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APPLICATION OF VIRTUAL SIMULATION TECHNOLOGY IN COMPUTER SCIENCE EXPERIMENT TEACHING

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Abstract: Virtual simulation technology plays an increasingly important role in the experiment teaching of professional courses in universities, demonstrating significant potential and value. This study aims to explore the current application status of virtual simulation technology in computer science experiment teaching. Through literature analysis and case studies, it analyzes the advantages and disadvantages, problems and challenges, and future development trends of virtual simulation technology in computer experiment teaching. The findings provide important references for further promoting the application of virtual simulation technology in computer science experiment teaching.
Keywords: Virtual simulation technology; Computer science; Experiment teaching

1 INTRODUCTION

Virtual simulation experimental teaching, characterized by the application of information technology, meets the demands of open education and resource sharing in higher education during the information age. It provides advanced methods, open platforms, and high-quality resources for students to engage in inquiry-based learning, autonomous experiments, and innovative practices. In the experimental teaching of computer science in higher education, traditional teaching models face challenges such as resource limitations, safety hazards, and low student participation. The application of virtual simulation technology can effectively address these shortcomings, becoming a necessary approach to enhance the quality of experimental teaching[1-2]. This paper systematically reviews the application of virtual simulation technology in computer science experimental teaching, noting its primary use in experimental courses related to computer networks, operating systems, Internet of Things technologies, computer graphics, and artificial intelligence. The advantages of applying virtual simulation technology in computer science experimental teaching include safety, cost-effectiveness, flexibility, repeatability, personalized learning, enhanced learning experiences, interdisciplinary integration, and data collection and analysis. However, challenges remain in the implementation of this technology, including high costs, insufficient teacher training, and outdated equipment.

2 APPLICATION OF VIRTUAL SIMULATION TECHNOLOGY IN COMPUTER EXPERIMENT TEACHING

2.1 Overview of Virtual Simulation Technology

Virtual simulation technology utilizes computer-generated virtual environments to simulate the behaviors of the real world or specific systems, facilitating interaction and learning. Depending on the application scenario, virtual simulation technology can be classified into types such as Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), and computer simulations. This technology possesses several notable characteristics: immersion, which makes users feel present in the environment; interactivity, allowing users to operate objects in the virtual environment in real-time; real-time response, ensuring that users' actions are immediately reflected in the environment; and repeatability, enabling users to conduct experiments and practice multiple times, thus reducing practical risks[3]. Virtual simulation technology is widely applied in various fields such as education and training (providing a safe experimental environment), healthcare (surgical simulations and skills training), military (tactical training and exercises), engineering (product design and testing), and entertainment (game development).

2.2 Typical Application of Virtual Simulation Technology in Experimental Courses

2.2.1 Computer network experiments

(1) Network Topology Simulation: Using tools such as Cisco Packet Tracer, GNS3, or NS-3 for simulating network topology design and configuration. Students can build and test various network architectures in a virtual environment, validating the functionality and performance of network protocols[4-6].
(2) Network Security Simulation: Conducting network attack and defense experiments through virtual simulation platforms, such as penetration testing with Kali Linux or simulating various types of network attacks (e.g., DDoS attacks) in a virtual environment[7-8].

2.2.2 Operating system experiments

(1) Virtual Machine Management: Using virtualization software like VMware or VirtualBox for experiments on operating system installation, configuration, and management. Students can test different operating system functions in a virtual environment without altering the settings of physical computers.
(2) Operating System Function Simulation: Simulating core functions of operating systems, such as process management, memory management, and file systems in a virtual environment, helping students gain a deeper understanding of the internal mechanisms of operating systems.

2.2.3 Artificial intelligence and machine learning experiments

(1) Algorithm Testing and Tuning: Conducting training and testing of machine learning algorithms in a virtual environment, utilizing virtual resources for large-scale data processing and model training. Common tools include TensorFlow and PyTorch, which can operate in virtual machines or cloud environments.
(2) Intelligent System Simulation: Simulating the operating environment of intelligent systems through virtual simulation technology, such as robot control and autonomous driving simulations, using tools like Gazebo and V-REP for virtual robot control and scenario testing.

2.2.4 Computer graphics experiments

(1) 3D Modeling and Rendering: Conducting 3D modeling and rendering experiments using virtual simulation technology, employing tools like Blender and Unity to create and showcase graphical works in a virtual environment.
(2) Graphics Algorithm Simulation: Testing and optimizing graphics algorithms in a virtual environment, such as ray tracing and shading models, helping students understand the practical applications of graphics algorithms.

2.2.5 Internet of things technology experiments

(1) IoT System Design: Using simulation tools like Cisco Packet Tracer and NS-3 for the design and testing of IoT networks[9-12].
(2) Sensor Networks: Simulating the deployment and data transmission of sensor nodes using virtual simulation platforms, such as Contiki OS for simulation[13-14].
(3) Embedded System Development: Developing and debugging embedded systems in a virtual environment, commonly using tools like QEMU and Proteus[15].
The application of these virtual simulation technologies not only enhances the teaching effectiveness of experimental courses but also helps students gain practical experience in simulated environments, reducing the need for physical experimental facilities and making the experimental process more flexible and safe.

3 COMPARISON OF TRADITIONAL EXPERIMENTAL TEACHING AND VIRTUAL SIMULATION TECHNOLOGY IN COMPUTER EXPERIMENT EDUCATION

Both traditional experimental teaching and virtual simulation experimental teaching have their advantages. Traditional experimental teaching emphasizes practical experience, allowing students to directly operate real equipment, thereby developing their problem-solving skills. This method is suitable for experiments that require an in-depth understanding of hardware and real environments. However, it comes with high costs, complex environment setup, and greater risks.
On the other hand, virtual simulation experimental teaching offers high flexibility and safety, capable of simulating various experimental environments and conditions, making it suitable for conducting multiple experiments and adjustments. Yet, it lacks practical operating experience with real devices, and the simulation results may not fully reflect real-world situations. When making a specific choice, it is important to consider the teaching objectives and experimental needs to achieve the best educational outcomes.
The following table compares and explains the advantages and disadvantages of traditional experimental teaching and virtual simulation experimental teaching, using examples from computer network experiments, operating system experiments, Internet of Things (IoT) technology experiments, and artificial intelligence and machine learning experiments.

Table 1 Comparison of Advantages and Disadvantages of Traditional Experimental Teaching and Virtual Simulation Experimental Teaching

Experiment Course	Teaching Method	Advantages	Disadvantages
Computer Network	Traditional	1.Provides real network devices for student to operation 2.Enhances practical operation and trouble shooting skills	1.High costs and complicated device maintenance 2.Network configuration can be complex and difficult to manage
	Virtual Simulation	1.Can simulate various network environments with high flexibility 2.Allows for quick resetting of the experimental environment	1.Lacks operational experience with real devices 2.Simulation of system response speed may not be realistic

Experiment Course	Teaching Method	Advantages	Disadvantages
Operating System	Traditional	1.Real operating system operation for deep understanding of system functions 2.Better understanding of hardware and software interaction	1.Dependency on specific hardware support 2.Security risks (e.g., system crashes)
	Virtual Simulation	1.Allows for safe experimentation, avoiding system crashes 2.Supports experiments on multiple operating systems	1.Lacks operational experience with real hardware 2.Performance simulation may be limited
IoT Technology	Traditional	1.Real hardware operation for a profound understanding of sensors and controllers 2.Learning in real application scenarios	1.High investment and maintenance costs for equipment 2.Complex and time-consuming environment setup
	Virtual Simulation	1.Flexibly build various IoT scenarios 2.Easy to test different configurations and conditions	1.Lacks direct operational experience with physical devices 2.May not fully simulate real-time data transmission
Artificial Intelligence and Machine Learning	Traditional	1.Real data processing and model training for a deep understanding of algorithms 2.Helps solve real-world problems	1.Long data processing and training time with high resource consumption 2.Actual projects limited by computing power
	Virtual Simulation	1.Can use large datasets and models to improve experimental efficiency 2.Easy to visualize experimental results	1.Lacks experience in solving real-world problems 2. Overly optimistic about model performance in virtual environments

4 ISSUES AND CHALLENGES OF VIRTUAL SIMULATION TECHNOLOGY IN EXPERIMENTAL TEACHING

Virtual simulation technology plays an important role in experimental teaching for computer science majors, but it also faces various problems and challenges.

High Technical Costs: One major barrier is the cost. High-quality virtual simulation software and hardware are often expensive, making it difficult for many institutions to afford, which affects the accessibility and quality of teaching.

Insufficient Teacher Training: Teachers often lack systematic training in the application of virtual simulation technology, leading to an inability to fully leverage the advantages of the technology during the teaching process. This can result in teachers being unable to provide effective guidance when students encounter problems in experiments.

Rapid Technological Updates: The fast pace of technological advancements makes it challenging for textbooks and course content to keep up. The rapid changes in the computer field require continuous updates to educational content; however, existing virtual simulation teaching platforms and course structures often lag behind technological developments, making it difficult to meet students' actual needs.

Impact on Student Motivation: Students' motivation to learn may also be affected. Some students may find the virtual environment lacking in realism, which can diminish their interest and engagement in learning.

Therefore, it is essential to strengthen investments in technology, teacher training, and content updates to address these issues effectively.

5 FUTURE DEVELOPMENT TRENDS OF VIRTUAL SIMULATION TECHNOLOGY IN EXPERIMENTAL TEACHING

The future development trends of virtual simulation technology in computer science experimental teaching are primarily reflected in the following aspects:

Increased Realism and Immersion: With continuous technological advancements, virtual simulations will become more realistic and immersive, enhancing student engagement and learning outcomes. The integration of artificial intelligence with virtual simulation allows for personalized adjustments to teaching content based on students' learning pace and abilities, improving the targeted nature of learning.
Support from Cloud Computing and Big Data: The application of cloud computing and big data provides robust support for experimental teaching, enabling students to conduct experiments anytime and anywhere while receiving real-time feedback, which promotes increased learning efficiency.
Innovation in Teaching Models: Innovative teaching models, particularly blended learning, will gradually become more widespread. This approach combines the advantages of online and offline teaching, fostering a blend of independent and collaborative learning, which cultivates students' comprehensive abilities.
Support and Investment from Education Policies: Emphasis on virtual simulation technology in educational policies will drive its widespread application. Additionally, teacher training and professional development are crucial for enhancing educators' proficiency in new technologies, ensuring effective implementation of virtual simulation in teaching.

6 CONCLUSION

Virtual simulation technology offers a safe and repeatable experimental environment in computer science education, enhancing students' practical skills and innovative thinking. While this technology is currently applied to varying degrees in many universities' computer science experimental teaching, challenges such as high costs, insufficient teacher training, and outdated resources remain. As technology continues to advance, virtual simulations will enable more personalized and diverse learning experiences, further promoting student autonomy and collaborative learning. Therefore, it is essential to encourage broader application and research, strengthen educational policy support, and promote the deep integration of virtual simulation technology with experimental teaching to enhance the quality of computer science education and improve students' employability.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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MERITS OF SAFETY PRACTICES WITHIN SCHOOL CULTURE MANAGEMENT FOR IMPROVED ACADEMIC ACHIEVEMENT IN RURAL PUBLIC SECONDARY SCHOOLS IN RIVERS WEST SENATORIAL DISTRICT

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Abstract: This study was conducted to examine merits of safety practices within school culture management for improved academic achievement in rural public secondary schools in Rivers West Senatorial District. Employing a descriptive survey design, the research targeted a population of 1,520 school staff, including 97 administrators and 1,423 teachers. A sample size of 400 participants was determined using the Taro Yamane formula, with a two-stage sampling technique integrating both stratified and disproportionate sampling methods. The final sample comprised 90 principals and 310 teachers from eight Local Government Areas (LGAs): Abua–Odual, Ahoada East, Ahoada West, Akuku-Toru, Asari-Toru, Bonny, Degema, and Ogba–Egbema–Ndoni. Data were collected through the Merits of Safety Practices within School Culture Management Questionnaire (MSPSCMQ), which underwent rigorous validation by experts and comprised 15 items distributed across three sections. Reliability was confirmed with a Cronbach Alpha coefficient of 0.78. Of the distributed questionnaires, 305 were returned, yielding an overall response rate of 76.25%. The study utilized mean scores and standard deviation to address research questions while hypotheses were tested using z-tests. Findings indicated significant inadequacies in safety practices affecting students' academic performance, leading to recommendations for comprehensive safety training, infrastructure improvements, and enhanced counseling services. The study underscores the imperative need for a holistic approach to safety in rural public secondary schools to foster a conducive learning environment.
Keywords: Safety practices; School culture management; Rural public secondary schools

1 BACKGROUND TO THE STUDY

Rural schools in Nigeria are crucial for national development but face systemic challenges such as inadequate funding, poor infrastructure, and limited access to educational resources. These schools are vital for fostering a literate and skilled populace that contributes to the nation's economic and social growth [1]. Therefore, effective school culture management that emphasizes safety practices is essential for creating a conducive learning environment. When school administrators prioritize safety, they enhance student performance and overall school effectiveness, as students who feel safe are more likely to engage in their studies and participate in activities. Conversely, neglecting safety can lead to negative outcomes, including increased violence, bullying, and mental health issues [2]. Effective school culture management involves establishing a positive climate that prioritizes safety, respect, and collaboration [3]. Key aspects of this management may include strong leadership practices, stakeholder engagement, and the consistent implementation of safety protocols. Prioritizing these elements may significantly improve the educational experience and academic success of students in rural settings.

In Rivers State, particularly the Rivers West Senatorial District, the rural nature of the area demands a customized approach to school culture management that prioritizes safety practices due to the unique challenges facing rural schools. This district, located in southern Nigeria, is known for its cultural diversity and primarily agrarian economy. However, its geographical and socio-economic conditions contribute to challenges for education. Many schools in the district are isolated and lack adequate supervision and essential safety measures to protect students [4]. Therefore, effective school culture management must emphasize safety practices to mitigate risks and enhance students' educational experiences. Safety practices encompass physical security, emotional well-being initiatives, and health protocols, forming the foundation for a conducive learning environment. Together, these factors help create a safe learning environment linked to better academic outcomes, including higher test scores and graduation rates. Thus, they are related to improved academic performance [5]. Therefore, this study sought to determine merits of safety practices within school culture management for improved academic achievement in rural public secondary schools in Rivers West Senatorial District.

2 STATEMENT OF THE PROBLEM

Despite the critical role of safety measures in fostering academic achievement, there remains a notable gap in the literature regarding their specific impact on rural public secondary schools within school culture management practices, particularly in Nigeria's Rivers West Senatorial District. With many schools isolated and lacking adequate safety measures, the absence of a structured approach to school culture management hinders students' educational experiences and academic performance. Key variables—such as physical safety measures, emotional support systems, and health-related protocols within school culture management practices—have yet to be comprehensively evaluated in this context. Thus, this forms the crux of the study.

3 AIM AND OBJECTIVES OF THE STUDY

This study was aimed at investigating merits of safety practices within school culture management for improved academic achievement in rural public secondary schools in Rivers West Senatorial District. Specifically, the study sought to:

1. ascertain the merits of existing physical safety measures for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District;
2. measure the merits of existing emotional support systems for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District; and,
3. examine the merits of existing health-related practices for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District.

3.1 Research Questions

1. What are the merits of existing physical safety measures for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District?
2. What are the merits of existing emotional support systems for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District?
3. What are the merits of existing health-related practices for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District?

3.2 Hypotheses

The following three (3) null hypotheses were tested at 0.05 alpha level.

1. There is no significant difference in mean scores between school administrators and teachers' opinion on the merits of existing physical safety measures for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District.
2. There is no significant difference in mean scores between school administrators and teachers' opinion on the merits of existing emotional support systems for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District.
3. There is no significant difference in mean scores between school administrators and teachers' opinion on the merits of existing health-related practices for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District.

3.3 Conceptual Framework

This study's framework is centered on merits of safety practices within school culture management for improved academic achievement in rural public secondary schools in Rivers West Senatorial District, as visually depicted below.

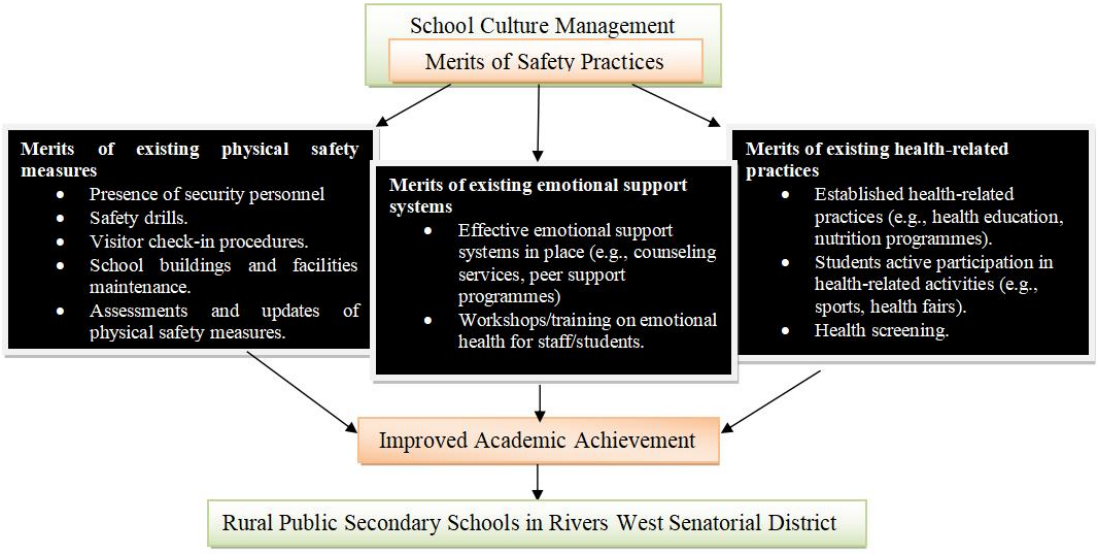

Figure 1 Conceptual Framework Showing the Relationship Between Variables
Source: Researchers' conceptualization (2024).

4 LITERATURE REVIEW

The term "merits of safety practices" refers to the benefits and positive outcomes derived from implementing safety protocols and measures within an organizational context, particularly in educational settings. Safety practices encompass a range of strategies designed to protect students, staff, and visitors from potential harm, including physical, emotional, and health-related aspects. In the context of school culture management, these practices are integral in establishing a secure and supportive environment that promotes student learning, sense of belonging and overall well-being. School culture management involves the deliberate shaping of the values, beliefs, and behaviours that characterize the school environment [3]. It plays a critical role in secondary schools, especially in rural public settings, where resources may be limited, and challenges unique to the community may arise.

The effective management of school culture requires a strong focus on safety practices, as they are pivotal in creating an atmosphere conducive to learning. In this regard, the administrative competencies of school leaders become paramount. Administrators are expected to possess the skills to assess risks, implement safety protocols, and foster a culture of safety that permeates every aspect of school life. The presence of security personnel is one significant merit of safety practices that enhances the school's safety culture[6]. According to Ogbo et al. [7], having trained security personnel on-site not only deters potential threats but also reassures students and staff, fostering a sense of security that is essential for focused learning. Complementing this, Graham et al. emphasize that a secure environment positively influences students' emotional and psychological well-being[5], further supporting their academic endeavors. Safety drills constitute another critical component of effective safety practices. Gairín and Castro point out that regular safety drills prepare students and staff for emergency situations[8], instilling confidence and familiarity with protocols that can save lives. In tandem with safety drills, visitor check-in procedures are vital for maintaining a secure school environment. Adejare highlights that stringent visitor management helps monitor who enters the premises[9], thereby reducing potential risks. Okoh and Afangideh also underscore the importance of effective communication and supervision in ensuring safety[10], suggesting that clear visitor policies enhance overall security. Maintenance of school buildings and facilities plays a crucial role in safeguarding the well-being of students and staff. Afriani et al. admit that well-maintained facilities prevent accidents and injuries[11], thereby ensuring a conducive learning environment.

Regular assessments and updates of physical safety measures are essential for adapting to emerging threats. Naji et al. substantiate that continuous evaluation of safety protocols reinforces a culture of safety and promotes positive outcomes for students and staff alike[12]. Emotional support systems are equally vital in fostering a safe and productive school culture. Effective counseling services and peer support programmes provide essential emotional resources for students navigating challenges. Cabrera, Larrañaga, and Yubero point out that comprehensive emotional support systems reduce instances of bullying and create a more inclusive environment[2], ultimately enhancing academic performance. Furthermore, workshops and training on emotional health for both staff and students are critical. Graham et al. agree that equipping educators with the skills to address emotional health issues leads to improved student outcomes[5], as a well-prepared staff is better able to support their students. Health-related practices, such as health education and nutrition programmes, are also instrumental in promoting a safe school culture. Shikalepo highlights that health education empowers students to make informed decisions about their well-being[13], while active participation in health-related activities, like sports and health fairs, encourages a holistic approach to health. Rajan et al. corroborate the assertion that engaging students in health initiatives can lead to

improved physical and mental health[14], which positively impacts academic performance. Moreover, regular health screenings are vital for early identification and intervention of health issues. Fiorentino et al. stress that proactive health measures not only ensure students' well-being but also contribute to lower absenteeism rates[1], thereby enhancing academic achievement.

5 THEORETICAL FRAMEWORK

5.1 Ubuntu Safety Model

Desmond Mpilo Tutu introduced the Ubuntu safety model in 1999, highlighting the philosophy of interconnectedness. This concept asserts that individual well-being is intrinsically linked to the well-being of others, encapsulated in the phrase "I am because we are"[27]. The Ubuntu model promotes a culture of mutual respect, empathy, and support, making it particularly relevant for managing school culture. By fostering a supportive environment, schools can encourage all members to take responsibility for each other's safety. Implementing Ubuntu principles allows for peer support systems and mentorship programmes, creating an atmosphere where every student feels valued and protected. This approach enhances physical safety, emotional support systems, and health practices essential for a conducive learning environment.

5.2 Methodology

This study employed a descriptive survey design, focusing on a total of 1,520 school staff, which included 97 administrators and 1,423 teachers. The sample size of 400 participants was calculated using the Taro Yamane formula. A two-stage sampling technique was utilized, incorporating both stratified and disproportionate sampling methods. Consequently, the sample consisted of 90 secondary school administrators and 310 teachers from rural areas across the eight Local Government Areas (LGAs) of the Rivers West Senatorial District: Abua–Odual, Ahoada East, Ahoada West, Akuku-Toru, Asari-Toru, Bonny, Degema, and Ogba–Egbema–Ndoni. Data collection was carried out using a self-structured instrument called the Merits of Safety Practices within School Culture Management Questionnaire (MSPSCMQ). This questionnaire underwent thorough validation by three experts and included 15 items divided into three sections. Responses were measured on a four-point Likert scale: Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1). The reliability of the MSPSCMQ was confirmed with a Cronbach Alpha coefficient of 0.78. Out of the distributed copies of questionnaire, 305 copies were completed and returned—72 from school administrators (72/90 x 100 = 80% return rate) and 233 from teachers (233/310 x 100 = 75.16% return rate), resulting in an overall return rate of 76.25% (305/400 x 100). The study addressed the research questions using mean and standard deviation, while hypotheses were tested through z-tests.

6 RESULTS

6.1 Answer to Research Questions

Research Question 1: What are the merits of existing physical safety measures for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District?

Table 1 Mean and Standard Deviation of Physical Safety Measures Impacting Management of School Culture in Rural Public Secondary Schools in Rivers West Senatorial District

S/N	Test Items- Merits of Existing Physical Safety Measures	Administrators (N = 72)		Teachers (N = 233)		Mean Set (xx)	Remarks
		$\bar{x}$	sd	$\bar{x}$	sd		
1.	I believe that while physical safety measures are in place, incidents of bullying and violence still occur and need further attention.	2.47	0.57	2.66	0.63	2.57	Agreed
2.	In my experience, the students are not satisfied with the existing perimeter fence, thereby causing distraction during school activities.	2.68	0.64	2.59	0.61	2.64	Agreed
3.	Although the physical layout of my school includes safety features, there are still areas that could pose risks during emergencies.	2.93	0.71	2.61	0.62	2.77	Agreed
4.	The existing security personnel, if given more attention, will improve in their functions.	2.52	0.59	2.58	0.61	2.55	Agreed
5	The presence of first aid kits in my school is helpful, but access to trained personnel during emergencies is often limited.	2.91	0.71	2.65	0.63	2.78	Agreed
	Cluster Mean/SD	**2.70**	**0.66**	**2.62**	**0.62**	**2.62**	**Agreed**

Results in Table 1 present the mean and standard deviation scores of the evaluation of the merits of existing physical safety measures for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District. The cluster mean score for the administrators is 2.70 with a standard deviation of 0.66, while the cluster mean score for the teachers is 2.62 with a standard deviation of 0.62, indicating a general agreement regarding the perceived merits of these safety measures. The overall cluster mean score of 2.62 surpasses the criterion mean score of 2.5, suggesting a significant level of agreement among both groups on the merits of the existing safety measures. The majority of specific items evaluated fall under the "agreed" category, indicating that both administrators and teachers recognize the positive aspects of these safety measures in promoting a supportive school culture and potentially enhancing academic performance.

Research Question 2: What are the merits of existing emotional support systems for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District?

Table 2 Mean and Standard Deviation of Emotional Support Systems Impacting Management of School Culture in Rural Public Secondary Schools in Rivers West Senatorial District

S/N	Test Items- Merits of Existing Emotional Support Systems	Administrators (N = 72)		Teachers (N = 233)		Mean Set (xx)	Remarks
		$\bar{x}$	sd	$\bar{x}$	sd		
6.	Though peer support programmes exist in my school, I believe they do not always effectively address students' emotional needs.	2.74	0.66	2.65	0.63	2.70	Agreed
7.	While we have counselors available, the accessibility of emotional support for all students is inconsistent.	2.70	0.64	2.53	0.59	2.62	Agreed
8.	The availability of mental health resources in my school is helpful, but access to these resources is often limited for students in need.	2.71	0.65	2.63	0.62	2.67	Agreed
9.	I believe that while emotional support systems are in place, issues like stress and anxiety among students still need further attention.	2.68	0.64	2.60	0.61	2.64	Agreed
10	I recognize that emotional support initiatives can enhance a positive school culture, but more structured events involving parents and guardians could foster a greater sense of community.	2.89	0.70	2.94	0.72	2.92	Agreed
	Cluster Mean/SD	**2.74**	**0.66**	**2.67**	**0.63**	**2.71**	**Agreed**

Results in Table 2 present the mean and standard deviation scores of the evaluation of the merits of existing emotional support systems for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District. The cluster mean score for the administrators is 2.74 with a standard deviation of 0.66, while the cluster mean score for the teachers is 2.67 with a standard deviation of 0.63, indicating a general agreement regarding the perceived merits of these emotional support systems. The overall cluster mean score of 2.71 exceeds the criterion mean score of 2.5, suggesting a significant level of agreement between the strata on the merits of the existing emotional support systems. The majority of specific items evaluated fall under the "agreed" category, indicating that both administrators and teachers recognize the positive aspects of these emotional support systems, such as the potential to enhance a positive school culture, even though they also acknowledge issues like inconsistent accessibility and the need for further attention to student emotional challenges like stress and anxiety. The recognition of the importance of structured initiatives involving parents and guardians indicates a shared understanding of the necessity for a collaborative approach to fostering community within the school environment.

Research Question 3: What are the merits of existing health-related practices for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District?

