology to learn mathematics is very important[7]. Importantly, most teachers still lack knowledge of mathematics learning techniques. Therefore, it is important to conduct basic research on mathematics teaching techniques.

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4.2. Teaching Strategies ana Multiple Approaches

Lynch and Star (2014) explore the advantages and disadvantages of using multiple strategies in middle and high school Algebra I instruction[8]. Their analysis, based on interviews and surveys, reveals that while middle and high school teachers often stick to traditional methods, they acknowledge the effectiveness of teaching multiple problem-solving strategies. The researchers advocate for training students to apply various strategies, which can enhance their problem-solving skills rather than limiting them to a single approach.

4.3. Impact of ICT on Student Achievement

Delen and Bulut (2011) conducted a study using data from the 2009 Program for International Student Assessment (PISA) to analyze the effects of ICT on student achievement[9]. Their findings indicate that students' familiarity with ICT and exposure to technology contribute to explaining achievement gaps in math and science between individuals and schools. This study highlights the importance of incorporating ICT in classroom environments to enhance educational outcomes.

4.4. Evolving Mathematics Instruction

Slakmon, B., Abdu, R. (2024) discuss teachers' ability to pay attention to collaboration in computer-supported collaborative learning (CSCL) environments and how professional development can enhance mathematics teachers' awareness in dialogic activities[10]. This echoes the approach of asking questions to promote logical thinking and exploration mentioned by Piccolo et al(2008)[11].They emphasize the importance of interaction between teachers and students, as well as a more open and collaborative approach to teaching.

4.5. Teacher' beliefs and Technology Integration

DeCoito and Richardson (2018) explore middle school teachers' beliefs about and use of technology through the lens of technology, pedagogy, and content knowledge (TPACK)[12]. Their study, based on surveys and interviews, identifies internal and external barriers that influence teachers' decisions to integrate technology into their teaching practices. These barriers must be addressed to effectively incorporate technology in education and improve pedagogical outcomes.

4.6. Challenges of Computer Assisted Instruction

Although computer-assisted instruction (CAI) provides many benefits to education, it also brings its own set of challenges[13][14].First, hardware failures, software compatibility issues, and network connection issues are common technical obstacles when implementing CAI. These issues may disrupt the teaching process and affect students' learning experience. Second, teachers need to receive appropriate training to be able to effectively integrate CAI into their teaching practices. Without adequate preparation, teachers may not be able to fully utilize the potential of CAI and may have difficulty responding to problems that arise in teaching. Additionally, students have varying levels of familiarity with technology, which may have an impact on their learning outcomes, as those who are less familiar with technology may feel uncomfortable or frustrated. Finally, purchasing and maintaining a CAI system requires a significant financial investment, which can be a significant obstacle for schools with limited resources. Therefore, while CAI offers many educational opportunities, these challenges need to be overcome through comprehensive strategies and planning to ensure that CAI can have a positive impact on all students.

In summary, the literature indicates that while the integration of technology and innovative teaching strategies in mathematics education offers significant benefits, it also presents challenges that must be managed. Effective professional development, addressing technical and infrastructural barriers, and fostering adaptive teaching methods are crucial for enhancing student performance and engagement in mathematics.

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5. Methodology

5.1. Research Design

The specific research routes are as follows.

5.1.1. Descriptive Analysis

Focus on the analysis of the basic information (age, gender, teaching experience, education background) of the grade-9 mathematics teachers in China, and the three kinds of information technology equipment (PPT, teaching software and network) used by the grade-9 mathematics teachers in the classroom.

5.1.2. Difference Analysis

First, analyze the situation and differences in the specific use of computers in the classroom by junior high school mathematics teachers with different basic information (age, gender, teaching experience, education), different cities and schools of different levels. Control the irrelevant variables strictly. Secondly, analyze the differences in teachers' teaching styles and its effects among schools in different cities and different levels, and the differences in the use of computers in the classroom by teachers who participate in and agree with information technology training in different degrees.

5.1.3. Correlation Analysis

Focusing on the analysis of the correlation between the specific use of computers in the classroom by mathematics teachers in the grade-9 of junior high school and the mathematics scores of students in the corresponding class: different styles of teaching use the multi-column correlation way to prove if it has the contact between teachers' teaching styles and students' mathematics grades.

5.2. Sample Design

One city was selected in North China (City1), South China (City2), West China (City3), Central China (City4), and East China (Shanghai). There were five cities in total. The data collected can accommodate the situation in all parts of China to the greatest extent. The sampling of schools is based on the two dimensions of the area (urban area, urban area and county) and school running conditions (key schools, general schools, and schools with relatively poor school running conditions). Expand and randomly select 2 schools from each category of eligible schools. 12 schools were selected from each city, a total of 60 schools.