Table 3 Mean and Standard Deviation of Health-Related Practices Impacting Management of School Culture in Rural Public Secondary Schools in Rivers West Senatorial District

S/N	Test Items- Merits of Existing Health-Related Practices	Administrators (N = 72)		Teachers (N = 233)		Mean Set (xx)	Remarks
		$\bar{x}$	sd	$\bar{x}$	sd		
11.	Programmes focused on menstrual hygiene management in my school provide essential information.	2.50	0.58	2.57	0.60	2.54	Agreed

12.	I believe there could be more accessibility to sanitary products to help girls feel comfortable and maintain attendance during their menstrual cycle.	3.10	0.76	2.86	0.69	2.98	Agreed
13.	The principal encourages student participation in health-related activities.	3.08	0.76	2.91	0.71	3.00	Agreed
14.	Teachers monitor students' health practices regularly.	2.59	0.61	2.77	0.66	2.68	Agreed
15.	Teachers support students' health practices regularly.	2.50	0.58	2.43	0.56	2.47	Disagreed
	Cluster Mean/SD	**2.75**	**0.70**	**2.71**	**0.64**	**2.73**	**Agreed**

Results in Table 3 present the mean and standard deviation scores of the evaluation of the merits of existing health-related practices for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District. The cluster mean score for the administrators is 2.75 with a standard deviation of 0.70, while the cluster mean score for the teachers is 2.71 with a standard deviation of 0.64, indicating a general agreement regarding the perceived merits of these health-related practices. The overall cluster mean score of 2.73 exceeds the criterion mean score of 2.5, suggesting a significant level of agreement among both groups on the merits of the existing health-related practices. The majority of specific items evaluated fall under the "agreed" category, highlighting recognition among both administrators and teachers of the positive aspects of health-related initiatives in schools. Notably, there is strong agreement on the importance of programmes focused on menstrual hygiene management, accessibility to sanitary products, and the principal's encouragement of student participation in health-related activities. However, there is a notable disagreement concerning the regular support and monitoring of health practices by teachers, suggesting an area that requires further attention.

6.2 Test of Hypotheses

Hypothesis 1: There is no significant difference in mean scores between school administrators and teachers' opinion on the merits of existing physical safety measures for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District.

Table 4 Z-test Analysis on the Mean Differences in Administrators and Teachers' Opinion Regarding Physical Safety Measures Impact on Management of School Culture in Rural Public Secondary Schools in Rivers West Senatorial District

Status	n	$\bar{x}$	Sd	df	z-cal	z-crit value	Sig.	Level of significance	Decision
Administrators	72	2.70	0.66						
				303	3.29	1. 96	0.00	0.05	Significant
Teachers	233	2.62	0.62						

Results in Table 4 present the z-test analysis on the mean differences in administrators and teachers' opinions regarding the merits of existing physical safety measures for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District. The calculated mean score for administrators is 2.70 with a standard deviation of 0.66, while the mean score for teachers is 2.62 with a standard deviation of 0.62. The z-calculated value is 3.29, which exceeds the critical z-value of 1.96 at a significance level of 0.05. With a significance level of 0.00, this indicates a statistically significant difference in the opinions of administrators and teachers regarding the merits of the existing physical safety measures. Therefore, the decision is to reject the null hypothesis, suggesting that there is a significant difference in the opinions of administrators and teachers on the effectiveness of these safety measures in enhancing school culture and academic performance.

Hypothesis 2: There is no significant difference in mean scores between school administrators and teachers' opinion on the merits of existing emotional support systems for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District.

Table 5 Z-test Analysis on the Mean Differences in Administrators and Teachers' Opinion Regarding Emotional Support Systems' Impact on Management of School Culture in Rural Public Secondary Schools in Rivers West Senatorial District

Status	n	$\bar{x}$	Sd	df	z-cal	z-crit value	Sig.	Level of significance	Decision
Administrators	72	2.74	0.66	303	2.20	1. 96	0.00	0.05	Significant

Teachers	233	2.67	0.63

Results in Table 5 present the z-test analysis on the mean differences in administrators and teachers' opinions regarding the merits of existing emotional support systems for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District. The calculated mean score for administrators is 2.74 with a standard deviation of 0.66, while the mean score for teachers is 2.67 with a standard deviation of 0.63. The z-calculated value is 2.20, which exceeds the critical z-value of 1.96 at a significance level of 0.05. Given the significance level of 0.00, this indicates a statistically significant difference in the opinions of administrators and teachers regarding the merits of the existing emotional support systems. Therefore, the decision is to reject the null hypothesis, suggesting that there is a significant difference in the perceptions of administrators and teachers regarding the effectiveness of these emotional support systems in promoting a positive school culture and enhancing academic performance.

Hypothesis 3: There is no significant difference in mean scores between school administrators and teachers' opinion on the merits of existing health-related practices for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District.

Table 6 Z-test Analysis on the Mean Differences in Administrators and Teachers' Opinion Regarding Health-Related Practices' Impact on Management of School Culture in Rural Public Secondary Schools in Rivers West Senatorial District

Status	n	$\bar{x}$	Sd	df	z-cal	z-crit value	Sig.	Level of significance	Decision
Administrators	72	2.75	0.70						
				303	6.21	1. 96	0.00	0.05	Significant
Teachers	233	2.71	0.64						

Results in Table 6 present the z-test analysis on the mean differences in administrators and teachers' opinions regarding the merits of existing health-related practices for school culture management to enhance academic performance in rural public secondary schools of Rivers West Senatorial District. The calculated mean score for administrators is 2.75 with a standard deviation of 0.70, while the mean score for teachers is 2.71 with a standard deviation of 0.64. The z-calculated value is 6.21, which significantly exceeds the critical z-value of 1.96 at a significance level of 0.05. With a significance level of 0.00, this indicates a statistically significant difference in the opinions of administrators and teachers regarding the merits of the existing health-related practices. Therefore, the decision is to reject the null hypothesis, suggesting that there is a significant difference in the opinions of administrators and teachers concerning the effectiveness of these health-related practices in enhancing school culture and academic performance.

7 DISCUSSION OF FINDINGS

The results of this study reveal that although rural public secondary schools of Rivers West Senatorial District have implemented various physical safety measures, their actual effectiveness remains questionable. Persistent issues such as bullying and subpar perimeter fencing undermine these safety efforts, as supported by Ogbo et al. [7] and consistent with the findings of Amadi et al. [4]. This stands in stark contrast to the insights of Mubita[15], who argues for a more precise definition of safety protocols in educational settings such as that of rural public secondary schools of Rivers West Senatorial District. The average ratings from administrators and teachers in this study indicate a shared recognition of the need for improved measures to reduce risks in emergency situations, aligning with Masekela et al. and Hofmann et al.'s multilevel safety framework. Moreover[16,17], the findings of this study highlight a significant gap in safety culture management, particularly the limited availability of trained personnel for emergencies in rural public secondary schools of Rivers West Senatorial District, even with first aid kits on-site. This issue is similarly noted by Ambali et al. and resonates with the findings of Sabo et al. [18,19], as well as the proactive strategies suggested by Sprick et al. [20], which emphasize the importance of comprehensive safety policies that are both actively enforced and monitored.

The call for better-trained security personnel in this study is further reinforced by Muadin and Akmalia and Weiner et al. [21,22], underlining the necessity for a holistic approach to safety management within educational institutions, which is crucial for creating a supportive learning environment, as highlighted by Oragwu and Nwabueze [23]. This study also underscores the critical role of emotional support systems within school culture management practices in rural public secondary schools, which is affirmed by various researchers. Graham et al. assert that effective emotional support is essential for meeting students' emotional needs[5]. However, many peer support programmes in public schools, particularly in rural areas, often fail to achieve this goal. This concern is reflected in the findings of Rajan et al. [14], who point to ongoing stress and anxiety among students, indicating that emotional support systems require significant improvement. The inconsistency in access to counselors in rural public secondary schools of Rivers West Senatorial District, highlighted in

this study is consistent with the findings of Amadi et al. [4], indicating a crucial gap in delivering adequate emotional support to all students in rural public schools, a need further articulated by Mubita[15], who advocates for comprehensive safety management practices. Additionally, the lack of access to critical health resources, as similarly identified by the World Health Organization[25], poses a barrier preventing students in rural public secondary schools from fully utilizing available support systems. This observation aligns with Li's assertion that effective health-related initiatives can greatly enhance students' overall well-being[26]. The findings also emphasize the importance of structured events involving parents and guardians, consistent with De Leersnyder et al. [24], which argue that community engagement fosters a positive school atmosphere. Focusing on health-related practices, the findings of this study highlight the importance of menstrual hygiene management in rural public secondary schools, reinforcing the views of Fiorentino et al. [1], who stress the need to address specific health needs in rural educational settings. Thus, calls for greater accessibility to sanitary products reflect challenges identified by Shikalepo[13], advocating for improved attendance and comfort for female students. Furthermore, this study shows that administrators play a crucial role in promoting student involvement in health-related activities, as equally noted by Naji et al. as well as Okoh and Afangideh [10,12], which is vital for nurturing a proactive school culture in rural public secondary schools.

8 CONCLUSION

The study reveals significant shortcomings in the safety practices within the school culture management of rural public secondary schools in Rivers West Senatorial District, which directly impact academic achievement. While physical safety measures exist, their effectiveness is undermined by ongoing issues such as bullying and inadequate infrastructure. A pressing need for trained personnel in emergency situations highlights a critical gap in safety culture management. Emotional support systems are similarly inadequate, with inconsistent access to counselors exacerbating student stress and anxiety. Health-related practices also fall short, particularly regarding menstrual hygiene management, which affects female students' attendance and comfort. The findings underscore the necessity for a comprehensive approach to safety that encompasses physical, emotional, and health-related dimensions, supported by community engagement.

9 RECOMMENDATIONS

Based on these findings, the following recommendations were made:

1. School administrators in rural public secondary schools should lead efforts to secure funding for infrastructure improvements. This encompasses enhancing physical safety features such as secure entry points, adequate lighting, and facilities for proper menstrual hygiene management, which are critical for creating a safe learning environment for all students, particularly female students.
2. School management should advocate for the hiring of additional trained counselors to ensure consistent emotional support for students. Establishing partnerships with local mental health organizations can provide access to resources and support systems that address the psychological well-being of students in rural public secondary schools.
3. Administrators in rural public secondary schools should initiate the formation of School Safety Committees comprising staff, parents, and student representatives. This committee would meet regularly to assess safety concerns, implement safety policies, and facilitate communication between the school and the wider community.
4. The school management should take advantage of the parent-teachers' association to organize safety awareness campaigns and workshops that involve students, teachers and parents. These initiatives can educate the school community about safety practices, emotional support systems, and health-related issues, thereby fostering a culture of safety and collaboration.
5. The school management should collaborate with local stakeholders to conduct regular safety audits. This process will involve collecting feedback from students, parents, and community members to identify safety gaps and develop actionable plans for improvement.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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ASSESSMENT OF MERITOCRACY-BASED MANAGEMENT STRATEGIES FOR ACADEMIC STREAMING OF STUDENTS AT FEDERAL GOVERNMENT GIRLS' COLLEGE, ABULOMA, RIVERS STATE, NIGERIA

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Abstract: This study was carried out to assess meritocracy-based management strategies for academic streaming at Federal Government Girls' College (FGGC), Abuloma, Rivers State, Nigeria. A descriptive survey design was employed, involving 54 educators, including 23 senior and 31 junior teachers, selected through a stratified total census sampling technique. Data were collected using a self-structured questionnaire titled "Meritocracy-Based Management Strategies for Academic Streaming," which consisted of 15 items rated on a four-point Likert scale. The questionnaire underwent face and content validation by three experts and achieved a reliability coefficient of 0.83, as determined by Cronbach Alpha analysis. Mean scores and standard deviations were used to address the research questions, while z-tests analyzed the hypotheses at a 0.05 alpha level. Findings revealed that respondents highly rated the management of assessment integrity, performance-based assignments and feedback. However, concerns regarding technology usage and support for slow learners were identified as critical areas needing improvement to enhance merit-based educational outcomes. Therefore, the study concluded that FGGC Abuloma requires enhancements in assessment integrity and technology to cater to diverse student needs. Recommendations include increasing technology use in assessments and providing retraining and supervision for teachers on performance-based evaluations.
Keywords: Meritocracy; Assessment integrity; Performance-based assignments; Feedback; Academic streaming

1 BACKGROUND TO THE STUDY

Unity Colleges, known officially as Federal Government Colleges, form a vital network of secondary schools established by the Federal Government of Nigeria. These schools were created to not only excel academically but also to promote social cohesion and bridge ethnic divides through education. The founding of the inaugural Unity Schools aimed to cultivate harmonious relationships among young people, enhancing national unity across Nigeria's diverse ethnic landscape[1]. The primary mission of Unity Colleges is to provide quality education while fostering a sense of belonging and understanding among students from diverse backgrounds. By embracing diversity, these schools serve as microcosms of Nigerian society, where students learn tolerance, respect, and collaboration[2,3]. The curriculum is designed to impart academic knowledge and values that support national integration. Meritocracy is at the core of these institutions, allowing students to enroll and be rewarded based on their abilities rather than socio-economic status[4]. This principle guides the academic streaming process, ensuring fair categorization based on performance.

The establishment of all-girls Unity Colleges aligns with both national and international goals to improve female education[5]. In Nigeria, many girls have historically faced significant obstacles to education due to socio-cultural factors. By creating these dedicated schools, the government aims to increase female enrollment and retention in a supportive environment that encourages self-expression, free from gender-related distractions. This initiative promotes fairness and inclusivity within the educational system, emphasizing academic streaming as a key element for the sustainability of Federal Government Colleges (FGCs) in a country with a large youth population. Academic streaming, a traditional practice in Nigeria, organizes students into groups based on their performance, allowing for movement between streams as they progress [6,7]. However, implementing merit-based management in academic streaming raises important questions about assessment integrity and the effectiveness of performance evaluations. Ensuring fair assessments is crucial for fostering trust in the educational system, which in turn enhances student motivation and self-esteem.

According to Torres and Quaresma [8], academic excellence in merit-based systems not only highlights top performers but also motivates all students to aim for greatness. When entrance exams and assessments are viewed as fair, students are more likely to engage in their education, believing their efforts will be acknowledged and rewarded. This fosters a motivated student body eager to enhance their skills and knowledge, knowing their hard work will yield results [9]. Equitable and transparent assessments can also create a level playing field for students from various backgrounds, enriching the educational experience by promoting diverse perspectives and talents [10,11]. A collaborative learning environment

emerges when everyone feels valued. Maintaining the integrity of assessment processes is crucial for the reputation of schools; perceived bias can lead to disillusionment[12]. Therefore, school leaders have the task before them to prioritize fairness in examinations and communicate effectively with parents to support a culture of learning at home. Consequently, this study is warranted as it sought to assess the extent of selected meritocracy-based management strategies in the academic streaming of students at Federal Government Girls' College (FGGC), Abuloma, Rivers State, Nigeria.

2 STATEMENT OF THE PROBLEM

The FGCs in Nigeria have documented a merit-based academic streaming system, which has prompted a demand for effective management from Nigerian parents and other stakeholders to ensure all students have access to quality education. However, it appears that although this management strategy is documented, little is seen in practice. Parents and students report a lack of knowledge or evidence of it when visiting these schools or attending parents-teachers association meeting. In response, other studies investigate the possibility of merit-based management in academic streaming, specifically among Unity Colleges', but not specifically to what extent and/or in FGGC. Thus, this study sought to assess meritocracy-based management strategies for academic streaming of students at FGGC, Abuloma, Rivers State, Nigeria to shed light on the issue of the identified strategies being employed by the school administrators and the teachers and answer the question of to what extent the merit-based strategies are being managed in these schools, highlighting the main focus of this research.

3 AIM AND OBJECTIVES OF THE STUDY

This study was aimed at assessing meritocracy-based management strategies for academic streaming of students at FGGC, Abuloma, Rivers State, Nigeria. Specifically, the study sought to:
1. Identify the extent to which assessment integrity is managed in the academic streaming of the students; and,
2. ascertain the extent to which performance-based assignments and feedback is managed in the academic streaming of the students

3.1 Research Questions

1. To what extent is assessment integrity systematically managed in the academic streaming of the students?
2. To what extent are performance-based assignments and feedback systematically managed in the academic streaming of the students?

3.2 Hypotheses

The following two (2) null hypotheses were tested at 0.05 alpha level.
1. There is no significant difference in mean scores reflecting the opinions of junior and senior teachers regarding the management of assessment integrity in the academic streaming of the students.
2. There is no significant difference in mean scores reflecting the opinions of junior and senior teachers regarding the management of performance-based assignments and feedback in the academic streaming of the students.

3.3 Conceptual Framework

This study focuses on evaluating meritocracy-based management strategies for academic streaming at FGGC, Abuloma, Rivers State, Nigeria, as illustrated in Fig. 1.

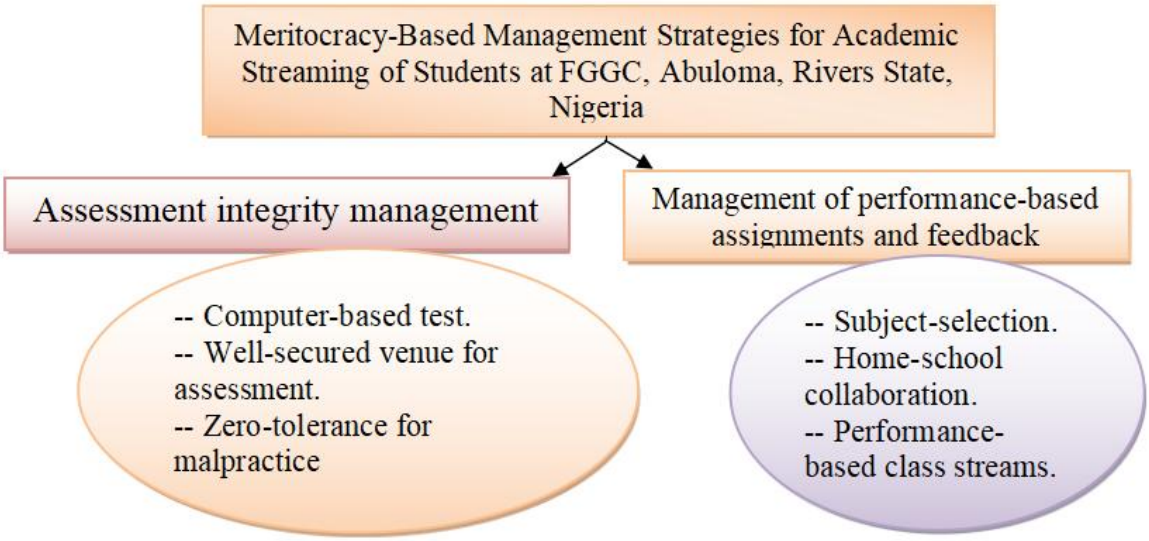

Figure 1 Conceptual Framework Showing the Relationship Between Variables

Source: Researchers' conceptualization (2024).

4 LITERATURE REVIEW

Unity Colleges in Nigeria, such as the FGGC, Abuloma, reflect the complexities of the educational system. Recent shifts towards merit-based admissions, as highlighted by Duruji et al. [13]and corroborated by Tolu-Kolawole [14], indicate a move away from the traditional quota system, which has prioritized mediocrity over merit for over two decades. While the quota system aimed to promote equity, Joshua et al. argue that it often obstructs learning and undermines meritocracy[4]. The repercussions of this system extend beyond education, fostering societal inequalities and resentment among those disadvantaged by arbitrary selection methods. Conversely, a meritocratic approach, as advocated by Obasanjo [3], emphasizes individual achievement, supporting a more equitable society. Based on record, the practice under contention entails that only 40% of admissions are merit-based, leaving 60% dictated by factors like state of origin and catchment areas, allowing for the entry of underqualified candidates and diminishing educational standards. Such policies have fostered discrimination, favouritism, and corruption, exposing the system to fraudulent practices when ability is not the primary criterion for student placement. As Nwagwu noted[15].

Arising from a down-grading of merit as a basis for admission, there is much racketeering during the exercise. Bribery, corruption and nepotism become agents that ensure admission of weak candidates and, at times, even of the bright ones who have lost faith in merit, fair play and justice. As a result of this situation, mediocrity and economic power take precedence over academic standards (p.12).

Consequently, the implication of this quota system is that a huge percentage of students in the Unity Colleges are not qualified to be there while those that are qualified are often denied admission [15]. The result of this is the creation of a frustration class of brilliant students who have lost faith in the system and have now turned to the alternatives or opted to further their education abroad, ultimately depriving the Nigerian state of intellectually sharp minds. This is similar to the views of Anya [4],

Despite the utilization of the concept of educational disadvantage states for a quarter of a century, for the allocation of resource and admission into educational institutions (Unity Colleges), the so called disadvantaged state have remained disadvantage as they were in 1975 (…) (The quota and federal character for admission) were clearly instruments of political manipulation which have proved ineffectual even for the purpose they were designed for (…) They must therefore be discarded (Pp. 13-14).

Based on the foregoing, a meritocratic-based Unity College system in Nigeria extends beyond mere enrollment and admission; it necessitates robust academic streaming influenced by factors such as assessment integrity and performance-based assignments [16]. Effective management of assessment integrity by school administrators and teachers is vital to ensure that streaming relies on merit rather than arbitrary criteria. The implementation of computer-based tests has proven beneficial in enhancing assessment integrity by reducing human error and opportunities for malpractice [16]. This highlights the importance of secure assessment venues to uphold examination credibility [17]. Emiloju and Adeyoju stress that maintaining the integrity of public examinations is crucial in Nigeria[18], where malpractice is gradually becoming a serious issue. A zero-tolerance policy for such misconduct is essential for mitigating it and fostering integrity in education, as noted by Adeniran et al. [19], who advocate for collaboration among stakeholders to combat examination malpractice.

Additionally, managing performance-based assignments and feedback by school administrators and teachers is essential for effective streaming, allowing for tailored educational experiences that align with students' abilities, interests and preparation for the world of work [1,10]. Mansor et al. support this strategy, emphasizing its potential to enhance learning outcomes and foster motivation among students[20].

5 THEORETICAL FRAMEWORK

Masaaki Imai (born 1930), a Japanese organizational theorist and management consultant, introduced the Kaizen theory in 1986, highlighting that continuous improvement arises from small, ongoing changes that lead to significant advancements. This philosophy supports streaming students, fostering engagement and sustainable academic performance. According to Suarez-Barraza et al. (2012:28), Kaizen serves as a new operational strategy to enhance the competitiveness of twenty-first-century companies. Following Imai's first book, *The Key to Japan's Competitive Success*, Kaizen gained global recognition among management experts and scholars, eventually proving valuable in education and illustrating the correlation between industry and academia for societal improvement. This has been corroborated by Ballantine and Roberts (2014:25) that:
The most creative and productive organizations and societies are the ones that are highly diverse because people of different backgrounds solve problems in different ways. Because of these diversities, it may be beneficial for teachers to differentiate instruction to include using various forms of grouping and modify the curriculum in order to maximize every student's potential.

6 METHODOLOGY

This study utilized a descriptive survey design to assess a population of 53 educators, comprising 23 senior teachers and 31 junior teachers at FGGC, Abuloma. To ensure comprehensive representation, a stratified total census sampling technique was employed. Data collection was conducted using a self-structured questionnaire, titled the 'Meritocracy-Based Management Strategies for Academic Streaming Questionnaire' (M-BMSASQ), which included 15 items rated on a four-point Likert scale. The questionnaire underwent rigorous face and content validation by three experts and was divided into two sections, with response options of: Very High Extent (VHE), High Extent (HE), Low Extent (LE), and Very Low Extent (VLE), assigned weighted values of 4, 3, 2, and 1, respectively. The M-BMSASQ demonstrated a reliability coefficient of 0.83, as determined by Cronbach Alpha analysis. Out of the distributed 54 copies of questionnaire, 47 were completed and returned, with 19 responses from senior teachers, reflecting a 82.61% return rate, and 28 from junior teachers, yielding an 90.32% return rate, resulting in an overall return rate of 88.68%. The study addressed the research questions using mean and standard deviation, while hypotheses were tested through z-tests.

7 RESULTS

7.1 Answer to Research Questions

Research Question 1: To what extent is assessment integrity systematically managed in the academic streaming of the students?

Table 1 Mean and Standard Deviation Scores of the Extent to Which Assessment Integrity is Systematically Managed in the Academic Streaming of the Students

S/N	Test Items – Management of Assessment Integrity	Senior Teachers (N = 19)		Junior Teachers (N = 28)		Mean Set (xx)	Remarks
		$\bar{x}$	sd	$\bar{x}$	sd		
1.	To what extent are the assessment criteria consistently applied across all academic streams at FGGC, Abuloma?	2.57	0.60	2.56	0.60	2.57	High Extent
2.	How clearly defined do you find the policies and repercussions for any breaches of assessment integrity at FGGC, Abuloma?	2.69	0.64	2.53	0.59	2.61	High Extent
3.	To what extent is technology utilized to uphold assessment integrity, such as plagiarism detection software at FGGC, Abuloma?	2.41	0.55	2.32	0.52	2.37	Low Extent
4.	How thoroughly are assessment results audited on a regular basis to ensure their accuracy and integrity at FGGC, Abuloma?	2.73	0.65	2.60	0.61	2.67	High Extent
5.	To what extent do you feel that assessment integrity issues are addressed promptly at FGGC, Abuloma?	2.50	0.58	2.54	0.59	2.52	High Extent

6.	How effectively do teaching staff demonstrate integrity in their assessment practices at FGGC, Abuloma?	2.66	0.63	2.72	0.65	2.69	High Extent
7.	To what extent do you feel that peer pressure influences students' adherence to assessment integrity at FGGC, Abuloma?	2.81	0.68	2.64	0.63	2.73	High Extent
Cluster Mean/SD		**2.48**	**0.63**	**2.56**	**0.60**	**2.52**	High Extent

Criterion mean score = 2.5

Results in Table 1 present the mean ($\bar{x}$) and standard deviation (SD) scores related to the systematic management of assessment integrity in student academic streaming at FGGC, Abuloma. The teachers rated their school's management of assessment integrity with a high extent, achieving a cluster mean of 2.52. Also, the SD, ranging from 0.52 to 0.68, reflects moderate variability in responses. Conversely, concerns regarding low extent of technology usage persist, as indicated by a lower mean score of 2.37.

Research Question 2: To what extent are performance-based assignments and feedback systematically managed in the academic streaming of the students?

Table 2 Mean and Standard Deviation Scores of the Extent to Which Performance-Based Assignments and Feedback are Systematically Managed in the Academic Streaming of the Students

S/N	Test Items- Management of Performance-Based Assignments and Feedback	Senior Teachers (N = 19)		Junior Teachers (N = 28)		Mean Set (xx)	Remarks
		$\bar{x}$	sd	$\bar{x}$	sd		
8.	To what extent are performance-based assignments aligned with learning objectives across all academic streams at FGGC, Abuloma?	2.50	0.58	2.43	0.56	2.47	Low Extent
9.	To what extent do teachers provide timely feedback on performance-based assignments of students across all academic streams at FGGC, Abuloma?	2.50	0.58	2.50	0.58	2.50	High Extent
10.	How well do performance-based assignments foster critical thinking skills among average learners at FGGC, Abuloma?	2.59	0.60	2.48	0.58	2.54	High Extent
11.	To what extent do performance-based assignments promote critical thinking among slow learners at FGGC, Abuloma?	2.52	0.59	2.44	0.56	2.48	Low Extent
12.	How well do performance-based assignments enhance critical thinking skills among fast learners at FGGC, Abuloma?	2.57	0.60	2.45	0.57	2.51	High Extent
13.	To what extent do performance-based assignments encourage problem-solving skills among average learners at FGGC, Abuloma?	2.50	0.58	2.52	0.59	2.51	High Extent
14.	How well do performance-based assignments support problem-solving skills among slow learners at FGGC, Abuloma?	2.61	0.62	2.52	0.59	2.57	High Extent
15	To what extent do performance-based assignments develop problem-solving skills among fast learners at FGGC, Abuloma?	2.61	0.62	2.50	0.59	2.56	High Extent
Cluster Mean/SD		**2.55**	**0.60**	**2.48**	**0.58**	**2.52**	High Extent

Criterion mean score = 2.5

Results in Table 2 detail the mean and SD scores regarding the systematic management of performance-based assignments and feedback within student academic streaming at FGGC, Abuloma. The teachers evaluated their school's management with a cluster mean of 2.52, indicating a high extent of effectiveness. The SD, ranging from 0.56 to 0.62, reflects moderate variability in responses. However, concerns exist in terms of alignment of assignments with objectives across all the streams (xx =2.47) and promoting critical thinking among slow learners (xx = 2.48) which were marked with low extents.

7.2 Test of Hypotheses

Hypothesis 1: There is no significant difference in mean scores reflecting the opinions of senior and junior teachers regarding the management of assessment integrity in the academic streaming of the students.

Table 3 Z-test Analysis on the Mean Difference Between the Mean Responses of the Teachers on the Management of Assessment Integrity in the Academic Streaming of the Students

Status	n	$\bar{x}$	Sd	df	z-cal	z-crit value	Sig.	Level of significance	Decision
Senior Teachers	19	2.48	0.63						
				45	3.08	1. 96	0.00	0.05	Significant
Junior Teachers	28	2.56	0.60						

Results in Table 3 indicated that a z-test was conducted to evaluate the mean difference in responses from senior and junior teachers regarding assessment integrity management in academic streaming of FGGC Abuloma students. The calculated z-value (3.08) exceeds the critical value (1.96), and the p-value (0.00) is below the significance level (0.05), leading to a significant conclusion. Therefore, the null hypothesis was not retained.

Hypothesis 2: There is no significant difference in mean scores reflecting the opinions of senior and junior teachers regarding the management of performance-based assignments and feedback in the academic streaming of the students.

Table 4 Z-test Analysis on the Mean Difference Between the Mean Responses of the Teachers on the Management of Performance-Based Assignments and Feedback in the Academic Streaming of the Students

Status	n	$\bar{x}$	Sd	df	z-cal	z-crit value	Sig.	Level of significance	Decision
Senior Teachers	19	2.55	0.60						
				45	5.10	1. 96	0.00	0.05	Significant
Junior Teachers	28	2.48	0.58						

Results in Table 4 indicated that a z-test analysis was performed to ascertain the mean difference in responses between senior and junior teachers regarding the management of performance-based assignments and feedback in academic streaming of FGGC Abuloma students. The calculated z-value (5.10) significantly exceeds the critical value (1.96), and the p-value (0.00) is below the significance level (0.05), confirming a significant difference. Therefore, the null hypothesis was not retained.

8 DISCUSSION OF FINDINGS

The findings from FGGC, Abuloma Rivers State, Nigeria, highlight the critical importance of systematically managing assessment integrity and performance-based assessment as strategies of meritocracy-based management within student academic streaming. Hancock et al. emphasize that the integrity of assessments is essential[21], and the high ratings assigned by FGGC, Abuloma teachers regarding their school's management reflect a strong commitment to ethical practices. However, despite this commitment, it is concerning that peer pressure significantly influences students' adherence to assessment integrity. This concern aligns with Abdaoui [22], who argues that social dynamics can undermine academic honesty and suggests various strategies to mitigate cheating. This reveals that while the teaching staff upholds integrity, external factors complicate the educational environment, necessitating a reassessment of current strategies[11]. Moreover, the findings of this study indicate a moderate variability in responses concerning assessment practices, which may suggest differing perceptions among staff, as discussed by Igbe et al. [23].

The challenges surrounding technology usage are particularly significant; Abubakar and Adebayo highlight the potential of computer-based testing to bolster assessment integrity[16]. Notably, the continued low level of technology utilization at FGGC raises critical questions about the effectiveness of existing assessment methods. This observation supports the argument made by Archibong et al. regarding the need for regular quality assurance assessment in educational practices[9]. Umeghalu [24] and Hancock et al. [21]further argue that seamless technology integration is vital for modern pedagogy, yet the low technology use in assessment management diverges from current trends aimed at educational improvement.

Furthermore, the systematic management of performance-based assignments encourages problem-solving skills across various academic streams in FGGC, aligning with the findings of Mansor et al. regarding the benefits of streaming practices[20]. However, concerns about aligning assignments with learning objectives and fostering critical thinking among slow learners in this study echo challenges identified by Emiloju and Adeyoju [18]. This misalignment may contribute to the significant differences in responses between senior and junior teachers in this study, indicating potential gaps in pedagogical approaches [6]. Overall, the findings of this study underscore the necessity for a cohesive strategy that integrates technology and addresses the diverse needs of students while upholding rigorous standards of assessment

integrity as acknowledged by Butler-Henderson and Crawford, Umeghalu as well as Hancock et al. [21,24,25]. Such an approach is essential for fostering a meritocratic system in the management of academic streaming in Unity Colleges in Nigeria for improved educational outcome.

9 CONCLUSION

The assessment of meritocracy-based management strategies in the academic streaming of students at FGGC, Abuloma, underscores the critical importance of maintaining assessment integrity and performance-based evaluations. While the institution's dedication to ethical practices is commendable, challenges such as peer pressure and limited technology adoption hinder the preservation of academic honesty. Additionally, differing perceptions among staff members highlight the necessity for a reassessment of existing evaluation methods, process and teaching strategies. A holistic approach that effectively incorporates technology and caters to diverse student needs based on merit is essential for cultivating a meritocratic educational environment that enhances student outcome in Nigeria's Unity Colleges.

10 RECOMMENDATIONS

Based on these findings, the following recommendations were made:
1. The Ministry of Education should invest in and facilitate seamless technology adoption within assessment practices in Unity Colleges to improve integrity, efficiency, and alignment with modern pedagogical standards.
2. School management should provide ongoing training for teachers on assessment integrity and technology utilization to enhance academic standards and collaboration across the different academic streams.
3. The school administration should strengthen policies and practices to uphold academic integrity and mitigate peer pressure that undermines honest assessment.
4. School administrators should supervise teachers to systematically manage performance-based assessments, ensuring they effectively evaluate critical thinking and problem-solving skills across academic streams.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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THE EFFECT OF LEARNING SELF-CONTROL ON LEARNING ENGAGEMENT OF HIGH SCHOOL STUDENTS UNDER WEBCAST TEACHING: THE MEDIATING EFFECT OF LEARNING SATISFACTION

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Abstract: Purpose: The purpose of this study is to investigate the mediating role of learning satisfaction in learning self-control and learning engagement in live online learning. 12,880 high school students are surveyed using the Chinese version of the learning self-control, learning satisfaction and learning engagement scale, and the correlation analysis showed that there is a positive correlation between learning self-control, learning satisfaction and learning engagement. The mediation effect analysis showed that after controlling for variables such as grade level, solitary or not, academic performance, and school level, learning satisfaction partially mediated the relationship between learning self-control and learning engagement, which means that students' self-control influenced their learning engagement through online teaching satisfaction. Thus, it is concluded that teachers in online teaching should enhance the quality and improve the teaching aspects to increase students' satisfaction, which in turn will enhance students' learning engagement and guarantee the effectiveness of online teaching.
Keywords: High school students; Self-control; Engagement; Satisfaction; Online learning

1 PROBLEM RAISED

The development of information technology has enabled more webcast teaching to be carried out. Webcast teaching not only breaks through the space limitation of both teachers and students, but also breaks through the time limitation due to its functions of playback and recording. In addition to the mutually agreed learning time, students can flexibly arrange their own learning plans and tasks, while students save preparation time before class and can enter the learning state faster. But it also has certain shortcomings. First, its lack of teaching atmosphere and its inability to ensure teaching effectiveness, and students' sense of belonging is poor. Second, in a smart learning environment, some students are not yet aware of the advantages of playing the function of technology to enhance learning efficiency, but only focus on the technology itself and lead to a lack of concentration in learning. Finally, the biggest problem of online courses is that students do not have strong self-discipline in learning. In an online learning environment, teachers have limited ability to supervise students' learning process and cannot control whether students listen carefully and complete exercises and assignments on time and in quantity. Therefore, students' self-control will affect their learning effectiveness.

Students are originally under great pressure to learn, and the new online learning conducted by the webcast teaching will make them anxious, which will lead to the impact of learning engagement and so on[1,2]. In addition to the change of teaching methods, students' own factors such as internal learning drive[3], learning self-efficacy[4], and students' learning self-control are also an important influencing factor[5]. Students' self-control is an important determinant of teaching effectiveness, and Kopp defines it more fully: self-control is the ability of individuals to regulate their behavior to match their personal values and social expectations, and consists of five main aspects: suppressing impulsive behavior, resisting temptation, delaying gratification, developing and completing behavioral plans, and adopting socially appropriate behavior[6]. Numerous studies have shown that academic self-control affects students' academic performance[7-9]. Students with poor academic self-control are more likely to develop problems such as boredom[10], emotional exhaustion[11] and negativity[12], and have an impact on engagement in learning[13-15]. If students invest more time in their learning, the more they will learn. Learning engagement refers to students' concentration and effort in learning, understanding or mastering knowledge and skills, and includes cognitive engagement, affective engagement and behavioral engagement[16]. Research has found that engagement in learning is a positive predictor of academic achievement[17] and also a key factor in addressing issues such as student burnout, loneliness and dropout[17]. Online learning engagement refers to the extent to which students are engaged in interactive online learning activities and learning experiences. Therefore, research on learning engagement is one of the most important elements in analyzing students' academic achievement. Other studies have found that the degree of student satisfaction with learning affects their learning engagement and the higher the satisfaction the higher the engagement. In an online environment, the quality of service and information affects user satisfaction. There is a correlation between users' online course learning satisfaction and students' final grades. Online live learning platform satisfaction is a systematic assessment made by students after perceiving the characteristics of the platform, and is an emotional response and psychological feeling formed by students during their long-term experience of using the platform.

It can be inferred that the higher the student's self-control, the higher the student's satisfaction with learning, and the higher the student's learning satisfaction, the higher the student's learning engagement, and the higher the student's learning self-control, the higher the student's learning engagement. In conclusion, this study analyzes the mediating relationship between learning satisfaction in learning self-control and learning engagement by taking high school students as the research object. It provides a reference and basis for improving education and teaching, promoting students' value-added development and psychological health growth.

2 RESEARCH METHOD

2.1 Research Object

In this study, sampling is conducted from first-tier, second-tier and third-tier cities based on different levels of economic development, and the studies are all conducted with high school freshmen, sophomores and juniors as subjects. 12,880 high school students are randomly selected from Guangdong Province, and these students are evaluated to be 16.45 years old (SD=1.44), between the ages of 16-19, and included 5,083 male students (48.3%). This study is approved by the ethics committee of University of Electronic Science and Technology of China， Zhongshan Institute and the principal of the participating schools. The selected students are resource participants and are not provided with an incentive to complete the questionnaire. After completing this test in the study by asking the subjects to provide information including gender, age, and solitary status, and thereafter students completed the Learning Self-Control, Learning Satisfaction and Learning Engagement scales, the counseling center or teachers at the subject's school are informed of any counseling and services needed.

2.2 Research Tools

2.2.1 Learning self-control scale

“Learning Self-Control”, prepared by Zhang Lingcong and revised by Zhang Yeyun, is adopted. The scale consists of 38 questions and contains three dimensions, which are self-control sense, self-control tendency, and self-control strategy. The self-control sense includes sub-dimensions such as task efficacy, self-awareness, and self-monitoring; the self-control tendency includes sub-dimensions such as planning, persistence, and summarization; the self-control strategy includes sub-dimensions such as emotional control, environmental control, help-seeking strategy, and remediation. The scale is scored on a 5-point Likert scale, from 1 to 5, indicating, respectively, completion does not meet, does not quite meet, somewhat meets, meets, and fully meets. After statistical analysis, the scale Cronbach α coefficient is found to be 0.842.

2.2.2 Learning engagement scale

“The Utrecht Work Engagement Scale-student” by Schaufeli is adopted. The scale consists of 17 items, and the questionnaire is scored on a 7-point Likert scale, representing never, almost never, rarely, sometimes, often, very often, and always, from 1 to 7, respectively. The questionnaire is divided into three dimensions, which are engaged motivation, engaged energy, and engaged concentration. The scoring is cumulative according to the selected numbers. The Cronbach α coefficient of the scale is found to be 0.950 after statistical analysis.

2.2.3 Online learning satisfaction questionnaire

The online learning satisfaction questionnaire is adapted from the "Learning Satisfaction Questionnaire" developed by Liu Li et al. The research is conducted in terms of learning format, effectiveness, Q&A, and resources. The questionnaire is scored on a 5-point Likert scale from 1 to 5, representing very dissatisfied, dissatisfied, and average, satisfied, and very satisfied, respectively. After statistical analysis, the Cronbach alpha coefficient of the scale is found to be 0.918.

2.3 Data Processing

SPSS 19.0 software and Process 3.4 are applied for data processing and results analysis in this research.

3 ANALYSIS OF RESULTS

Table 1 Correlation Analysis of Learning Self-Control, Engagement and Satisfaction

	1	2	3
1. Learning behavior control	1		
2. Learning engagement	0.621***	1	
3. Learning satisfaction	0.411***	0.534***	1
M±SD	3.20±0.211	4.51±0.317	3.74±0.341

3.1 Regression Analysis of Learning Self-Control, Learning Engagement and Satisfaction

In the regression analysis of learning self-control and learning satisfaction, students' summative, help-seeking strategies, persistence, and self-awareness had a predictive effect on learning satisfaction. The variables of summative, self-awareness, and help-seeking strategies in learning self-control had significant predictive effects on learning engagement, as shown in Tables 2 and 3.

Table 2 Linear Regression Analysis of High School Students' Learning Satisfaction on the Learning Self-Control Dimension

Order of Selected Variables	Multiple Correlation Coefficient R	Decision Factor R^2	Increase the Amount of Explanation△R^2	t Value	Net F Value
Summative	0.401	0.160	0.157	14.37	710.89***
Help-seeking Strategies	0.414	0.171	0.016	6.65	389.20***
Persistence	0.421	0.178	0.004	-4.665	272.79***
Self-awareness	0.427	0.183	0.005	5.41	211.92***
Mission Effectiveness	0.429	0.184	0.002	2.8	171.38***
Emotional Self-control	0.431	0.186	0.002	-2.65	144.23***

Table 3 Linear Regression Analysis of High School Students' Learning Engagement on ohe Learning Self-Control Dimension

Order of Selected Variables	Multiple Correlation Coefficient R	Decision Factor R^2	Increase the Amount of Explanation△R^2	t Value	Net F Value
Summative	0.583	0.340	0.240	94.10***	10769.54***
Self-awareness	0.610	0.373	0.032	47.94***	6199.81***
Help-seeking Strategies	0.624	0.390	0.017	34.61***	4447.54***
Mission Effectiveness	0.629	0.396	0.006	31.74***	3421.24***
Persistence	0.632	0.399	0.003	25.68***	2775.70***
Planned	0.633	0.401	0.001	21.79***	2325.89***
Environmental Control	0.634	0.401	0.001	19.76***	1998.816***

3.2 Mediating Role of Satisfaction in the Effect of High School Students' Learning Self-Control on Engagement

First, the Model4 model in ProcessV4.3 software prepared by Hayes is adopted to test the mediating effect of school satisfaction in the relationship between academic self-control and learning engagement, controlling for variables such as academic achievement, grade level, solitary student or not, and school level. The results (see Tables 4 and 5) show that learning self-control has a significant predictive effect on learning engagement, and the predictive effect of learning self-control on learning engagement remains significant after putting in the mediating variable learning satisfaction. Therefore, the positive predictive effect of learning satisfaction on learning engagement is significant. In addition, the upper and lower limits of the bootstrap 95% confidence intervals for the direct effect of learning self-control on the effect of learning engagement and the mediation effect of learning satisfaction did not contain 0 (see Table 5). It indicates that learning self-control not only predicted learning engagement but also is able to predict learning engagement through the mediating effect of learning satisfaction. This direct and mediating effect accounted for 78.57% and 21.43% of the total effect, respectively.

Table 4 Learning Satisfaction Mediation Model Test

Regression equation	Fitted index			Significance	
Resulting variable	R	R^2	F（df）	B	t
Learning satisfaction	0.311	0.081	70.14（5）	2.55	2.31***
Learning Engagement	0.517	0.301	2478.91（5）	0.678	7.187***
Degree of learning engagement	0.445	0.212	179.51（5）	1.605	14.053***

Table 5 Decomposition of Total Effect, Direct Effect and Mediating Effect

	Effect Value	Boot Standard	Boot CI Lower	Boot CI Upper	Relative Value

		Error	Limit	Limit	
Total Effect	0.687	0.030	0.547	0.711	
Direct Effect	0.497	0.022	0.378	0.559	72.34%
Mediating effect of teaching satisfaction	0.190	0.014	0.017	0.171	27.66%

4 DISCUSSION AND CONCLUSION

Learning self-control has a significant effect on learning engagement, and teaching satisfaction produces a mediating effect. Students' satisfaction with teaching in live online learning will enhance students' learning engagement. Currently, students have more poor self-control and procrastination behaviors. Without the regulation and restraint of classroom management in offline teaching, it is difficult for teachers to continuously focus students' attention on classroom teaching, therefore, the quality of teachers' teaching also affects students' learning engagement, and students' learning engagement is also high when students are satisfied with teaching. Teachers who want to attract students' attention need to adapt the content and aspects of teaching, adopt heuristic and problem-based learning models, and focus on guiding students' self-learning and cooperative learning skills to enhance their use of information technology. If teachers fail to improve the quality of teaching and learning, it will affect students' engagement in learning activities and will have a negative effect on students' self-control of learning. Therefore, when enhancing students' learning self-control, teachers should improve the quality of teaching, otherwise it will affect the summative of learning, help-seeking strategies, persistence, and self-awareness. Teachers should also place students at the center of learning through multiple forms of online learning, using participatory, collaborative, and project-based forms of instruction. If teachers' teaching quality is not high, then students' summative skills will be difficult to develop and will affect the persistence of their learning.

5 PROSPECT

Live online learning is a systematic project, which not only involves the functionality and convenience of the technology platform, but also is influenced by the individual characteristics of the student population and the quality and means of teachers' teaching, thus requiring further optimization of teaching contents, teaching methods and technologies. Although some of the results of this study have been obtained, there are still some shortcomings in the study because the live online learning is influenced by the subjective and objective factors such as individual students, parents, teachers' teaching and equipment functions. Therefore, further analysis and research are needed to address many factors such as teachers' online teaching methods, individual students and families.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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OPTIMIZING THE PATH OF INTERNATIONAL CHINESE LIVE TEACHING MODEL

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Abstract: Through the summary of international Chinese live teaching practice, this paper summarises that the live teaching mode has the advantages of authentic target language context and providing immersive cultural experience, and at the same time, it also finds that the live teaching mode has the shortcomings of high technological requirements and weak adaptability of course content, and puts forward the following optimisation suggestions: strengthening technical support, improving teacher quality, and adopting diversified teaching evaluation tools.
Keywords: International Chinese language teaching; Live broadcast; Online teaching

1 INTRODUCTION

With the advancement of globalisation and the continuous improvement of China's international influence, appeal and shaping power, more and more foreigners are interested in Chinese language and Chinese culture, and the number of Chinese language learners studying in China is increasing day by day. However, affected by the epidemic, Chinese learners from many countries are unable to come to China to study, which makes offline teaching hindered, and international Chinese language teaching has to be changed from offline teaching to hybrid teaching combining online and offline. By applying the real-life live teaching mode, the teaching environment can be changed from screen sharing to a real social scene, and the teacher will bring the real target language context to the online learners, help them communicate in the real target language context, and improve the learners' ability to use Chinese in a comprehensive way. It also meets the learners' needs to understand Chinese national conditions and Chinese culture. Online teaching has been gradually integrated into the daily teaching of international Chinese language, and the real-life live teaching mode still has great development space as a new online teaching mode.

2 REVIEW OF RELEVANT RESEARCH

The issue of language environment is a huge shortcoming of online teaching. The target language environment is very important to learners, and online teaching is less likely to provide authentic language environments, and the lack of immersion experience in the target language environment may affect learning outcomes. In her survey, Lin Xiuqin [1] found that one of the major issues raised by teachers was the lack of social and linguistic environment. During the epidemic, international students who were originally in China were forced to choose to 'study online' and lost the opportunity to communicate face-to-face with Chinese people, while language learning is also a humanistic activity, the social and linguistic environment of the target language is very important to the learners' humanistic experience, and language teaching and learning even has a "socio-emotional learning". The teaching and learning of language even has a process of "social emotional learning", where the classroom interacts with society to achieve socialisation. [2] Online teaching takes away the possibility of this proper humanistic experience and becomes a huge drawback.[3] These investigations and studies point out the importance of cultural immersion for online Chinese learning and lay the foundation for the proposal of new online Chinese teaching methods such as live streaming. The above overview of online Chinese teaching shows that with the development of Internet technology, the technical conditions for live teaching have basically matured, and an endless number of online teaching aids have also helped international Chinese teachers to complete online teaching more efficiently. However, there are still many problems in the process of online Chinese teaching, among which the problems of network technology still need the joint efforts of network professionals, technology developers and other parties, and international Chinese teachers can only find the tools and platforms suitable for online teaching of this course through continuous debugging. However, there is still a lot that international Chinese teachers can do in the process of teaching, whether it is to improve their online teaching ability, enhance their intercultural communication awareness, carefully select the teaching content, use various online tools to receive more timely interaction and feedback, or use more diverse interactive methods to enhance the learners' motivation and sense of cultural immersion, all these are the expected improvements in the new teaching mode of live broadcasting for online Chinese teaching. These are all areas that are expected to be improved in live streaming, a new teaching model for online Chinese language teaching.

3 RESEARCH DESIGN

3.1 Advantages of Live Streaming Teaching

3.1.1 Live streaming teaching promotes the teamwork ability of international Chinese language teachers

As the teaching location of live broadcast is often variable, uncertain and unfamiliar, teachers need to go to the field before the official teaching starts to ensure the reasonable arrangement and smooth progress of the teaching sessions. There are no ready-made teaching materials available for live broadcasting, and all the teaching content needs to be compiled by teachers themselves to determine the teaching key points according to the teaching target. In the teaching process, the live broadcast can not be completed by a teacher independently, need to have the main teacher, camera, assistant teacher at least three teachers to complete. After class, teachers also need to use online teaching aids to integrate data in a timely manner for learning feedback, to help students consolidate knowledge, check for gaps. [4] As a result, the preparation for live teaching requires more preparation than traditional online teaching, and the difficulty and workload of teachers' preparation has increased greatly. Therefore, the live streaming teaching mode must be completed by a team, which is a great test of teachers' teamwork ability.

3.1.2 Live streaming teaching promotes the improvement of international Chinese language teachers' teaching ability

In the process of live broadcasting, the main teacher needs to act as a guide, leading the whole classroom in an orderly manner, presiding over each link, constantly throwing out questions, setting up situations, and in the process, constantly adding the language and cultural knowledge to be learned in the class, always paying attention to the "student-centred" . A little carelessness, will occupy the classroom centre, the classroom into a stage for teachers to show, or before and after the connection is not in place, so that the classroom links become fragmented, only focus on students' communicative training, not to supplement the knowledge points in place, a real-life live in the short-term Chinese language teaching in the application of the research class down the students are just going to see the flowers, the gain is very little. Therefore, in the teaching process how to control the whole field but not occupy the whole field is a small problem for teachers.

Therefore, it is a great challenge for teachers to control the whole scene in the teaching process without taking over the whole scene.

3.1.3 Live streaming teaching also promotes the improvement of international

Chinese language teachers' personal comprehensive quality. In the process of live broadcasting, due to the changing teaching environment, flexible teaching content and complex teaching personnel, many uncontrollable factors may occur from time to time, such as students may ask questions about unfamiliar things on the scene at any time, and at this time the rhythm of teaching may be easily disrupted, and teachers need to bring students' attention back to the classroom in time; however, sometimes teachers may need to make timely additions to the knowledge, etc., which requires that the teachers have rich teaching experience, precise judgement, and profound teaching experience. This requires teachers to have rich teaching experience, precise judgement, deep knowledge, etc., which is a reflection of the excellent comprehensive quality of teachers.

3.1.4 Real-life Live streaming teaching can provide online learners with a real context of the target language

Real-life live teaching can achieve a large amount of communicative training in a short period of time, and continuously cultivate learners' cross-cultural communicative awareness and competence in the process of training. In the process of teaching, learners need to complete a large number of communication tasks while learning culture, and practice the tasks independently or cooperatively, so as to satisfy the learners' needs of learning Chinese culture and improve their language ability.

3.1.5 Live broadcasting enables learners abroad to understand Chinese culture, history and society

More intuitively Live broadcasting creates a sense of cultural immersion that is difficult to provide in traditional classroom teaching. Live streaming can help learners understand Chinese culture and national conditions, and at the same time, enhance the learners' sentiment of knowing China and being friendly to China. From the students' real feedback, we found that the live course can fully mobilise students' enthusiasm, make students have a deeper understanding of China's image, complete the teaching goal of enhancing learners' knowledge of China and friendship with China, and present students with a different kind of online classroom.

3.2 Disadvantages of Live Streaming Teaching

3.2.1 High technical requirements

Live teaching requires high technical support, such as a stable network environment, high-definition picture quality and so on. In a dynamic teaching environment, maintaining the clarity and stability of the live screen is a key factor in ensuring the quality of the classroom. [5] However, when you are outdoors, there is often no fixed network available. However, when you are outdoors, there is often no fixed network to use, so you need to use portable WIFI or 5G network, and you need to debug before the start of the teaching, which is time-consuming and time-consuming and laborious.

3.2.2 Weak adaptability of course content

Not all Chinese teaching content is suitable for live streaming, some abstract language points may need more explanation and examples, so live streaming is more suitable for cultural teaching. The preparation and design of live teaching is very complicated, from determining the theme in the early stage, preparing for the lesson to the live filming, each link requires a lot of effort from the teacher team, and after practice, I found that it takes much more effort than the traditional classroom to carry out a live teaching lesson. Students are also more energetic. It is not only the test of the

teacher's teaching ability, but also a great test of the teacher's teamwork, adaptability, technical mastery and so on. Therefore, live broadcasting can only be applied to short-term teaching.

4 CONCLUSION

Suggestions for optimising Live streaming teaching in short-term international Chinese language teaching:

4.1 Strengthen Technical Support

Teachers can consider co-operating with professional technology companies to share resources and develop a powerful online live teaching platform that can meet both live broadcasting needs and various needs of Chinese language teaching, such as real-time interaction, homework management, and examination assessment. Ensure that the teaching platform has a user-friendly interface design to reduce learners' difficulty in using it. During the live broadcasting process, virtual reality (VR) and augmented reality (AR) technologies can be used to create an immersive Chinese learning environment and enhance the sense of reality, so as to increase learners' interest and participation. Artificial intelligence technologies, such as speech recognition and natural language processing, can also be used to assess learners' pronunciation and grammar in real time and provide personalised guidance after class. At the same time, teachers should be trained in online teaching techniques to improve their online teaching ability, so that when a situation of unexpected technical problems occurs in the classroom, teachers can react and solve them in a timely manner to ensure that the classroom runs smoothly and provide students with a better learning experience. Encourage teachers to make use of Internet resources, such as social media and blogs, to share their teaching experience and resources and promote the sharing and exchange of teaching resources.

4.2 Enhance Teacher Literacy

To improve the adaptability of course content, teachers should carefully design live activities to ensure that they match the teaching objectives and learning content. The live broadcast can be supplemented by pre-recording some key parts of the video or providing supplementary materials afterwards. Meanwhile, more types of live streaming courses can be added to meet the learning needs of different students. Preparation of corresponding teaching materials for teacher sharing. Also in order to be able to reduce the burden on teachers, the form of '1+N' team-based teaching groups can be adopted to flexibly determine the lead teacher, teaching assistants, and technicians during the course of the lesson, which helps to solve the problems of insufficient teacher-student interaction and inability to take care of the individual needs of students.

4.3 Adoption of Multiple Teaching Assessment

Tools In the process of online Chinese language teaching, the adoption of multiple teaching assessment tools can effectively measure students' learning progress, comprehension and skill mastery. In order to effectively assess learning outcomes, other forms of assessment tools, such as online tests, homework and project assignments, can be used in combination. Regular online tests are conducted using the test function provided by the online teaching platform. These tests can include multiple-choice, fill-in-the-blank, short-answer, and other question types to comprehensively assess students' knowledge and application of Chinese. Make full use of the teaching platform's learning analytics tools, which can track students' learning activities, such as the number of logins, study time, and completion rate. With these data, teachers can assess students' learning engagement and progress. At the same time, teachers can make use of interactive sessions in live broadcasts, online discussion forums or forums to encourage students to evaluate each other and exchange learning. Through the comprehensive use of these multifaceted teaching assessment tools, teachers can gain a more comprehensive understanding of students' learning and make timely adjustments to their teaching methods and strategies in order to improve the quality and effectiveness of online Chinese language teaching.