Remark: The five cities selected for this sample are from different regions of China, and have different teaching styles and characteristics, and both urban and rural schools are considered, so the selection of the sample is universal.

5.3. Data Collection Procedure

5.3.1. Questionnaire Survey

Table 1: Design Framework of Teacher Questionnaire

Survey Kinds	Content of Survey	Involving information
Basic information	• Information	• Age,Gender,Experience ,Educational,Background,Teaching subject
Professional practice	• Prepare lessons	• The way or mechanism of teaching preparation
	• Professional development	• Mode ,frequency content effect and resources of professional development
	• Teaching scientific research	• The frequency and degree of teaching research
	• Workload	• Teachers' workload
	• Understanding of curriculum standards	• Teachers' understanding and application of curriculum standards
Teaching activity	• Structure types of classroom teaching activities	• Typical classroom activity types
	• Teaching materials	• The source and structure of teaching materials
	• The computer use in teaching	• The application of computer hardware and software includes application mode and frequency.
	• Design and treatment of homework and evaluation	• Homework and exam types, application methods, etc.

The questionnaire we designed based on *Table 1*,and the purpose of questionnaire is to understand

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the basic situation of Chinese junior high school mathematics teachers, their use of computers and whether they have received training, etc., to understand the teaching style of teachers and their impact on students' mathematics performance, and to compare the results of these questions collected for further analysis. Some cities have distributed online questionnaires.

5.3.2. Sample Stratification

According to the principle of category sampling, the course group is divided into three levels of cities, schools and students to select subjects. Among them, the distribution of cities according to the type of sampling locations was carried out. The sampling of students follows the standard of PISA test, randomly selects students from 2 classes in the grade-9 (15 years old) of each school, a total of 120 classes. Test the influence of teachers' use of technology on students' math scores. Divide the teacher styles of these 120 classes into three groups. The first group is the traditional teaching type, the second group is the cooperative type, and the third group is the student discussion type.

5.3.3. Sample Cleaning

In this process, we formalized the collected data in an excel form and screened some invalid questionnaires. For example, if all the choices of the subject are filled in the same situation, it proves that the subject did not answer seriously, and the result needs to be eliminated. Simultaneously, reliability and validity tests were carried out. We used a Cronbach's coefficient of 0.7 or higher, indicating good internal consistency for the questionnaire.

5.3.4. Reasonableness of data collection steps

a) Some city questionnaires were posted online.Firstly, in order to make the results of this study universal, our samples try to cover various research situations. The second is that the researchers conducted online questionnaires considering the time and cost of funds and the development of network information, and the use of computers is also one of the purposes of this proposal.

b) In order to study the impact of middle school mathematics teachers' use of computers and teaching methods on students' mathematics performance, this experiment will be divided into multiple categories of control variables for corresponding research to minimize the impact of irrelevant factors.

c) This process hope to obtain accurate data results as much as possible, so some invalid problems should be eliminated in time to reduce the impact on the results.

d) The samples selected in this proposal are all with the consent of the individual, and are only used for data research and analysis, and there are no other illegal purposes.

5.4. Discussion

5.4.1. Demography Analysis

Table 2: Demography Analysis

		Count	Percent	Total
Gender	Male	128	25.7%	
	Female	370	74.3%	498
Teaching age	Less than 5 years	158	31.7%	
	5-10 years	194	39.0%	
	More than 10 years	146	29.3%	498
Education	Lower than Undergraduate	41	8.2%	
	Undergraduate	291	58.4%	
	Master	153	30.7%	
	Doctor	13	2.6%	498

Sample Demographics(*Table 2*) Of the 498 valid responses (from 600 distributed questionnaires), 74.3% were female teachers. Teaching experience was evenly distributed, with most teachers holding undergraduate (58.4%) or master's degrees (30.7%).