In conclusion, as an innovative teaching idea of international Chinese teaching mode, live teaching has strong practical value and development potential. We should make full use of the advantages of this teaching mode to provide L2 learners with a richer, more interesting and more efficient Chinese learning experience, and help them better master Chinese knowledge and skills. At the same time, we should also pay attention to the problems of the teaching model, and continue to improve and innovate, so as to achieve better results in the future teaching practice.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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ASSESSING THE CORRELATION BETWEEN STUDENTS' ATTITUDE TOWARDS THE STUDY OF SOCIAL STUDIES AND THEIR ETHICAL VALUES AMONG JUNIOR SECONDARY SCHOOL STUDENTS IN KUJE AREA COUNCIL OF THE FCT, ABUJA, NIGERIA

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Abstract: The present study attempted to ascertain the correlation between students' attitude towards the study of social studies and their ethical values among junior secondary school students in Kuje area council of the FCT – Abuja. The study was conducted on 10 selected junior secondary schools in Kuje area council of the Federal Capital Territory, Abuja which were Junior Secondary School Buzunkure, Dafara, Gbaupe, Kuje, Pegi, Pasali, Tukpechi, Rubochi, Kiyi and Kayarda, 370 respondents were suggested as a sample size for the population of study, comprising 30 teachers and 340 students respectively. Using a researcher-designed questionnaire titled: "Questionnaire on Students' Attitude towards the study of Social Studies and their Ethical Values" (QSATSSEV) as the instrument to conduct the study and obtain relevant information from the respondent participants – students and teachers, which were gathered and analyzed using frequency counts and percentage and Pearson Product Moment Correlation Statistics (PPMC), using the Statistical Package for Social Sciences (SPSS) Statistical Pack 25 version; which revealed that the students have poor attitude towards the study of social studies due to their belief or thinking that it is more of moral and religious study, attitude of students towards Social Studies influences their ethical, there is a correlation between the attitudes of students towards the study of social studies and their ethical values and that the study of social studies is influenced by several factors such as teaching method, type of instructional materials employed in teaching, societal influence, teacher-students' relationship and the level of availability and functionality of teaching materials.
Keywords: Attitude; Correlation; Student; Secondary; Social; Studies

1 INTRODUCTION

The Society is constantly changing and its impact can be seen from the behavior and attitude of children. Social crimes such as abuses, robbery, and killing, use of drugs, bullying, and dishonoring parents have increased in the recent years not only in the western countries but also in our country Nigeria. The moral corrosion among youth has also been highlighted by Ulusoy et al. [1]; Mukui have greatly increased[2]. The increased use of technology and cyberspace has become a trend or tool in shaping the behavior and social well-being of people. Humans are highly mesmerized by the technological revolutions, which has not only improved global interaction, but has also adversely raised unethical practices. There are various factors which shape human conduct, which include social relations, friend circle, family environment, culture, etc. In the view of sociologists, norms, values, customs and social interactions greatly influence human conduct [3]. One of the most important aspects of human personality, which persuade human action, is morality, ethic and value. Moral development has its philosophical basis dated back to the Greek philosophers [4,5]. It studies about human nature in realizing social goodness [6].

Over the years, there have been growing concerns about the attitude of students towards the study of Social Studies in secondary schools. The need to adapt our education to the needs of the Nigerian society started before and after independence. Many educational elites began to recognize that the functional inadequacies of the educational system inherited from the colonial education failed to develop positive values, attitudes and habits in our, society because the Social Studies they taught was British oriented and has nothing to offer to the Nigerian child [7]. According to Celikkaya and Filoglu, [8]; Ayaaba [9], the school environment in this regard is very important, which encompasses the way teachers interact, the background of the classmates, the tactics teachers use to deal with students, the codes and rules, school connectedness, ethics, curriculum, all leading to harmonizing moral and ethical development [10]. Our Society is constantly changing and its impact can be seen from the behavior and attitude of children. Social crimes such as abuses, robbery, and killing, use of drugs, bullying, and dishonoring parents have increased in the recent years not only in the western countries but also in our Nigeria [11]. In this regard, it is very crucial to find, how moral and ethical value development is shaped among the school going students in Junior Secondary Schools and how their attitude toward social studies educational could

promote ethical practices and contribute to the moral development of students. Hence the need to assess the correlation between students' attitude towards the study of Social Studies and their ethical values among Junior Secondary School students in Kuje Area Council of the FCT, Abuja.

This study on the correlation between students' attitude towards the study of Social Studies and their ethical values among Junior Secondary School students in Kuje Area Council of the FCT, Abuja would be of great significance to our country Nigeria, the government, schools, parents, teachers, students and of course future researchers.

2 RESEARCH QUESTIONS

The following research questions guided the study:

i. what is the attitude of students toward the study of Social Studies among Junior Secondary School students in Kuje Area Council of the FCT, Abuja?

ii. how does the attitude of students towards Social Studies influence their ethical values in Junior Secondary Schools in Kuje Area Council of the FCT, Abuja?

iii. is there any correlation between the attitudes of students towards the study of Social Studies and their ethical values in Junior Secondary Schools in Kuje Area Council of the FCT, Abuja?

iv. what are the factors that influences students' attitude towards the study of Social Studies in Junior Secondary Schools in Kuje Area Council of the FCT, Abuja?

v. are there factors that influences ethical values amongst students' in Junior Secondary Schools in Kuje Area Council of the FCT, Abuja?

3 METHODOLOGY

3.1 Research Design

The research design for the study is descriptive survey method. Descriptive Survey design, according to Bolling et al. [12] is a study which aims at collecting data and describing it in a systematic manner; the characteristics, features or facts about the given population. It is a study-design that is interested in describing certain variables in relation to the population. According to Kankam et al. [13], the descriptive research design aims to accurately and systematically describe a population, situation or phenomenon. It can answer the what, where, when and how questions, but not why questions.

The descriptive survey design was employed for this study for the fact that it deals with the collection and analysis of factual information from the sample and helped to describe the correlation between students' attitude towards the study of Social Studies and their ethical values among Junior Secondary School students in Kuje Area Council of the FCT, Abuja.

3.2 Population, Sample and Sampling Techniques

The target population will comprise of 62 junior secondary schools in Federal Capital Territory, Abuja with a population of 9,021 students and 126 teachers.

Table 1 List of Public Junior Secondary Schools in Kuje Area Council

S/N	School Name
1	Junior Secondary School Agwai
2	Junior Secondary School Buzunkure
3	Junior Secondary School Chukuku
4	Junior Secondary School Dafara
5	Junior Secondary School Gaube
6	Junior Secondary School Gbaupe
7	Junior Secondary School Gudun Karya
8	Junior Secondary School Gwargwada
9	Junior Secondary School Huni

S/N	School Name
10	Junior Secondary School Kabin Kasa
11	Junior Secondary School Kabin Mangoro
12	Junior Secondary School Kayarda
13	Junior Secondary School Kiyi
14	Junior Secondary School Kuje
15	Junior Secondary School Kujekwa
16	Junior Secondary School Kwaku
17	Junior Secondary School Pegi
18	Junior Secondary School Pasali
19	Junior Secondary School Rubochi
20	Junior Secondary School Sabo
21	Junior Secondary School Shadadi
22	Junior Secondary School Tukpechi
23	Junior Secondary School Ukya
24	Junior Secondary School Yanga
25	Junior Secondary School Yenche

Source: fctemis.org

3.3 Sample and Sampling Techniques

The researcher used combinations of simple random sampling techniques and purposive sampling to get the sample of respondents for the study from junior secondary schools in Kuje Area Council of Federal Capital Territory. In the sampled schools the researcher used purposive sampling technique to select 30 Social Studies teachers. According to Law et al. [14], purposive sampling technique allows the researcher to use cases that have required information in respect to the objectives of the study. The researcher intends to choose Social Studies teachers because in the junior secondary schools curriculum, learning Social Studies is compulsory and it is also based on this study.

Using Mbaba and Omabe suggested 370 respondents as a sample size for a population of between 9000-9500[15]. That is, one-twenty-fifth of total population as calculated below:

$\frac{1}{25}$ of N where N = Total population

$= \frac{1}{25} \times 9{,}156$

$= \frac{9156}{25}$

$= 366.24$

Approximate = 370 respondents (340 students and 30 teachers respectively).

Table 2 Selected Sample for the Study

S/N	Name of Selected School	No. of Selected Teachers	No. of Selected Students
1.	Junior Secondary School Buzunkure	3	34
2.	Junior Secondary School Dafara	3	34
3.	Junior Secondary School Gbaupe	3	34

4.	Junior Secondary School Kuje	3	34
5.	Junior Secondary School Pegi	3	34
6.	Junior Secondary School Pasali	3	34
7.	Junior Secondary School Tukpechi	3	34
8.	Junior Secondary School Rubochi	3	34
9.	Junior Secondary School Kiyi	3	34
10.	Junior Secondary School Kayarda	3	34
Total		**30**	**340**

4 INSTRUMENTATION

The researcher designed questionnaires validated by an expert was used as the instrument to conduct the study. The Questionnaire instruments titled: "Questionnaire on Students' Attitude towards the study of Social Studies and their Ethical Values" (QSATSSEV) was designed to obtain relevant information from the respondent participants – students and Teachers.

The Questionnaire consists of two sections; A and B. Section A seeks information on the demographic data of participants such as gender, age, class or years of teaching experience while, Section B seeks information on Students' Attitude towards the study of Social Studies and their Ethical Values in terms of the research questions raised.

The rating techniques used for the questionnaires had a four-point scale based on Likert type scale weighted as follows:

Strongly Agree	SA	4
Agree	A	3
Disagree	D	2
Strongly Disagree	SD	1

4.1 Validity of the Instrument

Validity is the extent to which an instrument measures what it purports to measure. Bordoh et al., [16] defined validity as the "best available approximation to the truth or falsity of a given inference, preposition or conclusion. It refers to the accuracy and meaningfulness of inferences, which are based on the research results. In other words, validity is the degree to which results obtained from the analysis of the data actually represents the phenomena under study. To establish the validity of the instrument, this study used content validity to ensure adequate and appropriate items in the instruments that enhanced relevance of the research objectives. The constructed questionnaire would be submitted to the supervisors for perusal and corrections. Series of corrections would be made on the questionnaire to bring it to the acceptable standard for administering. The corrections made would be in the areas of face, content and construct validity, to suit the research objectives of the study.

4.2 Reliability of the Study

The reliability of the instrument will be established by conducting a pilot testing. This is in accordance with Mezieobi et al. [17]who confirmed that a pilot testing before the main study helps to check the problem areas, ambiguity and possible confusion that may be associated with the study. A pilot testing will be conducted on independent respondents using a draft questionnaire. This will be administered to twenty (20) students and ten (5) teachers outside the study area. The questionnaires will be personally distributed and explained to the students, with the assistance of their teachers, so as to avoid possible ambiguities. Cronbach Alpha procedure will be used to test the reliability. The results will determine the reliability of the instruments.

4.3 Administration of the Instrument/Data Collection Procedure

The researcher will visit the selected schools in the Area Council and seek permission from the principals to conduct the study after which the questionnaires will be administered to the teachers and students. This will be done by the researcher, with a research assistant to distribute the questionnaire to the respondents and retrieved them immediately they were filled. This is important so as to avoid loss and damage of questionnaire.

4.4 Method of Data Analysis

The data gathered were analyzed using frequency counts and percentage and Pearson Product Moment Correlation Statistics (PPMC), using the Statistical Package for Social Sciences (SPSS) Statistical Pack 25 version. Since the variables being

correlated were expressed as continuous scores, the test statistics appropriate to its measure is Pearson product moment correlation at 0.05 significant level. The data from the questionnaires were coded on the computer coding sheets and processed with the computer to analyze both main and operational hypotheses.

5 DATA PRESENTATION, ANALYSIS AND INTERPRETATION

5.1 Demographic Data

Respondents' demographic data according to gender, age, category (student or teacher), class/years of teaching experience is presented in this section.

5.1.1 Analysis for gender distribution

Table 3 Distribution of Respondents according to Gender

Gender	Frequency	Percentage (%)
Male	158	42.7
Female	212	57.3
Total	**370**	**100.0**

Table 3 shows the distribution of respondents according to their gender. The analysis indicated that 158 respondents representing 42.7% were male while 212 respondents representing 57.3% were female as illustrated in *fig.4.1* below. This implies that there were more female respondents.

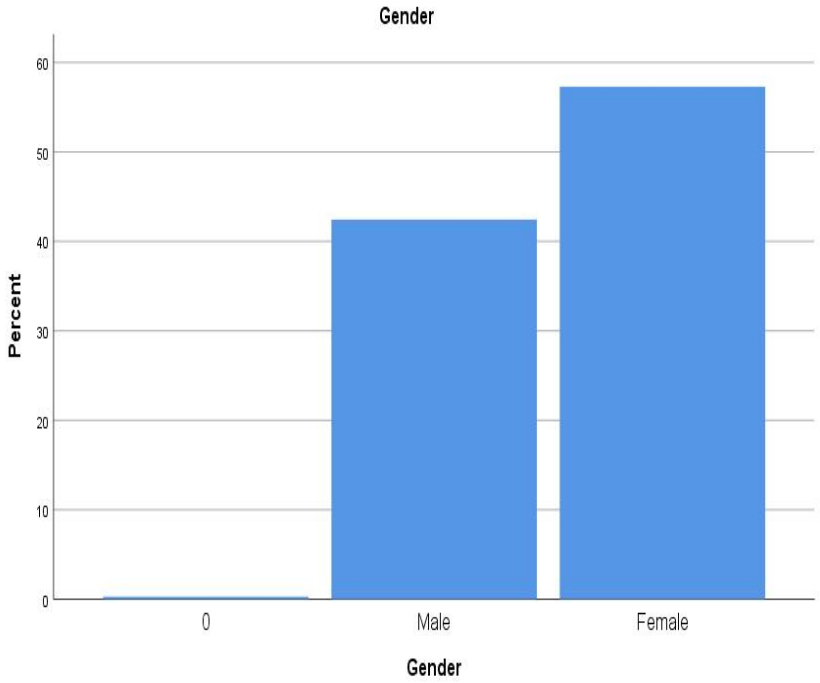

Figure 1 Distribution of Respondents Percentage (%) according to Gender

5.1.2 Analysis for age range distribution

Table 4 Distribution of Respondents according to Age Range for Teachers

Age Range	Frequency	Percent (%)
below 30	5	16.7

31-40yrs	12	40.0
41-50yrs	10	33.3
50yrs above	3	10.0
Total	**30**	**100.0**

Table 4 shows the distribution of respondent teachers according to their age range. The analysis indicated that 5 respondents representing 16.7% were aged below 30 years, 12 respondents representing 40.0 % were aged between 31-40 years, 10 respondents representing 33.3% were aged between 41-50 years, and 3 respondents representing 10% were aged above 50years. This implies that the highest number of the respondents were aged between 31-40 years while the least number of respondents were aged above 50 years as illustrated.

Table 5 Distribution of Respondents according to Age Range for Students

Age Range	Frequency	Percent (%)
below 12yrs	39	11.5
12-14yrs	163	47.7
15-17yrs	127	37.6
Above 17yrs	11	3.2
Total	**340**	**100.0**

Table 5 shows the distribution of respondent students according to their age range. The analysis indicated that 39 respondents representing 11.5% were aged below 12 years, 163 respondents representing 47.7% were aged between 11-14 years, 127 respondents representing 37.6% were aged between 15-17 years, and 11 respondents representing 3.2% were aged above 17years. This implies that the highest numbers of the respondents were aged between 12-14 years while the least number of respondents were aged above 17 years as seen in the table.

5.1.3 Analysis for respondents' category

Table 6 Distribution of Respondents according to Category

Category	Frequency	Percent
Teachers	30	8.10
Students	340	91.90
Total	**370**	**100.0**

Table 6 shows the distribution of respondents according to their category, that is either a teacher or Students of a school. The analysis indicated that 30 respondents representing 8.10% were teachers, while 370 respondents representing 91.90% were students.

5.1.4 Analysis for respondents' years of teaching experience

Table 7 Distribution of Respondents Teachers according to Years of Teaching Experience

Years. Of Experience	Frequency	Percentage (%)
Below 5yrs	3	10.0
5-10yrs	18	60.0
Above 10yrs	9	30.0
Total	**30**	**100.0**

Table 7 shows the distribution of respondents teachers according to their number of years of teaching experience. The analysis indicated that 3 respondents representing 10.0 % had below 5 years, 18 respondents representing 60.0% have between 5 to 10 years teaching experience while 9 of them making up 30.0% have over 10 years teaching experience. From the analysis, it implies that teachers with 5 to 10 years teaching experience made up the highest respondents for the study with 18 respondent teachers, followed by those with above 10 years teaching experience then the least participants had below 5 years teaching experience with 3 respondents.

5.1.5 Analysis for respondent students' class

Table 8 Distribution of Respondents according to their Classes

Class	Frequency	Percent
JSS 2	221	65.0
JSS 3	119	35.5
Total	340	100.0

Table 8 above shows the distribution of respondents according to their class that is responding from JSS 2 or JSS 3. JSS 1 was excluded as they are fairly new in the junior secondary schools. The analysis indicated that 119 respondents representing 35.0% were from JSS 3 classes, while 221 respondents representing 65.0% were from JSS 2 class. This implies that majority of the respondents of 65.0% are from JSS 2 class while 35.0% of them were JSS 3 students.

5.2 Test of Research Questions

This section seeks to analyze the research questions formulated for the study, with a view to determining whether or not the responses of the respondents were positive or negative. The summary of the analysis was presented one after the other, in what appeared to have been analyzed using mean deviation with the critical mean level of 2.50.

Research Question One: *What is the attitude of students toward the study of Social Studies among Junior Secondary School students in Kuje Area Council of the FCT, Abuja?*

Table 9 Mean Ratings of attitude of students toward the study of Social Studies among Junior Secondary School students in Kuje Area Council of the FCT, Abuja

S/N	Statement	Mean	S.D	Decision
1	Students offer social studies in Junior Secondary Schools just because it's a core subject in their curriculum.	3.29	0.92	Agree
2	Students do not think offering social studies in Junior Secondary Schools is of great importance as its not art or science related.	2.97	0.92	Agree
3	Students see social studies as a religious studies always making emphasis on morals.	3.00	0.91	Agree
4	Students responds to social studies with mixed attitude as they feel it lays too much emphasis on moral and ethics	3.01	0.96	Agree
5	Students respond poorly to social studies as a subject, especially when not well handled or taught.	2.98	0.88	Agree

N = 370

Table 9 presents data with respect to the attitude of students toward the study of Social Studies among Junior Secondary School students in Kuje Area Council of the FCT, Abuja. The items' mean indicates agreement with all items, showing poor attitude of students towards the study of social studies in junior secondary schools due to their belief or thinking that it is

more of moral and religious study, basing its contents mostly with ethical and behavioural values which they would not have ordinarily studied if it were to be elective other than compulsory subject.

Research Question Two: *How does the attitude of students towards Social Studies influence their ethical values in Junior Secondary Schools in Kuje Area Council of the FCT, Abuja?*

Table 10 Mean Ratings on how the Attitude of Students towards Social Studies Influence Their Ethical Values in Junior Secondary Schools in Kuje Area Council of the FCT, Abuja

S/N	Statement	Mean	S.D	Decision
6.	Students feel compelled to imbibe and exhibit their cultural and societal values	2.95	0.95	Agree
7.	Peer group and influence make students place western culture and behavior over their cultural and societal ethics	2.86	0.88	Agree
8.	Students ethical values and morals tend to tilt towards the trends and happenings in the society	2.85	0.90	Agree
9.	Students who like and pay attention to the teachings of social studies are observed to have better ethical values	2.82	0.87	Agree
10.	Students who attend and offer social studies because is a compulsory subject tend to have a lesser fair approach to ethical values	2.91	0.94	Agree

N = 370

From Table 10 which presented data with respect to how the attitude of students towards Social Studies influences their ethical values in Junior Secondary Schools in Kuje Area Council of the FCT, Abuja. The items' mean indicates agreement with all items. The sectional mean score of 2.88 which is above the agreement level of 2.5 further confirms this. The study therefore found that the attitude of students towards Social Studies influences their ethical values as those who offer the subject are found to have good and strong ethical values compared to those who offer the subject with a nonchalant attitude or are compelled by peer pressure to place western culture over the societal and cultural expectations.

Research Question Three: Is there any correlation between the attitudes of students towards the study of Social Studies and their ethical values in Junior Secondary Schools in Kuje Area Council of the FCT, Abuja?

Table 11 Mean Ratings of Teachers' Response on the Correlation between the Attitudes of students towards the Study of Social Studies and Their Ethical Values in Junior Secondary Schools in Kuje Area Council of the FCT, Abuja

S/N	Statement	Mean	S.D	Decision
11.	Students who are well taught social studies have sound ethical values	2.85	0.94	Agree
12.	Students with good knowledge of the societal duties and obligations value ethics and morals in the society	2.84	0.85	Agree
13.	Social study education influences students' ethical value	2.73	0.83	Agree
14.	Students tend to copy their social studies teachers, thereby having good values and ethics in the society	2.86	0.88	Agree
15.	Students' behavior and disposition on ethics and values are usually influenced by the study of social studies in their schools	2.73	0.84	Agree

N = 370

From Table 11 presented data with respect to the correlation between the attitudes of students towards the study of Social Studies and their ethical values in Junior Secondary Schools in Kuje Area Council of the FCT, Abuja. The items' mean indicates agreement in respondents' response with all items, indicating that there is a correlation between the attitudes of students towards the study of Social Studies and their ethical values. It could be said that, Social study education influences students' ethical value showing their correlation. The sectional mean of 2.80 which is above the agreement level of 2.5 further confirms.

Research Question Four: What are the factors that influences students' attitude towards the study of Social Studies in Junior Secondary Schools in Kuje Area Council of the FCT, Abuja?

Table 12 Mean Ratings of Teachers' Response on the Factors that Influences Students' Attitude towards the Study of Social Studies in Junior Secondary Schools in Kuje Area Council of the FCT, Abuja

S/N	Statement	Mean	S.D	Decision
16	Teaching methods adopted in the teaching of social studies either	2.94	0.88	Agree

	encourages or discourage the students of social studies			
17	The type of teaching or instructional materials used in the teaching of social studies affects students' attitude toward the study of the subject.	2.91	0.80	Agree
18	Societal trends and westernization tend to ride over the teachings of social studies, thereby affecting students attitude towards social studies	2.97	0.89	Agree
19	Social study teachers' behaviour and relationship the students influences their attitude towards the study of social studies	3.14	1.05	Agree
20	The availability and functionality of social studies teaching materials which makes the study of the subject meaningful and better understood affects students' attitude tow the subject.	2.92	0.91	Agree

N = 370

Table 12 presented data with respect to the factors that influences students' attitude towards the study of Social Studies in Junior Secondary Schools in Kuje Area Council of the FCT, Abuja. The items' mean indicates agreement in the respondents' response with all the items, showing that the study of social studies in junior secondary schools is influenced by several factors such as teaching method, type of instructional materials employed in teaching, societal influence, teacher-students' relationship and the level of availability and functionality of teaching materials for social studies.

6 DISCUSSION OF MAJOR FINDINGS

The study findings showed that students have poor attitude towards the study of social studies due to their belief or thinking that it is more of moral and religious study; basing its contents mostly on cultural, ethical and behavioural values. This is in agreement with Quashigah et al. [18]; Bekoe et al. [19], who observed that over the years, there have been growing concerns about the attitude of students towards the study of Social Studies in secondary schools. However, in our today's world, there are numerous developments in science and technology which could have caused the diversion of students' attention from the subject. He further stated that, while these advances have improved society, they sometimes have adverse effects on its overall development in the society. Therefore, specific areas must be the subject of focus to minimize the damage on society, which is one of the important fields, in the study of "Social Studies." Such importance is because of the fact that individuals feel the need to effectively and efficiently communicate as well as provide solutions to certain current issues generated from political, social, and cultural developments in our society and the world at large [20]. According to Jibililu [21]; Bariham et al. [22], the purpose of including Social Studies in a curriculum is to have students systematically gain explicit educational knowledge of values, ethics and morals needed for good living in a society, which Social Studies within the coursework through various teaching methods and techniques could offer. However, researchers have concentrated much on the cognitive aspect of teaching social studies in our secondary schools because of the importance attached to success in external and public examinations, but, there is interplay between the cognitive and affective areas of teaching and learning which has to do with the cultural, behavioural and ethical values required in the society.

The research question two analysis showed that the attitude of students towards social studies influences their ethical values as those who offer the subject are found to have good and strong ethical values compared to those who offer the subject with a nonchalant attitude. In tandem to this finding is the finding of Omolara and Adebukola [23]; Uge et al., [24], which showed that, there is a relationship between interest and developments in different subjects and its contents, therefore, it is believed that favourable attitude towards social studies may influence to a considerable extent the uptake of knowledge and acquisition of ethics and values which is one of the Social Studies' core objectives and goal. In the same vein, Gao [25]; Mathe [26], stated that social Studies enables people to develop a good sense of judgment and a sense of moral and social responsibilities which enables them become useful members of the society, In summary, he said Social Studies is applied social sciences, the humanities and other fields of study that bear direct or indirect relevance to effective social action of an individual. The ultimate goal of the study being or is to enable man adapt to his environment, utilize available resources optimally for his betterment, appreciate his ecological limitations, constraints and conditionality as well as preserve his environment.

Research question three analyzed the respondents' response and revealed there is a correlation between the attitudes of students towards the study of Social Studies and their ethical values. This is further buttressed by the findings of Redecker et al. [27]; Alazzi and Chiodo, [28]; Eshun, [29], who stated that the extent to which higher-level learning occurs for the individual learner is impacted by the quality of cognitive, social and teaching presences, which is evidenced by the degree to which the individual learner, community of learners and educator/s priorities notions of what is of personal, community and learning value. These prioritized goods and values-bases constitute the ethical-values presence and are, to a great extent, the driver for decisions by the individual learner, community of learners and educator/s on how to engage in learning and to what extent learning will take-place [30]. This implies that, the ethical-values presence impacts on the social presence, by promoting consensus building within communities of learners, respect for difference and fostering a safe and inclusive learning environment. It impacts on the teaching presence, by the prioritization of inclusive teaching and learning strategies

and the recognition of the importance of negotiated, collaborative and democratic learning opportunities. Furthermore, it impacts on the cognitive presence by giving the learner the confidence to interact and reason with the cognitive content and processes in a more critical manner. This shows there is a relationship between the attitudes of students towards the study of Social Studies and their ethical values.

Research question four showed that social studies education is influenced by several factors such as teaching method, type of instructional materials employed in teaching, societal influence, teacher-students' relationship and the level of availability and functionality of teaching materials. Confirming this finding, Datoo and Chagani[31], attributed the mal-functioning of the Social Studies curriculum, among other factors, to the inappropriate utilization of methodologies germane to effective teaching and learning of Social Studies. He therefore opine that, to ensure that Social Studies is effectively taught in schools, it should be, and in cognizance of the fact that Social Studies is a "skills" subject "skills" here, refers to process skills or rather problem solving skills, creative, analytical skills or reflective skills which involve the active participation of the learner in the teaching-learning process in fulfillment of the "Social character" of Social Studies teaching learning activity which for effectiveness ensures a joint teacher class activity which focuses on those methods which make for effective and efficient teaching of Social Studies and ultimately the accomplishment of the defined objectives of Social Studies. Furthermore, Thomson et al [32] report on Social Studies curriculum evaluation, stated that, when students have different roles they played in role playing method for instance, it would help them to retain such topics in the cognitive domain; it will also help them to appreciate the importance of such topics in the affective domain and manipulate it in the psychomotor domain. It has been previously established that Social Studies is a problem solving subject and also helps the students to be creative. In problem solving method, when the three domains in education are brought into play in the classroom, some of the purposes and objectives of Social Studies are achieved. Looking at teachers' attitude towards social studies as a militating factor, Sung and Yang[33], opined that an indigenous Social Studies teacher can device simulation games built around definite problem situations in and outside the classroom and the local community. Teacher-made simulation games are easier in terms of time saved in hunting for games that appropriate to instructional objectives, and more interesting as it is adapted to suit the needs and interest of the students. It inculcates in students that habit or skill of sorting out problems with a view to finding ways and means of solving the problems [34]. It captivates the interest of the; students and motivates them to learn, as interest is a necessary ingredient of effective learning. Also, Gao sees Social Studies deal with people in the society[25]. It helps people to understand their environment and its influence on them. It looks at people in their social and physical environment; it also examines the effects of science and technology on the social and physical environment. It is the study of people in the society with all these various aspects (social, physical, technological elements) working together, hence, should be appropriately taught.

7 CONCLUSION

From the findings of the study, it can be concluded that;

i. Students have poor attitude towards the study of social studies due to their belief or thinking that it is more of moral and religious study; basing its contents mostly on ethical and behavioural values

ii. the attitude of students towards Social Studies influences their ethical values as those who offer the subject are found to have good and strong ethical values compared to those who offer the subject with a nonchalant attitude

iii. there is a correlation between the attitudes of students towards the study of Social Studies and their ethical values.

iv. the study of social studies is influenced by several factors such as teaching method, type of instructional materials employed in teaching, societal influence, teacher-students' relationship and the level of availability and functionality of teaching materials.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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THE FACTORS INFLUENCING MIDDLE SCHOOL STUDENTS' MATHEMATICS GRADES BASED ON KERNEL REGRESSION

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Abstract: Students' math grades are often not very ideal. Due to the complexity and difficulty of mathematics, students' interest in learning is not high. Therefore, studying the factors that affect students' math grades has become an important research topic at present. This article uses the latest kernel regression models, including KLS and KRLS, to study a high school mathematics curriculum. The research results indicate that the weekly study time has a significant impact on children's academic performance; The more female, the higher the score; The educational level of parents was found to have a significant impact on children's grades through KRLS regression analysis.
Keywords: Kernel regression model; Mathematics grades; Influencing factors; Teaching quality

1 INTRODUCTION

As an important subject in high school, high school mathematics not only reflects students' academic level, but also has a profound impact on their future academic and career development. However, the abstraction and logicality of high school mathematics pose learning challenges for many students, leading to significant differences in their math grades. Therefore, exploring the factors that affect high school mathematics grades and seeking effective improvement strategies is of great significance.

In the literature on the mathematical performance of middle school students, Liu Chuangye, Dai Jinjun, Xu Zhangtao, and Peng Shuangjie focused on a series of specific cases and implemented the "one line connection" idea in university mathematics classroom teaching, connecting analysis, geometry, and algebra [1]. This approach effectively developed the professional knowledge and abilities of teacher trainees. To elevate this specific approach to a mechanism, it is necessary to vigorously develop university mathematics education research, expand the research field of mathematics education, and promote the disciplinary development of mathematics education. Li Qiuhua pointed out that the history of mathematics is a discipline that studies the origin, development, and evolution of mathematical knowledge. It covers various mathematical cultures and ideas from ancient to modern times, and its educational value cannot be ignored [2]. Zheng Xiaomei, Yao Yiling, and Lu Jijian conducted a comparative analysis of the mathematics talent education curriculum and its practices between China and the United States, exploring the problems existing in the mathematics curriculum of China's talent education and proposing the following suggestions: improving the legal policies for talent education; Overall design curriculum system; The course content returns to the mainstream of mathematics; Course development objectives should be de utilitarian; Actively carry out theoretical and practical research on the curriculum [3]. Qian Yiwen focuses on the theoretical and practical aspects of teaching reform in primary and secondary school mathematics curriculum, the theory and practice of mathematics teacher education, research on the evaluation and problem-solving of the new college entrance examination from the perspective of core competencies, research on mathematics education and teaching under the STEAM concept, and research on mathematics learning, thinking, and abilities in academic research reports [4]. Qin Desheng and Liu Pengfei have developed rich mathematical education ideas and conducted a series of innovative research based on the integration of arts and sciences [5]. Wang Limei and Song Naiqing selected 1727 CSSCI indexed papers on mathematics education research from CNKI in the past 20 years as samples, starting from the exploration of hot topics in the field of mathematics education research in China [6]. The study found that the overall development trend of mathematics education research in China has been steadily increasing despite fluctuations, with a decreasing trend in the number of publications in the past 5 years. Wang Ying and Wang Yujun proposed to establish a precise assistance mechanism for basic education mathematics teaching research at the national level to address the problem of uneven distribution [7]. In response to the problems identified through content analysis, support should be increased for research on key and difficult points in mathematics education and teaching, and a collaborative platform should be established between higher education institutions, research and management departments, and primary and secondary schools to continuously improve the quality of frontline mathematics education and teaching research. Song Yuanfeng, Ding Baoxia, Yu Xiaorui, and Li Xiuying studied the simplification of plane quadratic curve equations, the solution of cylindrical, conical, and rotating surface equations, the collinear and coplanar position relationships of vectors, and the learning methods of subspace sums for educational mathematics concepts. The methods provided are simple and easy to understand. Facilitating students' learning of relevant knowledge and enhancing their interest in learning [8]. Kong Fanzhe, Shi Ningzhong, and Zhao Xinyi creatively focus on the cultivation of students' correct values, key abilities, and essential character traits by inheriting the "Four Basics" of the "Mathematics Curriculum Standards for Compulsory Education", including basic knowledge, basic skills, basic ideas, basic activities, and experience, as well as the ability to identify, propose, analyze, and solve problems [9]. Zhu

Hua and Cao Yani focus on the development path of primary school mathematics textbooks over the past 70 years, gradually shifting from "knowledge-based" to "quality-oriented". It is not only a profound interpretation of mathematics and mathematics education by editors, but also an expansion process of mathematics education from "small" to "big" mathematics, that is, an educational process that gradually expands from learning mathematical knowledge to mathematical thinking, emotions, attitudes, spirits, etc. [10]. Sun Xinghua pointed out that mathematics education in primary and secondary schools was a key area of education reform in Ontario from 2003 to 2019. By analyzing the background of Ontario's education reform, several policy documents on mathematics education reform were introduced, including "Early Mathematics Strategies, Towards Mathematics Success, Mathematics Curriculum Standards, Focus on Mathematics Education, Revitalize Mathematics Strategies, and Focus on Mathematics Fundamentals" [11]. Li Zhuo, Yu Bo, and Zhang Yong conducted a statistical analysis of 255 doctoral dissertations in mathematics education using content analysis method. The study found that before 2002, sporadic doctoral dissertations in mathematics education were produced each year. Although the number of doctoral dissertations in mathematics education decreased in some years after 2002, it showed an overall upward trend; Suggestions are proposed from the aspects of the disciplinary status of mathematics education, the construction of doctoral programs, the research themes and methods of mathematics education [12].

2 RESEARCH METHODS AND INDICATOR SELECTION

2.1 KRLS and KLS Regression Analysis

The KRLS algorithm extends the processing capability of KLS algorithm for nonlinear data. It maps nonlinear data to a high-dimensional feature space through Mercer kernel function and converts it into a linear problem. Then, the RLS algorithm is used for linear fitting in the feature space. The mapping process of this Mercer kernel function is often referred to as the "kernel technique", which does not require explicit knowledge of the mapping form of the input sample in the feature space, but only calculates the inner product of the mapping through the Mercer kernel function. This technique uses relatively simple kernel function calculations to replace the complex calculations of mapping in high-dimensional feature spaces

Assuming the input sample is$\mathrm{u(i)}$, the input sample $\varphi\big(\mathrm{u(i)}\big)$is mapped to and simplified as in the feature space$\varphi\mathrm{(i)}$. This article uses the Gaussian kernel in the common Mercer kernel function, and its expression is

$$\mathrm{k\big(u(i)\big),\ u(j)\rangle} = \exp\left(-\frac{\|u(i)-u(j)\|^2}{2\sigma^2}\right) \tag{1}$$

Among them, $\sigma$is the width parameter of the kernel function. The meaning of the so-called "kernel technique" is the feature vector in any feature space

The inner product calculation can be replaced by kernel function calculation, that is

$$\mathrm{k\Big(u(i),\ u(j)\Big)} = \langle\varphi\mathrm{(i),\ \varphi(j)}\rangle \tag{2}$$

Among them, u $(i)$and u $(j)$are input samples, $\varphi\mathrm{(i)}$and and $\varphi\mathrm{(j)}$are their corresponding feature vectors in the feature space.

Input samples$\{u(j)\}$，$j = 1$, *2* Mapping *j* to the feature space yields$\{\varphi(j)\}, j = 1$, *2, j,* Ze Te

The cost function of RLS in the eigenspace is

$$\min_{\omega(i)} \sum_{j=1}^{i} |d(j) - \varphi(j)^T \omega(I)|^2 \tag{3}$$

Given the feature matrix, the $\emptyset\mathrm{(i)} = [\varphi(1), \ldots, \varphi\mathrm{(i)}]$, coefficient vector $\omega\mathrm{(i)}$ can be linearly represented by the mapping of input samples in the feature $\mathrm{i}\times$space as$\omega\mathrm{(i)}=\emptyset\mathrm{(i)}\alpha\mathrm{(i)}$, where the coefficient vector in the feature space $\alpha\mathrm{(i)}$is 1. Define $\mathrm{K(i)} = \emptyset\mathrm{(i)}^{\mathrm{T}}\emptyset\mathrm{(i)}$the $\mathrm{i}\times$kernel matrix of 1, which has the advantage of being able to be calculated from input samples using "kernel techniques". Obtain the new cost function of KRLS algorithm from equation (3)

$$\min_{\alpha(\mathrm{i})} \sum_{j=1}^{i} |d(j) - \varphi(j)^T \emptyset(j)\alpha(i)|^2 = \min_{\alpha(\mathrm{i})} \|\mathrm{d} - \emptyset\mathrm{(i)}^{\mathrm{T}}\emptyset\mathrm{(i)}\alpha\mathrm{(i)}\|^2 \tag{4}$$

Corresponding to the RLS algorithm, the purpose of the KRLS algorithm is to find the coefficient vector that satisfies the minimum $\alpha\mathrm{(i)}$value of the cost function (4)$\alpha\mathrm{(i)}$, and does not need to be $\alpha(\mathrm{i}-1)$recalculated with each new sample, but is calculated recursively. To avoid performing matrix inversion operations during each update, a kernel inverse matrix is defined $\mathrm{Q(i)} = \mathrm{K(i)}^{-1}$ to $\mathrm{Q(i)}$ simplify the $\mathrm{K(i)}$ complex process of recursive updating followed by matrix inversion. The cost function of equation (4) can be used to infer the iterative update expression of the KRLS algorithm. The following summarizes the basic update process of the KRLS algorithm:

(1) Map the new input sample to the feature space and calculate the inner product between the new sample and the original sample in the feature space mapping$\mathrm{h(i)}$;

(2) Calculate the prior estimation error based on the prior estimation value and the true value$\mathrm{e(i)}$;

(3) And (4), calculate the adaptive control quantity based on the kernel inverse matrix and the new input sample$\mathrm{r(i)}$;

(5) Adjust the coefficient vector of the kernel adaptive filter based on the adaptive control variable and prior error$\alpha\mathrm{(i)}$;

(6) Iteratively update the kernel inverse matrix based on the adaptive control variable.

initialization$\mathrm{Q(1)} = 1/\mathrm{k}\Big(\mathrm{u(1),\ u(1)}\Big)$，$\alpha\mathrm{(1)} = \mathrm{Q(1)d(1)}$

For loop i=2, 3

$$(1)h(i) = \left[k\left(u(i), u(1)\right), \ldots, k\left(u(i), u(i-1)\right)\right]^T$$
$$(2)e(i) = d(i) - h(i)^T\alpha(i-1)$$
$$(3)z(i) = Q(i-1)h(i)$$
$$(4)r(i) = k\left(u(i), u(i)\right) - z(i)^T h(i)$$
$$(5)\alpha(i) = \begin{bmatrix}\alpha(i-1) - z(i)r(i)^{-1}e(i) \\ r(i)^{-1}e(i)\end{bmatrix}$$
$$(6)Q(i) = r(i)^{-1}\begin{bmatrix}Q(i-1)r(i) + z(i)z(i)^T - z(i) \\ -z(i)^T \qquad\qquad 1\end{bmatrix}$$

As can be seen from the above, the $Q(i)$dimension of the kernel inverse matrix is equal to the number of input samples i. Therefore, the time and space complexity of a single update for the KRLS algorithm are both$O(i^2)$, meaning that its complexity will continuously increase with the training sample size.

2.2 Indicator System and Indicator Data

Table 1 Relevant Indicators of Mathematics Curriculum for Students in a Certain Middle School

variable	assignment
Sex - Student's gender	F=female, M=male
Age - student's age	15-22 years old
Medu - Mother's Education	0=none, 1=primary education (4th grade), 2=5-9th grade, 3=secondary education, 4=higher education
Fedu - Father's Education	0=none, 1=primary education (4th grade), 2=5-9th grade, 3=secondary education, 4=higher education
Traveltime - the time from home to school	1=<15 minutes, 2=15-30 minutes, 3=30 minutes -1 hour, 4=>1 hour
Study Time - Weekly Study Time	1=<2 hours, 2=2-5 hours, 3=5-10 hours, 4=>10 hours
Activities - Extracurricular Activities	Yes or No
Higher - Want to receive higher education	Yes or No
Famrel - Quality of Family Relationships	1=very poor, 2=poor, 3=average, 4=good, 5=very good
Freetime - free time after school	1=very few, 2=a bit few, 3=not much, not much, 4=a bit many, 5=very many
Absences - Number of absences	From 0-93
Internet - Internet access at home	(Binary: Yes or No)

Table 1 provides a brief description of the variables used in this article and their assignment methods, including continuous variables and categorical variables. Except for the student's age and absenteeism, which are continuous variables, all others are categorical variables.

3 EMPIRICAL RESEARCH

3.1 Mid Term Results of Nuclear Regression Analysis

If we use KRLS analysis to analyze gender (sex), student age (age), and mother's education (Medu) in Table 2, we found that coefficients of 0.026, 0.036, and 0.156 have a positive impact. Sex means that the more female the student, the higher the score; Age means that a student's age can affect the level of their score; Medu said that a mother's education can affect a student's personal qualities and learning attitude. A good family atmosphere can motivate students, and excessive scolding can lead to a decrease in students' interest in learning. However, according to KLS analysis, we found that coefficients of -1.080, -0.241, and -0.432 have a negative impact, meaning that the more female the math score, the lower the score; The younger the student, the lower their score, because students who are too young have less mature thinking abilities, which can affect their grades; The more excessive the mother's education interferes with students, the worse their self-care and learning abilities will be. The analysis results of the two methods are opposite and worthy of further exploration.

Table 2 Shows the Quantile Coefficient Test for Final Grades

Model	KRLS			KLS		
variable	coefficient	T value	remarkable	coefficient	Z value	remarkable
sex	0.026	0.083	0.934-	-1.080	-0.93	0.351-
age	0.036	0.459	0.647-	-0.241	-0.42	0.676-
medu	0.156	1.746	0.082*	-0.432	-0.56	0.579-
fedu	0.188	2.085	0.038*	0.854	1.05	0.293-
traveltime	-0.016	-0.108	0.914-	-0.107	-0.12	0.906-
studytime	0.301	2.671	0.008***	0.254	0.27	0.790-
activities	-0.273	-0.845	0.399-	0.163	0.69	0.889-
higher	-0.465	-1.491	0.137-	-2.093	-1.26	0.207-
internet	0.246	0.724	0.470-	0.226	0.20	0.845-
famrel	0.064	0.574	0.574-	0.310	0.27	0.786-

freetime	-0.005	-0.052	0.958-	-0.325	-0.43	0.671-
absences	-0.005	-0.441	0.659-	0.076	0.69	0.492-
Pseudo R^2						

Note: An * indicates that the p-value is less than 0.1; Two *'s indicate that the p-value is less than 0.05;
Three *'s indicate that the p-value is less than 0.01

If we analyze the father's education (Fedu) using KRLS, we find that a coefficient of 0.188 indicates a positive impact, which means that the father's education style has a significant impact on the child's grades. Specifically, a father's educational approach can affect a child's academic performance and mental health in various ways. Through KLS analysis, we found that a coefficient of 0.854 also indicates a positive impact, which means that the father's educational style directly affects the child's learning motivation and interest. If a father is too strict or uses negative evaluations when educating a child, the child may feel inferior and discouraged, thereby losing interest and motivation to learn. On the contrary, if fathers can adopt positive educational methods, encourage and support their children, they will be more willing to take the initiative to learn, thereby improving their academic performance.

If we analyze the travel time from home to school using KRLS and KLS, we find that coefficients of -0.016 and -0.107 respectively have a negative impact. This means that the travel time from home to school can affect a child's grades. If a child needs to spend a long time traveling from home to school, they may consume a lot of energy on the road, leading to decreased attention in class and affecting learning effectiveness. Children who wake up early and return late may not be able to ensure sufficient sleep time, and long-term sleep deprivation can affect their mental state and learning efficiency.

If we analyze the weekly study time using KRLS and KLS, we find that coefficients of 0.301 and 0.254 respectively have a positive effect. This means that the weekly study time has a significant impact on children's grades. Appropriate time limited learning can improve learning efficiency because children are more likely to concentrate without time pressure. Long term study will leave children with no time for proper rest and entertainment, which can lead to boredom and lack of motivation while studying. Appropriate rest and entertainment can help children relax both physically and mentally, enhance their interest in learning, and boost their self motivation.

If we analyze extracurricular activities using KRLS, we find that a coefficient of -0.273 has a negative impact. The main reasons why extracurricular activities affect children's grades include time allocation, psychological pressure, motivation, and learning efficiency. Time allocation is an important factor affecting children's grades. Extracurricular activities and studies both require students' time, and if time allocation is not reasonable, students may feel pressure between extracurricular activities and academic work, leading to a decrease in learning efficiency. However, through KLS analysis, we found that a coefficient of 0.163 indicates a positive impact. This means that students need to balance their extracurricular activities and study time to ensure that both receive sufficient attention. Proper time allocation can enable students to fully participate in extracurricular activities to develop their own qualities, while also maintaining learning efficiency, thereby improving their academic performance.

If we use KRLS and KLS analysis to study higher education, we find that coefficients of -0.465 and -2.093 respectively have a negative impact. This means that families with better economic conditions also have higher expectations for their children's education. This may be because these families can provide better educational resources and environment. Research shows that the higher parents' expectations for their children's education, the better their academic performance is usually. However, parents with high educational backgrounds may have excessively high expectations for their children, which can bring tremendous psychological pressure to them. This high-pressure environment may inhibit children's potential, causing them to lose interest and motivation in learning, thereby affecting academic performance. High expectations from the family may make children feel anxious and fearful, which in turn can affect their enthusiasm for learning and academic performance.

Using KRLS and KLS analysis, we find that the coefficients of Internet access at home and Famrel quality at home are 0.246 and 0.226, 0.064 and 0.310 respectively, which are positive effects. That is to say, home access to the Internet can positively affect children's performance, mainly by providing rich learning resources and promoting autonomous learning ability. First of all, the Internet provides children with rich learning resources. Children can learn through online education platforms, video courses, e-books, and other resources that are not only rich in content but also updated in a timely manner, meeting the learning needs of different subjects and grades. For example, children can watch video courses through online education platforms and read and learn through e-books, which can greatly enrich their knowledge reserves and enhance learning outcomes. The reason why the quality of family relationships has a positive impact on children's grades is that research has shown that in families that feel support and care from their families, the proportion of children with excellent grades is significantly higher than in other families. The democratic and negotiated parent-child interaction mode helps children's learning enthusiasm and self-management ability, thereby improving academic performance.

If KRLS and KLS are used to analyze the free time after school, we found that coefficients of -0.005 and -0.325 respectively have a negative impact on children's grades. This means that the two hours after school have a negative impact on children's grades because they have autonomy. If children do not plan properly, they can easily waste time on entertainment activities such as watching TV and playing mobile phones, resulting in reduced learning time and low learning efficiency.

If we analyze absenteeism using KRLS, we find that the coefficient of -0.005 has a negative impact, which means that absenteeism negatively affects children's grades. The main reason for this is that the child's learning progress is

hindered. If the child is frequently absent, they will miss key information such as the teacher's lecture focus, resulting in hindered learning progress and difficulty keeping up with the pace of the course.

Table 3 shows the quantile coefficient test for final grades

Model		KRLS			KLS	
variable	coefficient	T value	remarkable	coefficient	Z value	remarkable
sex	-0.958	-1.889	0.606-	-1.727	-1.12	0.265-
age	-0.268	-2.271	0.024**	-1.126	0.317	0.317-
medu	0.270	2.004	0.046**	0.660	0.52	0.602-
fedu	0.126	0.929	0.353-	0.426	0.35	0.725-
traveltime	-0.214	-0.954	0.341-	-0.567	-0.44	0.658-
studytime	0.299	1.783	0.076*	0.781	0.53	0.596-
activities	0.271	0.513	0.609-	2.195	1.55	0.122-
higher	-0.714	-1.529	0.127-	-4.954	-1.82	0.068*
internet	0.242	0.439	0.661-	0.259	0.14	0.891-
famrel	0.258	1.536	0.125-	-0.113	-0.07	0.947-
freetime	-0.031	-0.207	0.836-	0.145	0.14	0.891-
absences	0.034	1.870	0.062*	0.178	0.95	0.344-
Pseudo R^2						

Note: An * indicates that the p-value is less than 0.1; Two *'s indicate that the p-value is less than 0.05;
Three *'s indicate that the p-value is less than 0.01

3.2 Final Score of Nuclear Regression Analysis

If we analyze gender (sex) and student age (age) in Table 3 using KRLS and KLS, we find that coefficients of -0.958, -1.727, and -0.268, -1.126 respectively have a negative impact. The negative impact of sex means that the higher the female score, the lower the score. This is because in some social and cultural environments, there is a traditional role positioning of women, believing that women have weaker abilities in certain subject areas. This concept can affect women's self-awareness and learning motivation, leading to some women subconsciously having lower academic expectations, which to some extent affects their final grades. The negative impact of age refers to the fact that students of different age groups have different levels of cognitive development. The younger the students, the harder it is for them to keep up with their academic performance. This is because the thinking and reasoning abilities of low-level students are not yet fully mature, making it difficult for them to understand and master complex subject knowledge. Additionally, younger students have weaker self-control and lack effective learning strategies, resulting in lower learning efficiency and ultimately affecting their final grades.

If we analyze the mother's education (medu) and father's education (fedu) using KRLS and KLS, we find that coefficients of 0.270, 0.660, and 0.126, 0.426, respectively, have a positive impact. This means that both mother's education and father's education are important and have a significant impact on students. This is because well-educated parents can create a good family environment and resources for their children, cultivate a strong learning atmosphere at home, and cultivate their children's interest and habits in learning. At the same time, they also have reasonable and high expectations for their children's academic performance and future development. This expectation will be transformed into encouragement and support for their children, motivate them to study hard, facilitate their academic development, and thus affect students' final grades. Grades.

If we analyze the travel time from home to school using KRLS and KLS, we find that coefficients of -0.214 and -0.567 respectively have a negative impact. This is because the long travel time from home to school reduces the effective time available for students to study. If a student spends two hours commuting to and from school every day, while another student only needs half an hour, the former will spend much less time on learning than the latter. Over time, the gap in learning effectiveness may gradually become apparent, thereby affecting final grades.

If we analyze the weekly study time and extracurricular activities using KRLS and KLS, we find that coefficients of 0.299 and 0.781, and 0.271 and 2.195, respectively, have a positive impact. This means that both the weekly study time and extracurricular activities are important for students, and an increase in weekly study time helps to consolidate the knowledge they have learned. The more time students set aside to consolidate their studies every week, the better their grades will be compared to those who do not set aside a fixed amount of time to study. Their learning ability and self-control will also be stronger because memory requires continuous repetition and consolidation to be maintained in the long run. Sufficient study time every week can lead to qualitative changes over time. At the end of the term, quantitative changes can cause qualitative changes. The grades will improve. Extracurricular time allows students to arrange themselves, read professional books and literature, delve into knowledge not covered in the classroom, expand their knowledge base, and also engage in physical activities to relieve stress, maintain a good attitude, improve learning and efficiency, and help achieve better grades.

If we analyze higher education using KRLS and KLS, we find that coefficients of -0.714 and -4.954 respectively have a negative impact, due to economic cost factors and socio-cultural environmental factors. Higher education requires paying tuition fees, accommodation fees, textbook fees, etc., leading to an increase in economic costs. For some families with poor economic conditions, these costs can become a heavy burden, leading to a negative impact on their

willingness to receive higher education and a decrease in academic performance. In the social environment, there are beliefs such as the "uselessness of reading" that believe the chances of success through higher education are not greater than entering society early, which leads to a lack of enthusiasm for higher education among some people.

Using KRLS and KLS to analyze Internet access at home, we find that the coefficients of 0.242 and 0.259 are both positive, because there are massive learning resources on the Internet. Students can easily access various learning materials through the engine at home, broaden learning channels, enrich learning resources, and let students access more cutting-edge knowledge. The Internet also provides a variety of interactive learning tools, which can allow students to share learning experience and experience with each other, so as to improve their performance.

If we analyze the quality of family relationships (famrel) using KRLS, we find that the coefficient is 0.258, indicating a positive impact. This means that good family relationships can provide students with rich emotional support. Students who grow up in such a family environment will have a more positive and optimistic attitude, and their emotions will be more stable, leading to greater confidence in learning and life. However, using KLS analysis, it was found that a coefficient of -0.113 has a negative impact. This means that in some family relationships, parents have high expectations for their children's academic performance, overly focusing on grades and neglecting their physical and mental health. This can cause significant psychological pressure on children, leading to dispersed learning energy and a decline in grades. The two analysis results are opposite and deserve further exploration.

If we analyze the free time after school using KRLS, we find that the coefficient is -0.031, which has a negative impact. This may be because students have too much free time after school, and they may lack timely learning arrangements, which leads to an increase in forgetting and affects their grades. However, using KLS analysis, it was found that a coefficient of 0.145 has a positive impact. This means that if the free time after school is arranged reasonably, students can have the opportunity to participate in various interest classes and learn new skills independently. They can also use their free time to review and preview, better grasp the knowledge learned in class, and thus improve overall academic performance.

If we analyze absenteeism using KRLS and KLS, we find that the coefficients are 0.034 and 0.178, respectively, both of which have a positive impact. In fact, absenteeism has a certain influence in both positive and negative directions, because sometimes students may be absent due to physical discomfort or family matters, but excessive absenteeism can lead to students' grades not keeping up, thereby affecting their grades and causing a decline.

From the comprehensive analysis of Table 1 and Table 2, we can see that there are three significant factors in Table 1 (mid-term grades) and four significant factors in Table 2 (final grades) through data analysis. Comparing the significance of the two tables, it indicates that the overall grades of students do not show a clear level of achievement during mid-term exams, and the time from the beginning of the semester to the end of the semester is relatively short, so the significance is not high. But from the beginning to the end of the semester, the time is relatively long, the learning time is getting longer, and the knowledge reserve is constantly increasing. Learning is cumulative, and new knowledge is often built on the basis of old knowledge. Previous learning outcomes promote subsequent learning, forming a compound interest effect, which leads to a significant improvement in grades at the end of the semester.