5.4.2. Teaching Styles and Average Score

Through the questionnaire survey, found that the lecture teaching is the teacher's favorite. The average score of most students is 85-90 points. Content is shown in *Figure 1* and *Figure 2.*

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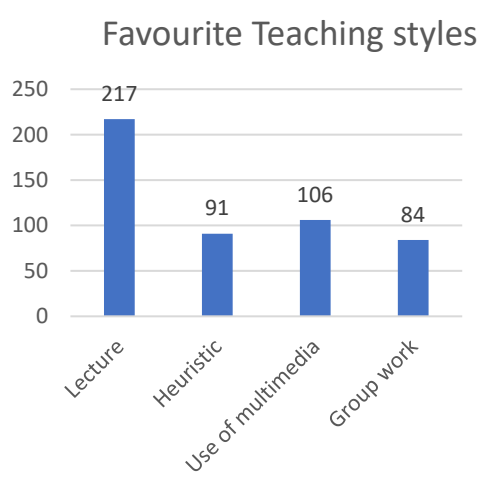

Figure 1: Favourite Teaching styles

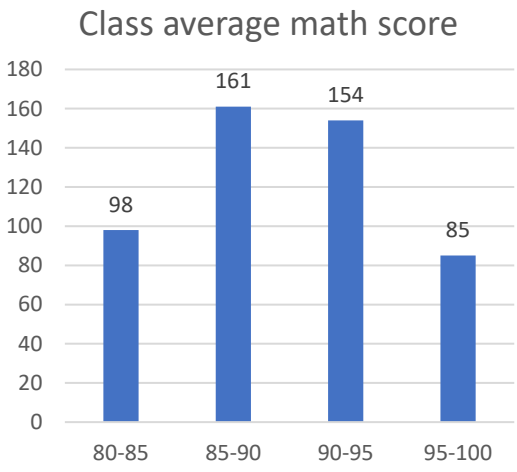

Figure 2: Class average Math score

5.4.3. Technology Training

Training in subject pedagogy or textbooks and subject expertise are most frequently perceived as highly effective, while training in computers or educational technology has the highest non-participation rate (34.5%). This suggests a need for increased participation and possibly enhanced focus on the effectiveness of technology training.This is shown in *Table 3*.

Table 3: How effective are the following trainings in your teaching?

	Participated and very effective	Participated and had a certain effect	Participated but the effect was not significant	Did not participate
A. Training in subject expertise	23.7%	34.9%	29.1%	12.2%
B. Training in subject pedagogy or textbooks	26.7%	27.1%	27.9%	18.3%
C. Training in computers or educational technology	19.3%	23.7%	22.5%	34.5%
D. General Technical Training for Curriculum and Instruction	25.1%	26.9%	24.1%	23.9%
E. Training on Psychological Development of Adolescents	21.3%	23.9%	24.5%	30.3%

5.4.4. Classroom Activities

We can find that most people have not received systematic computer training(in *Table 4*). Teachers occasionally play PPT in class, and they seldom use Internet media in class. Teachers do not know much about the use of teaching software.

Table 4: Classroom Activities

Classroom Activities	Always	More	Occasionally	Few
A. Play handout PPT	20.1%	23.7%	29.3%	26.9%
B. Demonstration process with teaching software	16.5%	20.5%	26.5%	36.5%
C. Internet use in class	20.9%	21.9%	25.9%	31.3%

5.4.5. Correlation Analysis

We break down computer use and teaching style into smaller variables and use SPSS Statistics 26 to analyze the impact of each variable of computer use and teaching methods on the average score of mathematics, as well as the joint effect of the two.The research content does not conform to the normal distribution, so we use Spearman for correlation analysis.We found that mathematics performance is not correlated with computer use and teacher teaching styles,but we still found some other relationships in *Table 5*.

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Table 5: Correlation Analysis

Variable1	Variable2	Significance	Correlation Coefficient	Correlation
Education	Training in subject pedagogy or textbooks	0.036	0.094	Positive Correlation
Favorite teaching method	Demonstration process with teaching software	0.026	-0.1	Negative Correlation
Training in computers or educational technology	Training on Psychological Development of Adolescents	0.037	-0.094	Negative Correlation

There is positive correlation between education and training in subject pedagogy or textbooks.A negative correlation between favorite teaching method and demonstration process with teaching software, and between training in computers or educational technology and training on psychological development of adolescents.

6. Conclusion

This study examined the impact of computer use and teaching styles on Grade-9 students' mathematics performance in China. Key findings reveal a positive correlation between teachers' education levels and their training in subject pedagogy or textbooks, suggesting that better-educated teachers are more effectively trained in pedagogy. Conversely, there is a negative correlation between favorite teaching methods and the use of teaching software, and between training in computers or educational technology and training in adolescent psychological development. Despite no direct correlation found between computer use or teaching styles and student math performance, these insights highlight areas for optimizing teaching strategies and enhancing training programs.This study reveals the critical role of teacher professional development training in improving teaching quality and highlights the importance of using diverse teaching styles to adapt to different student needs. It also points to the potential of educational technology to improve students' mathematics performance and provide education Policymakers and practitioners provide direction for improving instructional strategies and promoting educational equity.

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