4 RESEARCH CONCLUSION AND COUNTERMEASURES SUGGESTIONS

This article comprehensively uses kernel regression method to compare and analyze the changes in mid-term and final grades of students in a certain middle school. The analysis results lead to the following conclusions: Firstly, in the analysis data of mid-term grades, students' weekly learning is particularly important and the most significant feature in the entire data, indicating a positive impact. This suggests that the reasonable arrangement of weekly learning time can fully mobilize students' enthusiasm and thus affect their grades. In the analysis data of the final grades, the education of the father and mother is the most significant feature, which indicates that the education of the father and mother has a great impact on the entire growth and development of students. Excellent family education will cultivate children who are more proactive and goal oriented. Secondly, parental education is comprehensive. It covers multiple important areas such as lifestyle habits, moral cultivation, and learning attitudes. In terms of moral cultivation, teach children qualities such as honesty and friendliness; For learning, parents will cultivate their children's curiosity about knowledge and good study habits, which will run through their entire student life.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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A CRITICAL INTEGRATION OF MACHINE TRANSLATION INTO TRANSLATION TEACHING FOR NON-ENGLISH MAJORS IN CHINA

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Abstract: Non-English major students often exhibit uneven language proficiency, with a significant portion demonstrating below-average language skills. This characteristic leads to low motivation when faced with traditional translation tasks, resulting in poor translation quality. By integrating machine translation tools into teaching, it is possible to effectively bridge the gap between learners of varying language proficiency levels, enhancing their confidence and interest in translation. This study develops a set of post-editing guidelines for Chinese-to-English machine translation based on linguistic differences between Chinese and English. The guide is used to instruct students in post-editing tasks, reinforcing their skills in error identification and correction, and specifically training them to construct well-formed English sentences. This approach aims to improve learners' translation abilities and promote personalized autonomous learning.
Keywords: Machine translation; Non-English majors; Translation teaching; Post-editing

1 INTRODUCTION

China's higher education is entering a new era of digital humanity, where innovative language intelligence tools are being integrated into language study. This evolution has naturally intertwined translation with technology. Driven by the continuous advancements in artificial intelligence, mobile technology, and the internet, both accessibility and quality of machine translation has significantly improved, which promotes machine translation's prevalent use in educational settings. This trend has expanded translation competence beyond linguistic skills to include the ability to produce translated output rapidly and select translations confidently by effectively using machine translation tools. Translation teaching needs to evolve with technological advancements to address the challenges posed by those language intelligence tools. English translation courses for non-English majors, with their broad reach, play a crucial role in enhancing students' abilities to share Chinese stories, communicate professional information, and accelerate scientific innovation. In the era of digital humanities, the integration of new technologies to enhance language skill training and empower learners to improve their translation abilities has become an essential focus in university English translation teaching.

2 LITERATURE REVIEW

Research on machine translation in education primarily explores its use in assisting L2 writing and translation teaching, with focus on post-editing strategies developed based on common machine translation errors.

2.1 Machine Translation in Writing Instruction

Pre-editing was used creatively in writing classes through writing in the MT system and then editing the source text until the target text is in good condition. Shei [1] explored pre-editing by having students write in English or Chinese using machine translation in different cases, then adjusted their texts based on the Chinese or English output's alignment with their intentions until satisfactory English translations were obtained. Experiment reports and feedback were analyzed, showing that pre-editing enhances learning in cognitive and affective domains and trains students in using MT systems. Most studies, however, focus on post-editing. Niño [2] identified four educational uses of machine translation, emphasizing its role as an error source to enhance grammatical awareness and language skills through error identification and correction. Tsai[3] suggested that machine translation aids intermediate learners by increasing content exchange and improving lexical density and writing quality. Xu [4] found that machine translation enhances vocabulary and grammar learning, writing quality, and confidence in using a second language, fostering autonomous learning.

2.2 Machine Translation in Translation Instruction

Translation class activities of post-editing usually involve two core elements: (1) running texts into MT system; (2) identifying and correcting errors in MT raw outputs. Kliffer[5] analyzed translation errors, comparing machine translation, human translation, and post-editing, revealing that machine translation aids in improving text quality and understanding translation's essence. Post-editing allows students understand the challenges machine translation faces,

such as syntactic and lexical ambiguities and cultural nuances. Similarly, studies by Lee & Liao[6] indicate that post-editing improves text quality, language awareness, and confidence, narrowing proficiency gaps, especially when translating from L1 to L2. Yamada[7] examined students' ability to post-edit, finding it requires cognitive effort akin to human translation, and error correction training is essential. As machine translation quality improves, Yamada [8] pointed out that "NMT post-editing may be challenging for language learners".

Both pre-editing and post-editing were incorporated into teaching by Rico et al. [9]. They experimented with integrating pre-editing and post-editing in teaching and proposed pre-editing and post-editing suggestions for educational use. Bowker and Ciro [10] explored pre-editing and post-editing from an academic perspective, proposing a feasible definition and training framework for machine translation literacy. Similarly, Guo and Wang[11] examined the role of pre-editing and post-editing in enhancing text quality through error annotation, exploring human-assisted machine translation teaching. Qiu et al. [12] developed a fine-grained English-Chinese translation error corpus, identifying common error categories such as word choice, omissions, additions, named entities and word order with varying editing work load for different types of errors, providing insights for targeted teaching. Meanwhile, translation technology education is becoming integral to translation curricula, with researchers proposing modules and models for translation technology courses, offering MOOCs like "Computer-Assisted Translation" and "Academic Reading and Machine-Assisted Chinese-English Translation," demonstrating pre-editing and post-editing skills. Hu and Tian [13] advocated for language intelligence courses in MTI programs to enhance skills in machine translation evaluation, pre-editing, and language refinement.

These studies, examining translation error analysis, language acquisition, syntax processing, language linkage, and translation quality, demonstrate that machine translation post-editing helps students improve text quality, better hand syntactic and lexical ambiguities and cultural nuances, enhance language awareness and confidence, and narrow the gap between students of different proficiency levels. While these studies highlight machine translation's benefits in language learning and communication, most focus on translation majors or MTI students, which does not align with the reality that machine translation has expanded from expert literacy to everyday literacy. What's more, existing research at home and abroad rarely studies the application of machine translation in foreign language teaching from the perspective of language proficiency improvement, with some studies only involving the results of a single machine translation application, which hardly helps language proficiency development. To address these issues, this paper proposes an innovative model integrating machine translation into university English translation teaching, tailored to non-English majors' language characteristics and learning goals, exploring new paths for enhancing translation skills.

3 DEVELOPING A MACHINE TRANSLATION-INTEGRATED UNIVERSITY ENGLISH TRANSLATION TEACHING MODEL

3.1 Characteristics of Non-English Major Learners

College English classes target non-English major students who generally have uneven language ability development. According to the description of China's Standards of English Language Ability (CSE), their language proficiency roughly corresponds to the intermediate level (B1) of Common European Framework of Reference for Languages (CEFR). Their generally below-average proficiency leads to low motivation and unsatisfactory translation output in traditional tasks. Machine translation, now matching or surpassing intermediate learners, can bridge proficiency gaps, boost confidence, and spark interest in translation by assisting teaching.

According to Ma [14], the main language ability shortcomings in Chinese learners' translation ability development are: collocation ability, sentence writing ability, and discourse ability. For non-English majors, with machine translation already excelling in vocabulary selection, focusing on sentence construction training can efficiently improve their bilingual communication ability.

3.2 Post-Editing in University English Translation Teaching

3.2.1 Chinese-to-English post-editing guidelines

Post-editing involves the editing, modification, and polishing of machine translation output through error identification and correction, which enhances grammatical awareness and language proficiency. Generally speaking, translation errors are categorized into speech and accuracy errors, with common issues in Chinese-English translation involving polysemy, terminology, pronouns, named entities, particles, quantifiers, omissions, and word order. Given neural machine translation's high quality, students may struggle with error correction, necessitating guidelines to aid in identifying and correcting errors. Currently, publicly available post-editing principles are mainly for commercial purposes, such as the TAUS [15] guidelines. Based on the analysis of Chinese-English machine translation language characteristics, this study proposes the following Chinese-to-English post-editing principles for teaching: (1) converting Chinese linear structures to English hierarchical structures; (2) transforming secondary verbs in multi-verb Chinese sentences to non-predicative forms; (3) converting active to passive voice based on content; (4) converting preposed adverbials to postposed adverbials based on expression; (5) reducing modifiers for plurality and time.

3.2.2 Design of teaching activities

The instruction scheme include the following parts: (1) Warm-up Activity. Have students share machine translated sentence to discuss machine translation's strengths and weaknesses. (2) Translation Practice Activity. Students undergo four steps in this process, involving parallel text learning, human translation, post-editing, and reflection, aiming to train

students' language ability and their ability to quickly generate text and make choices among different translations. In this phase, after a 10-minute timed translation exercise, students modify their translations based on provided machine translation texts and continue completing unfinished parts of the human translation in a post-editing manner. The training mainly focuses on sentences with Chinese parataxis structures, often problematic in machine translation, to provide ample error correction practice. Machine translation serves as peer feedback, offering language comparison and improvement suggestions. (3) Discussion. Students discuss machine translation problems with each other, cultivating critical thinking. (4) Reflection. Organize language and cultural insights from translation comparisons, reflecting on human and machine translation issues. See Table 1 for details.

Table 1 Design of Teaching Activities

Steps	Main Objectives	Key Points
Warm-up	Discuss advantages and potential drawbacks of MT	Share translation of self-selected sentences using MT
Translation	Train language ability, quick text generation, and decision-making	Training through parallel text learning, human translation, post-editing, and human-machine collaboration
Discussion	Train critical thinking skills	Discuss problems in machine-translated texts
Reflection	Reflect on language and cultural knowledge, translation techniques	Summarize language and cultural knowledge points

4 CONCLUSION

Current college English translation teaching overly emphasizes language skills, reducing translation teaching to language instruction, with theory and practice often disconnected, leading to low student engagement. This paper expands traditional translation contents and addresses the use of free online MT in translation teaching for non-English majors in China by positioning machine translation tools as cognitive and motivational aids. In this study, we first reviewed the previous studies on the use of MT in education settings. Inspired by their positive results, we propose a teaching design focusing the procedure of performing PE to integrate MT into translation class for non-English majors in China. By implementing machine translation post-editing activities, developing pedagogical post-editing guidelines, new paths for skill enhancement are explored to innovate non-English major translation teaching by integrating information technology with curricula. The application of technological tools to support translation teaching offers learners novel, convenient support for critical thinking and translation quality improvement, guiding learners to adapt to a language life co-constructed by human and machine.

COMPETING INTERESTS

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MATHEMATICS IN M.C. ESCHER'S GALLERY

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Abstract: M.C. Escher, a Dutch graphic artist, is renowned for his masterful integration of mathematical concepts into his art. His work, particularly the piece *Gallery* exemplifies the seamless blend of art and mathematics, showcasing the beauty and complexity inherent in both fields. This paper delves into the mathematical structures underlying Escher's *Gallery* exploring the principles of complex transformations and wallpaper groups. By analyzing these elements, we aim to uncover the profound connections between art and mathematics, and how Escher's work challenges our perception of reality.
Keywords: M.C. Escher; Complex transformation; Wallpaper Group; Symmetry; Spiral; Infinity

1 INTRODUCTION

M.C. Escher, born in 1898, was a Dutch graphic artist whose work has left an indelible mark on both the art and mathematics communities, and has become a symbol of the intersection of these two seemingly separate fields. His unique ability to incorporate mathematical principles into his art has fascinated scholars and enthusiasts alike for decades. Escher's journey began with a passion for drawing and a keen interest in the natural world, which led him to explore the intricate patterns and shapes found in nature, such as the Fibonacci sequence, tessellations, and the golden ratio. Throughout his career, Escher created numerous works that showcased his mastery of the art of visual illusion and mathematical concepts. Among his most iconic works is *Gallery* (1957), a visual exploration of space, symmetry, and infinity. Through meticulous planning and execution, Escher created a self-referential artwork that blurs the lines between reality and illusion, inviting viewers to ponder the nature of perception and human experience [1].
Escher's spiral designs are another prominent feature of his work, demonstrating his deep understanding of mathematical concepts such as rotation and reflection. These designs often feature intricate patterns that seem to endlessly spiral outward or inward, captivating the viewer with their beauty and complexity. Escher's exploration of spirals in his art not only showcases his artistic talent but also his fascination with the mathematical properties of these forms. In addition to his renowned spiral designs, Escher also delved into the world of wallpaper group designs. These patterns are created by repeating geometric shapes in a specific arrangement, resulting in visually striking and intricate designs. Escher's exploration of wallpaper group designs demonstrates his ability to combine art and mathematics, creating visually appealing works that also possess deep mathematical significance [2-3].
Escher's work has had a profound impact on both the art and mathematics communities, inspiring generations of artists and mathematicians to explore the intersections between these fields. His unique approach to art, which combines mathematical principles with visually stunning and thought-provoking designs, has made his work a lasting influence on the creative landscape. In contemporary culture, Escher's influence extends far beyond the art world, with his designs and concepts being applied in various fields such as architecture, design, and even technology. For example, the intricate patterns and structures found in Escher's work have inspired the design of modern buildings and public spaces, while his exploration of self-referential artwork has contributed to the development of artificial intelligence and virtual reality technologies.
M.C. Escher's life and work have left a legacy on both the art and mathematics communities. His innovative approach to combining mathematical principles with art has resulted in iconic works like *Gallery*, and his exploration of spiral designs and wallpaper group designs has captivated and inspired generations. Escher's impact extends beyond the art world, with his designs and concepts influencing various fields and continuing to be a source of fascination and inspiration for many [4].
Inspired by *Gallery*, in this paper we first analyze its structure. Then, we establish an automatic method to create Escher-like spiral patterns like *Gallery*, which can be used in decorative fields.

2 MATHEMATICAL STRUCTURE OF GALLERY

M.C. Escher's *Gallery* [4] is an iconic lithograph that exemplifies the artist's mastery of visual illusion and mathematical concepts. Created in 1956, this artwork features a complex, self-referential scene that invites viewers to ponder the nature of perception and human experience. In *Gallery* Escher depicts a gallery of paintings that appears to be tilting forward, with the viewer standing at the bottom looking up. The ceiling of the gallery is a series of angled arches, and the floor appears to be a grid pattern that extends into the distance. The most striking feature of the artwork is the presence of a small figure in the lower left corner, who is looking through a spyglass at a painting that is hanging on the wall in the upper right corner. This painting, in turn, depicts the gallery from an elevated perspective, with the same figure standing in the lower left corner, holding the spyglass.

The self-referential nature of *Gallery* creates a sense of infinite recursion, as the viewer is constantly drawn back and forth between the two-dimensional surface of the lithograph and the three-dimensional space depicted within it. This visual exploration of space, symmetry, and infinity is a testament to Escher's deep understanding of mathematical concepts and his ability to incorporate them into his art.

One of the key mathematical principles at play in *Gallery* is the concept of projective geometry, which deals with the relationship between points, lines, and planes in space. Escher's use of angled arches and a grid-patterned floor creates a sense of depth and perspective, while the self-referential nature of the artwork challenges our understanding of reality and illusion. Another mathematical concept that Escher explores in *Gallery* is the idea of tessellation, or the repetition of geometric shapes to create a pattern that covers a surface without gaps or overlaps. The grid-patterned floor and the angled arches of the ceiling can be seen as tessellations, while the overall composition of the artwork can be viewed as a complex tessellation of shapes and spaces [5-6].

Overall, M.C. Escher's *Gallery* is a masterpiece of visual art that combines mathematical principles with artistic innovation to create a work that is both aesthetically pleasing and intellectually stimulating. Its impact on both the art and mathematics communities has been profound, inspiring generations of artists and mathematicians to explore the intersections between these fields and to push the boundaries of what is possible in both domains.

3 GRIDS AND COMPLEX PERIODICITY IN GALLERY

At the heart of M.C. Escher's *Gallery* lies the ingenious Escher grid, a sophisticated method that enables the creation of an illusion of an infinite loop, where the boundaries between reality and illusion blur seamlessly. This grid serves as the foundational structure upon which Escher builds his intricate visual masterpiece, demonstrating his profound understanding of both mathematics and art.

The Escher grid is a remarkable hybrid of linear and curvilinear worlds, where complex transformations occur in a manner that preserves the integrity and coherence of the image. In the linear world, Escher employs a meticulous approach to each rotation and scaling operation, ensuring that the transitions between different elements of the artwork are continuous and harmonious. This precision allows the viewer to perceive the artwork as a cohesive whole, despite the intricate and seemingly paradoxical nature of its construction. To achieve the desired effect of an infinite loop, Escher employed a technique involving arc-shaped grids, which distinguishes his work from more conventional grid systems. Unlike straight grids, which can become rigid and unnatural during transformation, arc-shaped images allow for smooth bending and expansion. This flexibility ensures that the image remains fluid and organic, even as it undergoes complex transformations that would typically result in distortion or loss of coherence.

The concept of complex periodicity is central to understanding *Gallery*. A complex period γ is defined as a value that, when applied repeatedly, results in the original image. In Escher's work, this periodicity is achieved through a combination of rotations and scaling. Let g be a function defined on the complex plane C, taking values in {black, white}. For every point $z \in C$, the color assigned to z is g(z). Since *Gallery* is a periodic image with period γ, we have

$$g(\omega)=g(\gamma\omega).$$

To find the relationship between the rotation factor of 256 and the rotation period γ, Escher introduced a scalar α on the complex plane C*. By mapping the line graph back to a dual-periodic graph using the exponential function, Escher was able to create a new image that remains invariant under translation

$$L_{256} = Z2\pi i + Zlog256.$$

This approach shows Escher's deep understanding of complex analysis and his ability to apply mathematical concepts to create visually stunning artwork. The use of complex periodicity and dual-periodic graphs not only adds to the aesthetic appeal of *Gallery* but also highlights the intricate connections between mathematics and art. Moreover, the Escher grid serves as a powerful tool for exploring the relationship between mathematics and art. Through his use of this grid, Escher demonstrates how mathematical concepts can be employed to create visually appealing and conceptually rich artworks. This has had a lasting impact on both the art and mathematics communities, inspiring generations of artists and mathematicians to explore the intersections between these fields and to push the boundaries of what is possible in both domains. In Fig 1, we show the process of grid construction used in creating *Gallery* [1].

Escher grid and the concept of complex periodicity are critical components of M.C. Escher's *Gallery* enabling the creation of an illusion of an infinite loop that captivates and intrigues viewers. His innovative use of mathematical principles and artistic techniques showcases his mastery of both disciplines, making *Gallery* a timeless masterpiece that continues to inspire and challenge us today.

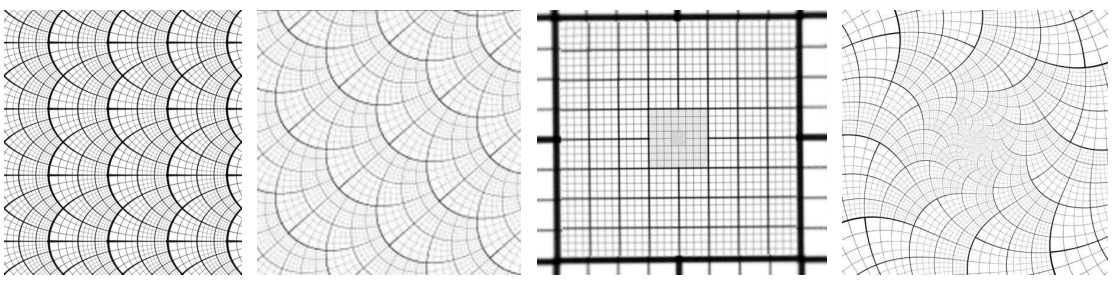

Figure 1 Left to Right: The Four Construction Steps of the Conformal Grids Used in *Gallery*

4 CONFORMAL MAPPING AND WALLPAPER GROUP IN GALLERY

Conformal mapping[7-8], a mathematical technique that preserves angles locally, plays a pivotal role in the creation of M.C. Escher's masterpieces, including *Gallery*. By mapping the plane onto the complex plane and applying conformal transformations, Escher was able to fashion images that are not only mathematically rigorous but also possess a remarkable aesthetic appeal. In *Gallery* Escher's use of conformal mapping is particularly noteworthy, as it ensures that the angles between curves remain unchanged, even as the shapes themselves undergo intricate transformations. This property is crucial for maintaining the illusion of continuity and coherence throughout the artwork, allowing viewers to perceive complex patterns and structures as if they were part of a single, cohesive whole.

Figure 2 Left to Right: Basic Wallpaper Pattern, Spiral Pattern Similar to *Gallery*, and Spiral Pattern with more Intense Spiral Scale

Wallpaper groups [9-11], also known as plane crystallographic groups or plane symmetry groups, are mathematical structures that describe the symmetries of patterns that repeat infinitely in two dimensions. These groups consist of combinations of translations, rotations, reflections, and glide reflections, and they play a significant role in Escher's work. In *Gallery* Escher employs several wallpaper group symmetries to create a sense of depth and complexity that is both visually striking and mathematically precise. The primary symmetries used are translations and rotations, which work in harmony to produce a composition that is both stunning and meticulously crafted. Fig 2 shows two spiral patterns like *Gallery* and the wallpaper motif used.

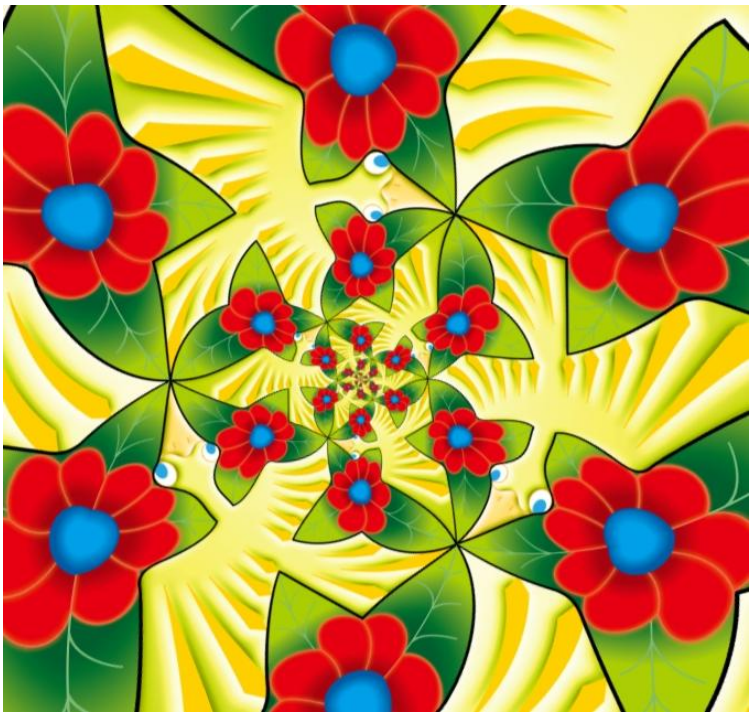

Figure 3 Flower-Bird Spiral Pattern Similar to *Gallery*

Translations involve shifting the entire pattern by a fixed vector, and in *Gallery*, they are employed to create the illusion of an endless corridor. Repeated motifs of doors and windows appear at regular intervals, creating a sense of movement and continuity that draws the viewer into the artwork. This use of translation symmetry not only enhances the visual appeal of the piece but also reinforces the illusion of an infinite loop that is characteristic of Escher's style. Rotations

involve rotating the pattern around a central point, and in *Gallery*, Escher uses rotations to introduce a sense of dynamism and symmetry into the composition. Certain elements within the image rotate around specific points, creating a harmonious and balanced arrangement that is both pleasing to the eye and mathematically sound. In Figs 3-4, based on the method introduced, we display show two Escher-like patterns similar to *Gallery*.

The combination of conformal mapping and wallpaper group symmetries in *Gallery* showcases Escher's deep understanding of mathematical principles and his ability to apply them to create visually stunning artworks [12]. This fusion of art and mathematics is a hallmark of Escher's style and has had a lasting impact on both fields, inspiring generations of artists and mathematicians to explore the intersections between these disciplines. Moreover, the use of these mathematical techniques in *Gallery* serves as a powerful testament to the potential for art to convey complex ideas and concepts in a way that is accessible and engaging to a wide audience. Escher's ability to blend mathematical rigor with artistic innovation has made his work a timeless classic that continues to resonate with viewers today.

Figure 4 Flower Spiral Pattern Similar to *Gallery*

Conformal mapping and wallpaper group symmetries are essential components of M.C. Escher's *Gallery* enabling the creation of an artwork that is both mathematically sophisticated and aesthetically captivating. The innovative use of these mathematical techniques showcases Escher's mastery of both disciplines and serves as an enduring example of the potential for art to inspire and challenge our understanding of the world around us.

5 CONCLUSION

M.C. Escher's *Gallery* is a masterpiece that beautifully illustrates the intersection of art and mathematics. Using complex transformations and wallpaper group symmetries, Escher created a work of art that challenges our perception of reality and invites us to explore the hidden beauty of the mathematical world. M.C. Escher's work transcends mere displays of mathematical prowess; it represents a profound creative exploration of the intricate relationship between art and mathematics. By skillfully incorporating complex transformations and wallpaper group symmetries, Escher was able to craft images that are not only visually stunning but also intellectually stimulating, inviting viewers to delve into the layers of meaning and mathematical elegance embedded within his creations.

One of the most captivating and striking features of *the Gallery* is the so-called *Bird Effect*, where birds appear to transform seamlessly into flowers as they move through the image. This remarkable effect is achieved through a sophisticated combination of rotations, scalings, and translations, which collectively create a sense of metamorphosis and continuity that is both enchanting and thought-provoking. The bird-to-flower transformation is not merely a visual trick but a testament to Escher's ability to harness mathematical principles to serve his artistic vision, resulting in an image that challenges our perceptions and invites us to explore the boundaries of what is possible in the realm of visual representation.

In addition to the *Bird Effect*, *Gallery* is adorned with intricate patterns of flowers and leaves that further exemplify Escher's mastery of mathematical principles in art. These patterns are meticulously created using similar mathematical concepts, with each element strategically positioned to maintain the overall symmetry and coherence of the image. The careful arrangement of these elements not only enhances the aesthetic appeal of the artwork but also reinforces the underlying mathematical structure, creating a harmonious balance between form and content. Escher's use of complex transformations and wallpaper group symmetries in *Gallery* goes beyond mere technical proficiency; it reflects a deep

philosophical inquiry into the nature of reality and the ways in which we perceive and interpret the world around us. By pushing the boundaries of traditional artistic techniques and mathematical applications, Escher invites viewers to reconsider their understanding of space, form, and the interplay between the two.

Escher's work serves as a bridge between the worlds of art and mathematics, demonstrating that these two seemingly distinct fields can intersect in profound and meaningful ways. His creations inspire artists to explore mathematical concepts as a source of inspiration and creativity, while also encouraging mathematicians to seek out the aesthetic beauty inherent in their work. In essence, M.C. Escher's *Gallery* stands as a testament to the power of creative exploration and the unifying force of mathematical principles in art. It is a work that not only dazzles the eye but also stimulates the mind, inviting viewers to embark on a journey of discovery and appreciation for the intricate dance between art and mathematics. Moreover, the enduring legacy of Escher's work lies in its ability to transcend time and cultural boundaries, speaking to a universal human desire to understand and appreciate the beauty and complexity of the world around us. *Gallery*, with its rich tapestry of mathematical concepts and artistic innovation, remains a timeless masterpiece that continues to captivate and inspire generations of viewers, offering endless possibilities for exploration, interpretation, and admiration. Escher's legacy is not just in his art; it is in his ability to inspire us to see the world through a different lens. By blending art and mathematics, Escher showed us that these two fields are not only related but also complementary. His work continues to inspire artists, mathematicians, and scientists, encouraging us to explore the endless possibilities that lie at the intersection of these disciplines.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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APPROPRIATE INTEGRATION: CHINA'S "LEARNING IN REGULAR CLASSES" POLICY

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Abstract: This review examines China's "Learning in Regular Classes" policy, aimed at integrating children with special needs, particularly those with hearing impairments, into mainstream education. The study utilizes policy analysis and literature review methodologies to assess the alignment of the policy with the ideals of appropriate integration. Findings indicate that while the policy reflects an intent towards inclusivity, there are significant gaps in implementation, especially in effectively integrating students with hearing impairments. These gaps are attributed to inadequate support systems, lack of specialized training for teachers, and insufficient adaptations within mainstream environments. The review calls for a reevaluation of the policy to address these disparities, ensuring a truly inclusive educational framework.
Keywords: Learning in regular classes; Hearing impaired children; Appropriate integration

1 INTRODUCTION

Education is a fundamental right of every citizen regardless of their social class, race, beliefs, or physical and mental differences." [1]. In June 1994, the United Nations Educational, Scientific and Cultural Organization (UNESCO) passed the Salamanca Statement and Framework for Action on Special Needs Education. The declaration stated that children with special educational needs should be accommodated in inclusive schools that can meet their needs and use child-centred teaching methods to provide learning support (European Agency for Special Needs and Inclusive Education, 2020). With the actions of UNESCO, the concept of inclusive education has become a global policy vision [2].

The education philosophy advocated by inclusive education, which includes zero rejection, creating an environment that enables success for all children, inclusiveness, equity, and respecting the diverse learning needs of each student, has greatly promoted the renewal and transformation of traditional education. In China, the policy of Learning in Regular Class has been the main approach to implementing inclusive education. Since the late 1980s, Learning in Regular Classes has always played a primary role in accommodating and educating children with special needs [3]. In the 1990s, the scale of special education expanded rapidly, playing a decisive role in improving the enrollment rate of compulsory education for children and adolescents with disabilities .The policy of Learning in Regular Classes is the localized development trend of international inclusive education (European Agency for Special Needs and Inclusive Education, 2020), reflecting the theoretical and practical paradigm of inclusive education with Chinese characteristics.

Since the 21st century, Learning in Regular Classes has been written into newly revised laws and regulations such as the *Compulsory Education Law*, the *Law on the Protection of Persons with Disabilities*, and the *Regulations on the Education of Persons with Disabilities*, significantly enhancing its legal status and expanding its scope from compulsory education to the entire education system [4]. special education topic assessment report issued by National Medium and Long-term Education Reform and Development Plan Outline (2010-2020) shows that the quality of Learning in Regular Classes is worrisome, especially in the integration of students with hearing impairments, where many problems exist [5]. This is mainly manifested in the physical mixing characteristics of "attending classes without participating" or "mixing without integrating." As students with hearing impairments progress through grades, they continuously "return" from regular schools to special education schools .According to the results of the Basic Statistics on Education Development by the Ministry of Education of China [6], the proportion of students included in regular classrooms dropped from 69.86% in 2001 to 49.47% in 2020. The frequent questioning of teaching quality in inclusion in regular classrooms and the phenomenon of returning, as well as the reasons behind it, have attracted the attention of scholars. Several scholars have pointed out that the difficulty in ensuring integration at the social and teaching levels is the main reason for the return of students with hearing impairments [7]. The overall development of inclusive education in China is facing the dilemma of bridging theory with practice, balancing equity with efficiency, and balancing commonality with individuality. "The effect of Learning in Regular Classes has lost the original intention of inclusive education" . In this paper, I attempt to whether the policy Learning in Regular Classes reflects appropriate integrated education for children with hearing impairments in China by highlighting the individual and social models of disability in an inclusive educational environment. This paper also aims to provide valuable suggestions for the theoretical development of inclusive education in China by integrating the advantages and reasonable components of various disability models.

2 CONCEPTUAL DEFINITION

2.1 Inclusive Education and Related Policies

Learning in the Regular Classes refers to a method of integrating capable special students into mainstream education, an important form of placing special students for education in China, and a key means to achieve inclusive education [8]. According to the definition by the Organization for Economic Co-operation and Development (OECD), we, in this paper, refer to "children with special education needs" as an umbrella term for special students. Special students are those who require additional resources or practices to ensure they have equal opportunities to learn alongside their non-disabled peers. This term encompasses children with disabilities, children with learning difficulties, and children living under disadvantaged conditions.

Inclusive education in China has been in existence since the late 1980s. In 1994, the *Provisional Measures for the Education of Disabled Children and Adolescents in Regular Classes* were formulated and promulgated. As inclusive education has continued to develop, an increasing number of special children have entered mainstream schools for education. Inclusive education legally ensures the right of disabled children to receive education equally [9]. In 2020, the Ministry of Education issued the *Guiding Opinions on Strengthening the Work of Inclusive Education at the Compulsory Education Stage for Children and Adolescents with Disabilities*, which is China's second special guidance document issued 26 years later on inclusive education, explicitly proposing to "adhere to scientific assessment, include as fully as possible, respect differences, teach students in accordance with their aptitude, integrate general and special education, enhance quality, and achieve equitable and quality development of special education" to promote the high-quality development of special education. In 2020, the Ministry of Education issued the *Guiding Opinions on Strengthening the Work of Inclusive Education at the Compulsory Education Stage for Children and Adolescents with Disabilities*, which is China's second special guidance document issued 26 years later on inclusive education, explicitly proposing to "adhere to scientific assessment, include as fully as possible, respect differences, teach students in accordance with their aptitude, integrate general and special education, enhance quality, and achieve equitable and quality development of special education" to promote the high-quality development of special education. In 2021, the General Office of the State Council of the People's Republic of China also explicitly proposed in the 14th Five-Year Basic Education Plan to aim for appropriate integration in providing quality special education.

2.2 Children with Hearing Impairments

Hearing impairment (hereinafter referred to as "hearing loss") is a condition caused by various reasons that result in the inability to hear or difficulty hearing sounds around, affecting daily life and work [10], and is classified under special students. In China, severe hearing loss is defined as a hearing loss of 41 to 70 dB. Students who meet the requirements for inclusive education often have undergone cochlear implant surgery or wear hearing aids. These students are at the intersection of normal and abnormal hearing. This study will focus on these hearing-impaired students who qualify for inclusive education.

2.3 Reverse Inclusion

Reverse Inclusion describes the phenomenon where, during the process of inclusive education, students commonly encounter difficulties in learning, lack of concentration, low self-esteem, and insufficient classroom participation, etc., which can easily prompt their return to special schools [11]. In this paper, the focus is on the phenomenon of hearing-impaired students returning from mainstream schools to special schools for the deaf during inclusive education. The phenomenon of Reverse Inclusion is contrary to the current advocacy of inclusive education philosophy.

3 INCLUSIVE EDUCATION POLICY AND DISABILITY MODELS

3.1 The Individual and Social Models of Disability

The individual model of disability has always carried forward the value system and ethics of traditional society, defining disability as a personal issue of the disabled individual. Society tends to respond to disability with a negative attitude, underlying the assumption that disability is a personal matter of the disabled individual, unrelated to society. Therefore, the cause, fault, and responsibility are considered purely individual [12].

With the progress of science and technology and the liberation of thought, many doctors and other enlightened members of society began to focus on the medical roots of disability in the mid-19th century, striving to find treatments for disabled people, giving rise to the medical model, which became increasingly popular. The medical model sees disability as a medical issue existing within the individual. It is a defect or malfunction of the bodily system leading to an abnormal and pathological condition [13]. The goal of intervention is to cure, improve physical condition and rehabilitation to the greatest extent possible (i.e., the disabled person adapts to their physical condition and environment). Disabled individuals are expected to utilize the various services provided to them and spend time playing the role of a patient or learner with the help of trained professionals. For medical professionals adhering to the disability medical model, disabled people should appropriately play the “patient” role if they wish to receive ongoing help and support. However, in the disadvantages of the medical model's “sick role” approach, especially in relation to many

chronic illness sufferers or disabled people who do not consider themselves sick [14]. Moreover, the “sick role” approach fails to consider the important distinction between impairment and illness. As Thomas & Woods (2003) pointed out, “Many disabled people are not sick but have a continuing impairment, which does not manifest as a daily health problem”(p.15) [15].

Inspired by the British disability movement of the 1960s and 70s, the social model of disability was developed in response to the limitations of the medical model. The social model views society as “disabling people with impairments and therefore any meaningful solution must target social change rather than individual adjustment and rehabilitation”. The social model particularly focuses on addressing the “barriers to participation” that disabled people encounter due to various advantageous social and environmental factors in society. In recent years, The Social Model is having a significant impact on the traditional Individual Model or Medical Model [16]. In China, the social work approach for disabled individuals is shifting from the Individual Model towards the Social Model, with a trend towards integrating both models. The inclusive education policy for Chinese children with hearing impairments is a typical embodiment of the integration of these two models.

3.2 Deconstructing the Medical and Social Models in China’s Inclusive Education

Although there are stark differences between the medical and social models in terms of how disabled people are identified and defined, the two are not entirely separate. China's inclusive education policy, which aims for equal educational rights, embodies the perspectives of the social model while integrating features of the medical model. For example, inclusion of children with hearing impairments in regular classes often requires students to have undergone cochlear implant surgery or to wear hearing aids. The two models together have formed a continuum, moving from opposition to integration. Inclusive education demands changes in children with hearing impairments to make them closer to 'normal' before reintegrating them into mainstream society. Practically, the inclusion of children with hearing impairments represents a shift from the medical to the social model, achieving appropriate integration. However, in terms of practical outcomes, the equality manifested in inclusive education is merely formal. Inclusive education predicates on ability, allowing only "disabled children who can keep up with the class" the possibility to learn in regular classrooms, focusing mainly on visual impairments, hearing impairments, and mild to moderate intellectual disabilities. During the inclusion process, teachers often do not accommodate individual differences among disabled students but instead require them to become like their non-disabled peers, pursuing a form of homogeneous equality. Fu and Wang’s qualitative study on the phenomenon of students returning to special education also points out: although national laws explicitly grant special children the right to attend regular schools, whether they can benefit from mainstream education still depends on the special children's level of ability, with those unable to meet the requirements of regular school learning being redirected back to special schools [17]. The homogeneous equality view of traditional education hinders students in inclusive education from pursuing equal educational opportunities.

On the other hand, China's special education (including inclusive education) has long adhered to a medical model of disability, overlooking the deficiencies in the social environment and ignoring the interaction between social expectations and individual abilities. Teachers and administrators tend to understand children from the perspectives of their problems, symptoms, and differences from non-disabled children, amplifying the disabilities; they predispose to a dichotomy of normal versus abnormal when facing special and non-special children; in education, the aim is to eliminate the differences in special children, changing and treating the disability itself. This represents a unidimensional demand on disabled people, without requiring substantial changes from non-disabled people [18].

The *Standard Rules on the Equalization of Opportunities for Persons with Disabilities* states that disability does not necessarily lead to handicap; it only becomes a handicap when there is a conflict between the disability and the environment or societal attitudes towards disability. From this rule, it is evident that the inclusion of children with hearing impairments in China has not achieved equal opportunities, but the social model has promoted the shift of these students from segregation to integration. From the international perspective of inclusive education, it is a method that encourages diversity and promotes equal educational opportunities for all students, regardless of any differences they may have. Thus, theoretically, China’s inclusive education policy contradicts the social construct of disability upheld by popular international inclusive education. However, what constitutes inclusive education remains debatable. Therefore, to answer whether China’s inclusive education policy is appropriately integrated, an analysis of the practical outcomes of inclusive education for children with hearing impairments is needed.

3.3 Reasons for the Reverse Inclusion Phenomenon of Children with Hearing Impairments in Mainstream Classes in China

Existing research indicates that the reverse inclusion phenomenon of children with hearing impairments in mainstream classes is a significant and complex issue within China's special education system, involving schools, families, society, and the unique characteristics of children with hearing impairments.

Firstly, the technical or equipment support in schools is still lacking. This results in deaf or hard-of-hearing children not being able to fully participate in learning under conditions similar or close to those of other children. Many of these children wear hearing aids or have cochlear implants. Whether they can communicate smoothly, establish good interpersonal relationships, and achieve effective learning largely depends on whether they can "hear clearly" and

"understand and express themselves." Hearing clearly involves issues with the equipment. If the hearing compensation effect of the hearing aid is not ideal, it will affect the child's reception of information. "Understanding" involves issues related to the rehabilitation education of deaf children, such as how teachers can teach these children to understand and express themselves in various ways. Many scholars have found in their research on the reintegration of deaf children that due to not understanding the content of the lessons and not being able to keep up with the pace of regular schools, these students develop feelings of inferiority, passivity, confusion, and panic, leading to a lack of motivation to learn. Therefore, the language barriers and psychological issues of deaf children are one of the objective reasons for their reintegration challenges. [19]

Secondly, the social support system needs improvement. Children with hearing impairments in mainstream classes require a comprehensive social support system, necessitating collaboration among rehabilitation institutions, civil affairs, disabled persons' federations, mainstream schools, special education schools, teachers, and parents. Currently, such a social support system is not yet established. Children with hearing impairments move directly from rehabilitation institutions to mainstream schools, where educational philosophies and teaching models differ. There is a lack of transitional and adaptive phases[11]. Therefore, the students in inclusive education seldom receive personalized teaching support in regular classrooms, making it difficult for them to succeed within them . This further explains why many children with hearing impairments in mainstream classes "return" to special schools or institutions.

It is evident that without a comprehensive support system in special education, indiscriminately placing special children in regular classes is not the wisest choice.

Thirdly, parents' attitudes and behaviors also impact the reverse inclusion issue. Research shows that special children's parents' educational expectations, understanding of special education, and the quality of home education directly affect the learning and social development of children with hearing impairments. For example, parents' expectations for special children may be unrealistic. Lack of accurate judgment of children's abilities and needs can lead to inappropriate educational methods, affecting children's adaptability and learning effectiveness in regular schools [20].

Therefore, by analyzing the reasons of the reverse inclusion of children with hearing impairments, a conclusion can be drawn that when educating special children, besides providing cognitive training for parents, it is essential to fully consider the students' abilities and disabilities. The most suitable placement method for special children should be selected based on the type, degree of disability, and existing placement conditions. Teaching according to students' capabilities is a form of educational equity. If special children who are currently unsuitable for mainstream classes are placed in regular classes, where teachers are unable to teach and peers do not accept them, causing these students to be neglected and waste time in regular classes, this does not align with the original intent of inclusive education.

4 EVALUATION OF CHINA'S INCLUSIVE EDUCATION POLICY

4.1 Philosophical Reflections on the Reverse Inclusion for Children with Hearing Impairments in China

The concept of inclusive education, originating from the human rights movement of the 1960s, emphasizes that disabled people should enjoy the same educational rights as the general population, as clearly articulated in the Salamanca Statement. This overturned the "separate but equal" dual-track education system, reintegrating disabled individuals into mainstream society. This ideology a noble ideal, a philosophical thought, a notion and attitude, rather than something practical.The practice of inclusive education in China, especially the situation of hearing-impaired children attending regular classes, reveals the discrepancy between ideology and actual implementation [21].

Supporters of the social model of disability argue that disabilities and special needs in education are the result of social constructs. That is, difficulties and needs are often caused by the rigidity of the school system and its inability to meet the diverse needs of children. This study also shows that the challenges faced by children with hearing impairments in mainstream schools are not only due to their hearing disabilities but also to the limitations of the school system in dealing with diversity and differences. However, currently in China, few students with hearing impairments are included in mainstream classes, and some do not even meet the criteria for inclusive education. It is impractical and a waste of resources to equip every school with resources for students with special educational needs. Therefore, in practice, it is necessary to consider the guidance of theory as well as the feasibility, adaptability, and efficiency of practice.

Additionally, if there are few students with special needs in an inclusive education environment in mainstream schools, but special students require additional support, this could impact the class pace, thereby affecting the progress of other students and making them feel their learning needs are not fully met, which is in itself an educational inequality.

From the analysis above, it is evident that the practice of inclusive education in China faces significant challenges.

Furthermore, this paper argues that treating inclusive education as an ethical standard to evaluate and criticize all education forms considered unjust is unscientific. The disabled population displays diversity and differences in characteristics and needs, meaning they face various challenges and difficulties within the general education system [22]. This means no single education model can meet the needs of all disabled individuals, but rather, education plans and support measures should be customized based on individual circumstances. Therefore, inclusive education should be undertaken responsibly and cautiously according to the type and degree of disability. The focus should not only be on the quantity of inclusion but also on the quality and effectiveness of inclusion.

In 2022, the European Agency for Special Needs and Inclusive Education published a report on the proportion of inclusive education in EU member states for the 2018-2019 academic year, showing that the proportion of inclusive

education in EU countries reached up to 98% (European Agency for Special Needs and Inclusive Education, 2020). In this context, Germany, with a lower rate of inclusive education about 20%, did not appear in the report and has been criticized by German scholars as a failed inclusive education reform [23]. However, this study believes that using the rate of inclusive education to judge the success of a country's inclusive education is unrealistic. Conversely, some of Germany's special education strategies are worth learning for China. For example, the German education system, through ability streaming, assigns students to different types of secondary schools, effectively organizing homogeneous learning groups. This streaming system has gradually been seen as a positive policy of differentiated treatment. That is, students with disabilities can choose different types of special education schools based on their own needs.

Finally, vocational education aimed at returning to mainstream society allows disabled individuals to become self-sufficient in society after vocational training. This is a well-developed special education system. This study believes that integration in society is true integration. Germany's special education experience proves that focusing on education quality and meeting individual needs is more important than simply increasing the proportion of inclusive education.

4.2 Strategic Considerations for the Reverse Inclusion of Children with Hearing Impairments in China

Firstly, the problem needs to be addressed at its root. When discussing strategies for the “reverse inclusion” of children with hearing impairments in China, the conversation often only scratches the surface, lacking in-depth solutions. For instance, strategies proposed by Chinese scholars such as personalized teaching and mental health improvement are important,.but without corresponding professional support, such as technology, equipment, and rehabilitative teaching, these strategies are difficult to implement effectively. The education of children with hearing impairments in China requires not only high-quality hearing aids or cochlear implants but also a comprehensive social support system, including collaboration among rehabilitation institutions, civil affairs departments, mainstream and special schools, teachers, and parents. However, such a support system has not yet been established in most areas.

Secondly, there should be an integration of the advantages and rational components of different disability models to construct a theoretical model suited to local application. There are seldom simple answers on how to successfully implement appropriate inclusive education. Different countries face different challenges, and schools differ, leading to diverse policies. Combining the strengths and rational components of theories from different periods to integrate into a policy framework is an effective approach that meets local needs. This paper rejecting the notion of associating inclusivity with a single dominant set of values and practices. For example, if the inclusive education policy only considers the perspective of equality based on the social model and merely achieves integration in terms of where classes are conducted, it will face deep dilemmas, such as an inability to guarantee teaching quality and achieve true equality. An inclusive model should first be inclusive of various ideologies, and this inclusiveness should be a combination of emotion and rationality.

In addition, the understanding of inclusive education should pursue moderation. Moderation means that the development of inclusive education requires a coordinated education system. Whether to adopt a single-track or dual-track system, that is, full inclusion or partial inclusion, should be implemented based on specific circumstances, as long as the goal is for students to receive high-quality education and ultimately integrate into society. Therefore, in understanding inclusive education, it is crucial to fully consider the actual situation of the relevant education system, allowing it to develop moderately.China’s “Guidelines for Inclusive Education for Students with Disabilities” systematically summarizes nearly 40 years of experience in inclusive education practices in China, forming a practical model with Chinese characteristics. For instance, the principles of “Inclusion as much as possible” and “priority placement” reflect a rational and progressive approach from mild to severe, and from a minority to a majority of disability types in the process of realizing the equal right to education for children with disabilities [24]. These align with China’s current national conditions. This study posits that inclusive education based on quality rather than quantity is what can truly achieve appropriate integration.

5 CONCLUSION

From the analysis of this study, it is clear that merely limiting China's inclusive education policy to superficial spatial integration is insufficient and does not fully reflect the appropriate integration of education for Chinese children. China's special education is currently in a new phase of construction and faces challenges, with both its theory and practice filled with uncertainties. However, it is affirmative that, over the past two years, the promotion plans and guidelines issued by the Chinese management have driven the inclusive education policy from formal integration towards improving the quality of education, gradually forming a practice model with Chinese characteristics. Yet, at the operational level, we still need to clarify the essence, from system to ideal, from ideal to practice, and from abstract to concrete, to build a more effective inclusive education system. It's essential to avoid applying idealistic thinking to the evaluation and guidance of specific practices. Therefore, this paper proposes the following recommendations:

Firstly, on an ethical and moral level, an inclusive and accepting environment should be constructed. Meanwhile, policymakers and scholars need to avoid morally hijacking inclusive education in the name of human rights and should instead use rational and diverse perspectives to coordinate the differences between various groups. On the foundation of diversity, the various models of disability (such as the individual model, social model, human rights model, etc.) should join forces, contributing their theoretical insights to the field of disability.

Secondly, in terms of educational structure, a supportive environment needs to be established. In the context of inclusive education, special education schools should become integrated, expanding their functions to become leaders in

local special education and resource support centres for inclusive education, playing a comprehensive role in education and rehabilitation. Administrative regions should also support the quality improvement of special classes in mainstream schools, allowing special students to attend schools nearby. With sound teacher qualifications, advanced theories, and economic, and policy support, an open environment for inclusive education that facilitates students attending nearby schools can be constructed. Additionally, the assessment methods for admitting special students in mainstream schools should respect student wishes, avoid excessive assessments, and allow students who have received medical model interventions to smoothly transition to mainstream schools for learning.

Thirdly, regarding the understanding of inclusive education, we need to correctly view isolation and integration. This study believes that true integration is not just about special students integrating into mainstream schools but about students being better integrated into society. Mainstream students in schools are also isolated by the class system, and in China, middle to high school transitions are isolated by the high school entrance examinationsystem, but ultimately, all are to integrate into society. Thus, if certain forms of isolation contribute to improving the quality of special education, then this isolation is designed for better integration. Otherwise, even if disabled students are superficially integrated into schools, they may not truly integrate into society. The role of peers can be achieved in various ways, such as community activities or cooperation between mainstream and special schools.

These are the preliminary thoughts on the practice strategies of inclusive education in China from this study, which requires further research to perfect. It is hoped that China's special education can gradually develop a system and localized model of inclusive education that suits China's national conditions, contributing Chinese wisdom and experience to the international theory and practice of inclusive education.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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REFORM AND PRACTICE OF TEACHING OBJECT-ORIENTED PROGRAMMING COURSES

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Abstract: Object-Oriented Programming (OOP) is a core course in the computer major. With the rapid development of technology, the teaching content urgently needs to be updated to adapt to new frameworks and tools. This teaching reform systematically innovates the teaching content and methods in terms of the syllabus, teaching design, practical teaching materials, and the construction of auxiliary teaching platforms, aiming to improve the teaching quality and cultivate students' practical ability and innovative thinking.
Keywords: Teaching reform; Practical ability; Innovative thinking

1 INTRODUCTION

Object-Oriented Programming (OOP), as the foundation for constructing modern large-scale complex software systems, holds significant importance for cultivating computer science talents[1-2]. With the continuous emergence of new programming languages, frameworks, libraries, and tools, teaching content must evolve to maintain its cutting-edge and practicality. Students, as the vanguard of the era, are eager to learn the latest technologies to prepare for future challenges. This demand prompts educators to rethink the curriculum structure and integrate cutting-edge technologies into teaching. However, existing courses often face the contradiction of tight schedules and voluminous content. How to efficiently utilize limited class hours to achieve effective teaching has become an urgent issue to be resolved. This project aims to enhance teaching quality and strengthen students' practical abilities and innovative thinking. By designing teaching syllabi, writing experimental textbooks, designing auxiliary teaching platforms, and constructing teaching design cases, we explore the formation of a promotable and sustainable teaching reform model. This paper will detail the project's research contents, research achievements, features, and innovative points, as well as the application and promotion of the results, demonstrating the significant effects of teaching reform in improving students' comprehensive qualities and course teaching quality.

2 OBJECTIVES AND APPROACH

The research objectives encompass several key areas:
(1) To author an experimental textbook that meets the practical needs of teaching and emphasizes the cultivation of practical skills.
(2) To design an efficient and intelligent tool platform for assisting with or automatically grading Java code in object-oriented programming.
(3) To construct a series of innovative and exemplary teaching design cases to enhance the efficiency and quality of teaching evaluations.
(4) To promote the reform and innovation of teaching methods.
The research approach begins with key aspects of course teaching. It aims to enhance students' practical abilities and creative thinking. By integrating educational theories and computer technology from various disciplines, the project undertakes the development of experimental textbooks. It also involves designing a platform for assisting or automatically grading Java code in object-oriented programming. Additionally, it includes the study of teaching design cases. The research outcomes are applied to actual teaching processes. Through practical testing and continuous improvement, a promotable and sustainable model for teaching reform is formed.

3 RESEARCH CONTENT

3.1 Experimental Textbook

Object-Oriented Programming (OOP) is relatively straightforward when starting out, but designing systems that are clear in structure, easy to maintain, and implementable in complex systems is indeed a challenge. Additionally, the Java language involves a multitude of components, containers, and framework technologies, making the knowledge points quite extensive.
This book focuses on enabling learners to quickly grasp the syntax of the Java language and the concepts of object-oriented programming. The most efficient way to achieve this is through case-based practice. The author, drawing from years of teaching and research experience, has meticulously designed and arranged the content

organization and learning guidance in this book, addressing the characteristics of the Java language and the difficulties students encounter in their learning process.

(1) The textbook comprehensively covers the Java language knowledge system. To help learners systematically master Java, this book focuses on its core content. It extensively covers Java's knowledge points, allowing learners to continue learning important content beyond the classroom and aiding teachers in selecting relevant material for teaching and self-study. By studying this book, learners can lay a solid foundation for further study.

(2) Case-based teaching demonstrates syntax standards and programming concepts. Reading and imitating case programs and projects is an effective way to learn program design and software development. For beginners, extensive theory can be overwhelming and demotivating, but presenting theoretical knowledge through cases makes it more accessible. This book includes well-designed case studies in the preliminary knowledge section of each experimental project. These cases come with detailed descriptions, examples, code, and annotations. They explain their objectives and the problems they address. By showcasing the application of knowledge needed for experiment projects and demonstrating programming standards, methods, and ideas, learners will gradually acquire the necessary syntax, algorithms, and design techniques. Through reading, understanding, and imitating these case projects, learners will naturally develop the ability to think of solutions to experimental problems.

(3) The book integrates cutting-edge artificial intelligence knowledge into case studies to enhance practicality and novelty. "Java Programming Practice Tutorial" is a book published by the School of Computer and Information Security at Guilin University of Electronic Technology. It uses Java syntax and programming skills to implement image processing and common deep learning operations such as convolution and pooling. The book includes computer vision and artificial intelligence-related cases and experimental tasks. It combines the study of Java object-oriented programming with foundational artificial intelligence algorithms. This approach enhances the course's appeal, practicality, and cutting-edge nature.

(4) Content decoupling and a mix of difficulty levels reduce the learning curve. Each experimental project provides learners with the prerequisite knowledge and explanations needed to complete the experiment. Theoretical knowledge required for the experiment is presented concisely, accompanied by specially designed typical cases that offer various guidance and instructions for learners. This design minimizes the need for learners to consult additional theoretical materials or reference books, as the book itself meets the basic knowledge needs for the experiments. The structure of the tutorial is self-contained, so it can be used regardless of the theoretical textbook in use, without affecting students' ability to complete the experiments. The content is arranged from simple to complex, and from basic syntax to advanced applications. Each experiment lays the groundwork for the knowledge needed in subsequent ones, ensuring a gradual learning process. This approach prevents sudden difficulties and ensures that learners are never at a loss on where to start, maintaining coherence and balance throughout the content[3-4].

(5) The book bridges subsequent knowledge to enhance application development skills. As mentioned earlier, Java is widely used in Java EE system development and Android app development. Many learners lack a clear understanding of how to approach these two areas, which hinders their ability to improve in application development. To address this, the book includes four experimental projects that cover commonly used Java EE development topics such as JavaBeans, Servlets, and JSP, which can be applied to simple system development immediately after learning. It also introduces the basics of Android development. These projects allow students to quickly understand and get started with Java for Java EE and Android app development. This lays a solid foundation for enhancing their engineering application skills and boosts their interest and motivation to learn.

The use of experimental teaching materials has significantly improved students' understanding and mastery of object-oriented programming knowledge, enhanced their programming practice skills, and laid a solid foundation for their subsequent professional course studies and practical project development.

3.2 Construction of Auxiliary Teaching Platform

(1) The web-based automatic paper generation system we developed has comprehensive user management features, including roles for teachers, students, and administrators. Teachers can easily manage exams, create papers, publish tests, grade papers, and view score analysis reports. Students can take exams online, check their scores, and see detailed answers. Administrators are in charge of system maintenance and data management. The system uses various intelligent evaluation technologies to automatically and accurately grade objective questions like multiple-choice and fill-in-the-blank. For programming questions, it evaluates through code syntax analysis and comparison of runtime results, providing error prompts and suggestions for improvement[5-6].

(2) The auxiliary teaching resource system established on the Educoder platform provides students with a wealth of practical project cases and a coding practice environment. After students write their code on the platform, they can submit it for automatic grading. The platform assesses the code based on preset evaluation criteria and provides timely feedback on the grading results and suggestions for improvement. This helps students continuously enhance their code quality and programming skills.

The auxiliary teaching platform significantly enhances the efficiency and accuracy of teaching evaluations. It reduces the workload for teachers and provides timely feedback for students. This feedback helps students identify and improve their learning issues. The platform plays a crucial role in fostering students' practical programming skills and awareness of code quality.

3.3 Teaching Design Cases

Teaching design includes teaching objectives, teaching design and implementation, teaching evaluation, and appropriately introduces ideological and political content. The main content of teaching design cases includes:
(1) Knowledge objectives and moral education objectives are combined. Knowledge objectives include understanding object-oriented concepts such as classes, objects, inheritance, polymorphism, encapsulation, interfaces, exception handling, abstract classes, and generics. Students should master the basic methods of object-oriented programming and be able to apply them throughout the process of analyzing and solving complex problems in the field of computer engineering, designing basic object-oriented architectures and plans. Knowledge objectives also involve mastering practical Java platform technologies, such as commonly used utility classes, input/output streams, GUI programming, multi-threading, network programming, and database programming. Students should be able to correctly apply these technologies to solve real-world problems in computer engineering practice. Moral education objectives aim to stimulate students' national pride, patriotism, and awareness of people's livelihood during the course implementation. They aim to cultivate students' team collaboration, effective communication, and independent thinking skills. The objectives also include fostering professional qualities such as a spirit of excellence and craftsmanship, instilling good ethical behaviors like not plagiarizing or stealing, and encouraging students' self-learning and innovative consciousness.
(2) A variety of teaching methods and strategies are integrated, with appropriate introduction of ideological and political elements. The teaching design and implementation use a range of teaching methods and strategies to enhance students' learning interest, practical ability, and ideological and political quality. The teaching design includes various methods such as project-driven teaching, case teaching, and group collaborative learning. For instance, in Lesson 10 "Composition of Java Graphical User Interfaces," a problem-driven approach combined with case introduction is used, drawing an analogy between GUI composition and pasting paper cuttings for window decoration. Students are guided to consult materials and solve problems through "user registration interfaces" and "QQ login interfaces." At the same time, ideological and political elements such as "scientific literacy, exploration of the unknown, pursuit of truth, the spirit of striving for excellence, practical problem-solving ability, and the integration of learning and thinking" are introduced to cultivate students' basic scientific literacy and rigorous academic attitude. In the lecture on "Java Multithreading Development," case introduction is used, taking the 12306 ticketing system as an example to introduce concepts of processes, threads, multithreading, and shared data in multithreading. Ideological and political elements like "competition and cooperation" are also introduced, guiding students to understand the importance of resource sharing and cooperative win-win awareness. In practical projects, project introduction methods are used, where team collaboration is emphasized to foster students' team spirit. Students are encouraged to have an exploratory and innovative spirit when analyzing and solving problems. They are also guided to have a rigorous work attitude when designing schemes and debugging code. Students are taught to complete reports independently and to reject plagiarism, fostering their integrity and a truthful scientific attitude.
(3) The teaching evaluation is comprehensive and diverse. The course's evaluation system is characterized by its all-encompassing and multifaceted approach, aiming to assess students' learning outcomes and capability development from various perspectives. The evaluation system consists of three parts: regular scores, experimental scores, and final exam scores, which account for 20%, 30%, and 50% of the total grade, respectively. This proportion emphasizes both formative and summative assessment.
Regular scores focus on students' daily learning performance, including online exercises and tests, weighted at 70% and 30%. This design encourages continuous student engagement in learning activities rather than relying solely on the final exam.
The assessment of experimental scores places greater emphasis on students' practical operation skills and innovative thinking. The experimental score is composed of 50% regular experimental performance and 50% hands-on assessment, with the regular experimental performance further divided into 80% experimental completion scores and 20% experimental report scores. This detailed evaluation method more accurately reflects students' performance in the experimental process and the quality of their reports.
The final exam score assessment focuses on students' mastery of course objectives, especially their understanding and application of core concepts like classes, inheritance, and interfaces. Different levels of assessment criteria clearly define students' performance at various levels.
Additionally, the evaluation system particularly emphasizes the cultivation of integrity, requiring students to complete reports independently and refusing to plagiarize, which helps students develop a truthful scientific attitude. Overall, the course's teaching evaluation system aims to promote students' comprehensive development, focusing not only on knowledge acquisition but also on capability enhancement and character building.
The teaching design and implementation reflect a student-centered teaching philosophy, stimulating students' learning enthusiasm through diverse teaching methods, and cultivating their comprehensive qualities. It also emphasizes the cultivation of students' ideological and political qualities, enabling students to develop correct values and outlooks on life while mastering professional knowledge. This teaching design not only improves teaching effectiveness but also lays a solid foundation for students' all-around development[7-8].

4 FEATURES AND INNOVATION POINTS

The experimental textbook focuses on the combination of practice and theory, introducing a large number of actual

project cases, and the cases have strong scalability and comprehensiveness, which is convenient for teachers to adjust and expand flexibly according to the actual teaching situation. The practice resource system built based on the Educoder platform provides students with a convenient practice environment, achieving seamless connection and efficient interaction in the learning process. Teaching design cases innovatively integrate various teaching methods organically, oriented by projects, centered on students, breaking the traditional teaching model where teachers lecture alone. Teaching design appropriately introduces ideological and political elements, giving full play to the main role of students and cultivating students' comprehensive qualities[9].

5 APPLICATION AND PROMOTION OF RESULTS

The research results of this project have been applied and promoted in our college. The experimental textbook has been used as the experimental textbook for the object-oriented programming course in our college, and teachers and students have feedback that the textbook content is practical and the cases are rich, which can effectively help students improve practical ability. The practice resource system built based on the Educoder platform has become an important auxiliary support for teachers in the course group, making the teaching process more vivid and efficient. Teaching design cases have been shared and promoted among course group teachers through activities such as teaching seminars and teacher training. Many teachers have applied the cases to their own classroom teaching and have achieved good teaching effects, with a significant increase in students' learning enthusiasm and academic performance[10-11].

6 TEACHING EFFECTS

Observe the participation and learning effects of students in a course number in the 2023-2024-2 semester. (1) Educoder platform, student participation and effects, as shown in Figure 1. (2) The distribution of final total scores is shown in Table 1.

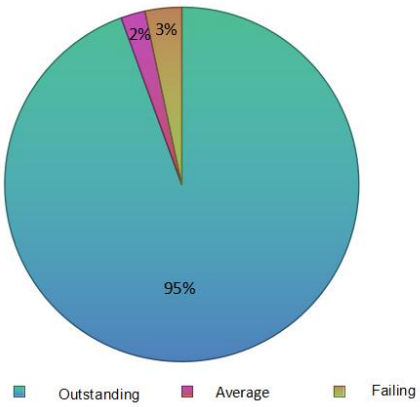

Figure 1 Average Practical Scores on the Educoder Platform (2023-2024-2 Semester)

Table 1 Distribution of Final Total Scores (2023-2024-2 Semester)

Score Range	[90, 100]	[80, 90)	[70, 80)	[60, 70)	[0, 60)
Number of People	11	38	27	10	2
Percentage	12.22%	42.22%	30.00%	11.11%	2.22%

7 CONCLUSION

The teaching and practice reform of the object-oriented programming course has yielded fruitful results. Through the research and application of experimental textbook writing, auxiliary teaching platform construction, and teaching case design, the teaching quality of the course and the comprehensive quality of students have been effectively improved, which has a high application value and promotion prospect. In the future, the project team will continue to deepen and improve the relevant results, and make greater contributions to the teaching reform of computer majors.

COMPETING INTERESTS

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THE INFLUENCE OF "PRODUCTION-ORIENTED APPROACH" TEACHING ON THE DEVELOPMENT OF COLLEGE ENGLISH WRITING FLUENCY AND WRITING STRATEGIES

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Abstract: This paper adopts the action research method and designs the corresponding "Production-oriented approach"(POA) teaching of college English based on the diagnostic test report of the "Udig" platform, to explore whether POA teaching can effectively improve students' English writing fluency and strategies. After one semester of POA teaching, with the statistics of the pre-test and the post-test compared, we find that POA teaching can effectively improve students in more fluent output in writing in terms of word number, word length, sentence number and sentence length; and also in better usage of writing strategies in the aspect of accumulation of writing materials, diversification of vocabulary and expression, the polishing of the text and structure of writing the whole passage.
Keywords: Production-oriented approach; Diagnostic assessment; Action research

1 INTRODUCTION

In recent years, concepts such as “assessment for learning” and “learning-oriented Assessment” have been a growing trend, diagnostic tests as a new generation of test theory in language testing, have received more and more attention, as a practical application of test areas, diagnostic assessments are designed to provide learners with detailed feedback for the next stage of their learning [1].Diagnostic Assessment System (Udig) is a platform created by Foreign Language Teaching and Research Press, provides diagnostic assessments based on the “Rating Scale of English Proficiency of Chinese College Students" for ability level analysis. He Lianzhen [2] proposed that diagnostic assessment offer personalized feedback for the future development of students and the design of compensatory teaching and learning activities. As we know, it is difficult to dedicate time to writing strategies development and writing practice in college English teaching, the concept of "output-oriented method" highlights the close combination of input learning and output-based application in college English, few research are conducted on the effect of highlighting “input” on the development of writing strategies and writing fluency.

2 LITERATURE REVIEW

2.1 Production-Oriented Approach

Production-oriented approach is a unique foreign language teaching method for Chinese universities advanced by Professor Wen Qiufang's team. This approach highlights cognitive assumptions that emphasizes the close combination of input learning and productive application.
In the teaching, the teaching objectives are highlighted with three teaching steps of driven-enable-evaluate in guided teaching with clear goals in the output of language in both driven-and evaluate steps, where in the middle steps of teaching, teachers offer scaffolding help that are needed in the other two steps [3]. The teaching content is placed in a very clear position, and the explicit reinforcement are presented again and again in the limited classroom time. It has been 15 years since the "Production-oriented approach" was first proposed, and some studies have been conducted with specific teaching purposes in the classroom Empirical studies, for example, Zhang Lingli [4], found transformation of students’ English learning concepts, improvement of self-confidence and interest in learning, as well as the development of comprehensive ability, are better under this teaching approach, ; Zhang Wenjuan [5] research results show that POA has a significant effect on students' writing skills.

2.2 Diagnostic Assessments

Diagnostic assessments include tests and self-assessments aiming at improving students' self-recognition in language skills, in understanding the standards testing, and improving the awareness of learning strategies of the target language that are

tested [6]. The main diagnostic language testing systems in the academic context are the DIALANG, DELTA(Diagnostic English Language Tracking Assessment),DELNA(Diagnostic English Language Need Assessment, University of Auckland) [1], and foreign language teaching Udig (https://unilearn.fltrp.com).Diagnosis Assessment includes language proficiency testing and cognitive ability testing [7-8]. Language proficiency testing is a test or exam, while cognitive ability assessment is a test of strategy, efficacy, and other aspects. Through the diagnosis of these two factors, students can not only see their grades but also receive corresponding learning strategies and suggestions. For teachers, the diagnostic results also contribute to the adjustment of teaching objectives, teaching design, etc. Pan Mingwei, Song Jieqing, & Deng Hua [9] conducted a research on “Online English development and validity verification of self-assessment scales in language writing diagnostic assessments”, proposing that teachers can incorporate students' self-assessment into diagnostic assessments evaluation to obtain feedback information, and then use data to guide teachers to carry out corresponding compensatory teaching.
On the other hand, the introduction and applied research on diagnostic assessments are carried out. Sun Hang [10] conducted research on the feedback results of reading diagnostic assessments and believed that diagnostic assessments can help teachers understand the mastery of different reading micro skills by student, and adjust teaching objectives and content to guide the students to learn and improve in a targeted manner. In short, self-evaluation in diagnostic assessment can truly promote learning through evaluation [11].

3 RESEARCH DESIGN

3.1 Research Objectives

We aim at exploring the diagnostic test feedback of the online diagnostic assessment platform "Udig" (University Edition) developed by the Foreign Language Teaching and Research Press, and design compensatory teaching for college English comprehensive courses based on the "production- oriented approach" (POA) driven by feedback opinions, and exploring the impact of POA teaching design on improving fluency in college English writing and enhancing writing strategies.

3.2 Research Participants

The participants of this study are students in the second semester of their first year of college English course at a university in South China, who have not yet taken the College English Test (CET) and are taught by the same teacher.

3.3 Diagnostic Assessment tools

The assessment tools for pre-test and post test are the English CET-4 argumentative essay test on the "Udig" platform, and the self-assessment scale for writing strategies after completion of the writing (a total of 22 questions). The questions involve content preparation before writing, content selection during writing, material collection, vocabulary diversification, expression methods diversification, polishing and modification, discourse structure, tone, style, grammar, punctuation, and other writing strategies self-assessment. The above items are measured using a 4-point scale, ranging from "completely unachievable" (1 point), barely achievable (2 points), basically achievable (3 points), and achievable (4 points). Based on the research question, we only extracted five self-assessment questions about writing content strategies from the pre-test and post test analysis (Question 1: Planning Strategy - Material Accumulation, Questions 2, 3, and 4: Content Generation Strategy - Vocabulary, Expression, and Editing, Question 5: Chapter Organization Strategy - Chapter Structure). The specific title wording is: 1) Planning Strategy - Material Accumulation: I am able to collect and organize writing materials as needed when writing; 2) Diversification of vocabulary: When writing, I can use common words or phrases according to changes to avoid repetition in the text; 3) Diversified means of expression: When writing, I can enhance the effectiveness of expression by using some rhetorical devices; 4) Polishing of the text: I am able to modify the wording, sentences, and structure of the text as needed when writing; 5) discourse structure: When writing, I am able to organize the article according to the planned structure and achieve clear hierarchy(questionnaires referred to the expression in the Chinese English Proficiency Scale for Evaluation Language).

3.4 Action Research

3.4.1 Pre-testing

Participants completed a writing test on the "Udig" platform, and at the beginning of the semester, a pre-test for writing CET-4 argumentative essays was conducted based on the "Uidg" platform. The two natural classes conducted the same test time, with the same writing content and different adjustments to the order of evaluation content, totaling 50 minutes. After completing the writing of the CET-4 argumentative essay, participants are required to complete a self-assessment scale for writing strategies, including material accumulation, vocabulary diversification, expression diversity, polishing of the text, and discourse structure. Based on the data from the pre-test and post test self-assessment, there were a total of 103 students who were able to complete the overall assessment. Therefore, these 103 students were selected as our research subjects for this study.

3.4.2 Analysis and diagnosis of pre-test data

Based on the "Optimal Diagnosis" test report, analyze the learners' existing writing level and their strategy self-assessment scale data. The evaluation report shows that students' overall self-assessment scores for writing strategies are low, indicating problems in writing such as "low language sensitivity and insufficient absorption and application of language knowledge". Teaching suggestions are also provided, such as "encouraging students to boldly use the language knowledge they have learned in writing practice, and strengthening the accuracy and fluency of language knowledge application through continuous practice". By analyzing the writing scores of diagnostic tests and corresponding teaching suggestions, identifying the problem, and starting compensatory teaching through the selection of teaching materials and the design of teaching activities.

3.4.3 Research questions

In response to teaching suggestions such as "encouraging students to boldly use the language knowledge they have learned in writing practice, and strengthening the accuracy and fluency of language knowledge application through continuous practice", we propose the POA teaching method as a compensatory teaching activity design to verify the following two questions:

1). Will POA teaching lead to changes in students' writing fluency?

2). Will POA teaching lead to changes in students' awareness of writing strategies?

3.4.4 POA teaching

Adopting the compensatory teaching concept based on the POA, after one semester of 2 face-to-face classes of teaching per week, the teaching content is the second volume of the third edition of "New Horizon College English". The “production-oriented approach” teaching mode mainly includes the following 3 processes: 1) Driving-process: designing writing to stimulate the desire for expression based on the theme of the text - evaluating and analyzing the strengths and weaknesses of writing expression, and providing revision suggestions; 2) Enabling-process: Emphasize the teaching of exciting phrases and sentence structures in the text, and strengthen the awareness of improving language sensitivity and quality through highlighting methods such as translation, fill in the blank, sentence construction, and use in writing; 3) Evaluating-process: Conduct a second writing session, emphasizing the use of three word, four word phrases or excellent sentence patterns from the text. Emphasize the use of phrases and sentence patterns again through writing using underlined phrases, calculating expressions used to highlight the target phrases and expressions. Practice the diagnostic assessment report's of "improving language sensitivity, strengthening the accuracy and fluency of language knowledge application through continuous practice" in teaching activities.

3.4.5 Post testing

In the post test, we use a self-assessment scale for writing efficiency and writing strategies after wiring a CET-4 argumentative essay writing, at the same writing level and the similar content compared with the pre-test but the self-assessment scale questions appeared in different order. SPSS27.0 software was used to statistically compare the pre-test and post-test evaluation reports, to evaluate and analyze the result in the corresponding research questions.

3.5 Data Collection

In the writing proficiency test, all students were able to complete their writing submissions within the specified time. However, in the subsequent self-evaluation test, if incomplete forms were found, the incomplete self-evaluation papers were excluded, and the sample size for the second part was only 97. SPSS 27.0 was used for data statistics.

3.5.1 Writing fluency

The main observation of writing fluency in our research mainly focuses on the changes in the number of words(WN.for short), average word length(Avg.WL for short), number of sentences(SN for short), and average sentence length(Avg.SL for short) of students' writing in the pre-test and post test. The feedback data from the testing system is put into SPSS27.0 statistical software, and the T-test of pre-test and post test statistical results are shown in Table 1:

Table 1 Independence Sample Test of Writing Fluency

A(Levene’s Test)			vAvg. Equal Variance T Test					
F	F	Sig.	T	Sig.(T-T)	MD	SD	95% CL	95% CU
WN Equal Variance	2.066	0.152	-9.819	< 0.001	-47.7331	4.86159	-57.3043	-38.16330
Unequal Var.			-9.819	< 0.001	-47.7331	4.86159	-57.3043	-38.15877
Avg.WLEqualVar.	.000	1.000	.000	1.000	.00000	.03992	-.07858	-.07858
Unequal Var.			.000	1.000	.00000	.03992	-.07858	-.07858
SN Equal Var.	1.585	.209	-6.090	< 0.001	-2.17266	.35764	-2.87493	-1.47039
Unequal Var.			-6.090	< 0.001	-2.17266	.35764	-2.87518	-1.47014
Avg.SLEqual Var.	.191	.662	-3.529	< 0.001	-1.74820	.49536	-2.72337	-.77303
Unequal Var.			-3.529	< 0.001	-1.74820	.49536	-2.72342	-.77298

Note: *p<0.05

From Table 1, it can be seen that in terms of word number, the Levene's variance homogeneity test Sig=0.152 is greater than 0.05, indicating that there is no significant difference in variance between the pre-test and post test, assuming the assumption of equal variance. The mean value of the two tests is equal to the t-test Sig (two tailed)<0.001, which is less than 0.05, indicating a significant difference in the mean values of the two tests. Therefore, it can be concluded that there is a statistically significant difference between the pre-test and post test scores; In terms of sentence number, the Levene's test for homogeneity of variance Sig=0.209, which is greater than 0.05, indicates that there is no significant difference in variance between the pre-test and post test, assuming the assumption of homogeneity of variance. Sig. T-T (Significance two-tailed)=0.001, less than 0.05, indicates a significant difference in the average of the two tests. Therefore, it can be concluded that there is a statistically significant difference in pre-test and post test scores; In terms of average sentence length, the Levene's variance homogeneity test Sig=0.662, which is greater than 0.05, indicates that there is no significant difference in variance between the pre-test and post test, assuming the assumption of equal variance. The mean value of the two tests is equal to the t-test. Sig. T-T (Significance two-tailed)<0.001, which is less than 0.05, indicating a significant difference in the mean values of the two tests. Therefore, it can be concluded that there is a statistically significant difference between the pre-test and post test scores; However, in terms of average word length, the Levene's test for homogeneity of variance Sig=1.000, which is greater than 0.05, indicates that there is no significant difference in variance between the pre-test and post test, assuming the hypothesis of equal variance holds. The mean value of the two tests is equal to the t-test Sig (two tailed)=1.000, which is greater than 0.05, indicating that there is no significant difference in the mean values of the two tests. Therefore, it can be concluded that there is no statistically significant difference in the pre-test and post test scores. There were significant changes in the number of words, sentences, and average sentence length between the pre-test and post test, indicating that teaching activities based on POA can significantly improve students' writing fluency.

3.5.2 Writing strategies

The main focus is on detecting changes in students' self-evaluation of material accumulation (MA for short), word diversity(WD for short), expression diversity (ED for short), text polishing(TP for short), and discourse structure(DS for short) in the completed scale after writing, as shown in Table 2:

Table 2 Independence Sample Test of Writing Strategies

A(Levene's Test)			vAvg. Equal Variance T Test					
F	F	Sig.	T	Sig.(T-T)	MD	SD	95% CL	95% CU
MA Equal Variance	26.592	<.001	-17.755	< 0.001	-1.65979	.09348	-1.84418	1.47540
Unequal Var.			-17.755	< 0.001	-1.65979	.09348	-1.84445	-1.47514
WD EqualVar.	3.332	.070	-15.199	< .001	-1.46392	.09632	-1.65390	-1.27394
Unequal Var.			-15.199	< .001	-1.46392	.09632	-1.65400	-.1.27383
ED Equal Var.	3.572	.060	-10.196	< 0.001	-1.07216	.10516	-1.27957	-86476
Unequal Var.			-10.196	< 0.001	-1.07216	.10516	-1.27963	--86470
TP Equal Var.	15.871	<.001	-14.566	< 0.001	-1.39175	.09555	-1.58021	1.20330
Unequal Var.			-14.566	< 0.001	-1.39175	.09555	-1.58046	-1.20305
DS Equal Var.	.079	.779	-14.906	< .001	-1.46392	.09821	-1.65762	-1.27021
Unequal Var.			-14.906	< .001	-1.46392	.09821	-1.65769	-1.27014

Note: *p<0.05

According to Table 2, in the Levene's test for homogeneity of variance for "material accumulation", Sig.=0.001, which is less than 0.05, indicates that there is a significant difference in variance between the pre-test and post test. Meanwhile, the mean values of the two tests were found to be equal using a t-test with Sig. (T-T) =0.001, which is less than 0.05, indicating a significant difference in the mean values between the two tests. From this, it can be concluded that there is a statistical relationship between pre-test and post test scores. The Levene's ANOVA test for "word diversity" showed Sig=0.070, which is greater than 0.05, indicating that there is no significant difference in variance between the pre-test and post test, assuming the assumption of equal variance. Meanwhile, the average value of the two tests is equal, the Sig. (T-T) test was found to be 0.001, which is less than 0.05. Therefore, it can be concluded that there is a significant difference in the average values between the two tests; in the Levene's test for homogeneity of variance for "diverse means of expression", Sig.=0.060, greater than 0.05, indicates that there is no significant difference in variance between the pre-test and post test, assuming the hypothesis of equal variance holds. At the same time, the mean of the two tests is equal to the t-test Sig. (T-T) =0.001, less than 0.05, indicates a significant difference in the average of the two tests. Thus, it can be concluded that there is a significant difference in pre-test and post test scores. The ANOVA test for "text polishing" showed Sig.=0.010, which is greater than 0.05, indicating a significant difference in variance between the pre-test and post test. At the same time, the mean of the two tests is equal to the t-test Sig. (T-T) =0.001, less than 0.05, it can be concluded that there is a significant difference in the average value between the two tests; Regarding the 'discourse Structure', the homogeneity test of variance Sig=0.779, greater than 0.05, indicates that there is no significant difference in variance between the pre-test and post test, assuming equality. At the same time, the mean values of the two tests were equal to the t-test Sig. (T-T)=0.001, which is less

than 0.05, indicating that there is a significant difference in the average of the two tests. From this, it can be concluded that there is a statistically significant difference in pre-test and post test scores.

4 DATA ANALYSIS AND DISCUSSION

4.1 Will POA Teaching Lead to Changes in Students' Writing Fluency?

The teaching activity of POA emphasizes output skills, starting from the driving stage to stimulate students' demand for output expression. Through the gaps in expression, students can perceive the learning goals and directions. In the facilitating stage, they receive language input and the expression framework provided by the teacher. By comparing cognitive gaps and expression frameworks, they can more clearly compare excellent and poor expressions, and improve their sensitivity to excellent expressions in the input content. In the evaluation stage, they can repeatedly strengthen their training in writing expression through writing application. The design of POA encourages students to strengthen and improve their expression by using three word, four word phrases, and refined sentence patterns. Therefore, they are more proficient in writing and increase their absorption and application of language knowledge in the teaching process. There were significant changes in the number of words, sentences, and average sentence length between the pre-test and post test, indicating that teaching activities based on POA can significantly improve students' writing fluency. But there was no significant change in word length between the pre-test and post test, mainly due to our compensatory approach. There is no specialized training for word replacement in teaching activities, only phrase combinations and sentence patterns are highlighted, which further demonstrates that students' language sensitivity can be strengthened with targeted measures. This is also in line with the research findings of domestic and foreign scholars (such as Nation 2001 [12]; Meara 2005 [13]), The improvement of writing fluency mainly lies in the overall extraction and output of phrases, sentence patterns, and other chunks, which is also due to the increased frequency, attention, focus, learning or usage needs of chunk training in POA-driven teaching process. Learners' participation in the target language has improved the speed of language application.

4.2 Will POA Teaching Lead to Changes in Students' Awareness of Writing Strategies?

The teaching activity of POA is a teaching mode emphasizing more interaction between teachers and students, and between students. The multi-dimensional teaching activity of driving, enabling, and evaluating can fully attract students' attention and learning interest. In this teaching process, the learning of phrases and sentence patterns is highlighted, so students can collect and organize writing materials as needed when writing. After a semester of teaching, a post test was conducted on the "Udig" platform. Comparing the data, it was found that students had a significant improvement in "material accumulation". At the same time, in the evaluation section, the use of different phrases was counted, which also aroused students' awareness of "vocabulary diversity" and the diversity of expression methods in terms of wording, sentences, and other aspects; At the same time, the repeated evaluation of writing also enhances the awareness of discourse structure. It can be said that the teaching design driven by POA helps students better mobilize the application of strategies. As Zhuang Zhixiang and Shu Dingfang [14] pointed out, every language learner will consciously or unconsciously adjust all their existing knowledge and cognitive strategies when attempting to complete a certain learning and cognitive task, and in many aspects, learner strategies show astonishing consistency.

5 CONCLUSION

After a semester of teaching action research, we found that based on feedback reports from diagnostic tests, teachers can quickly understand students' learning levels, especially the self-evaluation information of writing strategies attached to the "Excellent Diagnosis Learning" diagnostic assessment. Evaluation feedback and suggestions can help teachers better design teaching. The "production-oriented approach" teaching design can provide more direct exercise for the development of college English writing in comprehensive teaching. The repeated training of text phrases such as three words and four words has indeed been strengthened and accumulated in teaching, and there is a significant improvement in fluency in writing in the post test compared to the pre-test. In the multiple learning tasks of driving facilitating evaluation, students' accumulation of writing materials, vocabulary, expression methods, There have been significant improvements in polishing discourse structure. These results indicate that instructional design driven by the output oriented approach can effectively enhance students' awareness of English writing strategies and fluency in writing.

COMPETING INTERESTS

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