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Evaluating the Impact of Reciprocal Teaching Strategy on International Postgraduate Science Education Programs

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ABSTRACT

This paper aims to assess the impact of the reciprocal teaching strategy on the academic performance of student-teachers enrolled in the Higher Professional Diploma (HDE) program at Ajman University, United Arab Emirates. The study adopts a quasi-experimental design, employing pre- and post-tests and a control-experimental group configuration. The sample comprises 80 student-teachers selected from Ajman University during the second semester of the academic year 2022-2023. An academic achievement test in a multiple-choice format serves as the research instrument. The study's outcomes reveal noteworthy differences, indicating significant mean variations in the post-test scores between the experimental and control groups, favoring the control group in the context of the Reciprocal Teaching strategy. These results hold implications for international students, prompting considerations about the transferability and generalizability of teaching strategies across diverse cultural and educational settings. The findings suggest the broad effectiveness of the reciprocal teaching method, emphasizing the necessity of aligning teaching strategies with international students' specific needs and preferences. The research underscores the importance of tailoring teaching approaches to meet the unique requirements of a diverse cohort of global learners. It suggests that reciprocal teaching demonstrates efficacy across varied groups of international students, emphasizing the importance for instructors to select instructional methods that cater to the distinct needs of their diverse international student body.

Keywords: *Teaching Methods, Reciprocal Teaching strategy, Achievement, Science Education, Student Teachers, Higher Professional Diploma (HDE).*

INTRODUCTION

Educational planning holds a pivotal position in the realm of education as it imparts to educational administrators a comprehensive understanding of the intricacies inherent in the educational landscape. It stands as a cornerstone, positioning itself as one of the foremost influential agents in the field of education (Al-Qatawneh et al., 2020). The ultimate objective of pedagogy is to empower learners with the capacity to autonomously instruct themselves and cultivate a disposition for perpetual learning. In the evolving landscape of education, the pivotal factors of adaptability and efficacy in teaching methodologies persist as indispensable elements in fostering a dynamic and intellectually enriching learning milieu (Alsalhi, 2020; Smeplass, 2023). Within the foundational framework of educational planning, instruction is acknowledged as the central facet pivotal to the attainment of a universally comprehensive educational system (Karalis, 2020). Evidently, the efficacy of pedagogical strategies assumes a crucial role in moulding the comprehension and retention of educational information for each individual, facilitating its practical application in their lives (Haleem et al., 2022). The importance of catering to diverse learning modalities in the structuring of educational systems, particularly within inclusive classroom settings, has emerged as a noteworthy sub-discipline within the field of pedagogy (Karagianni & Drigas, 2023). It is noteworthy that the overarching objective of proficient pedagogy is to enable global citizens to evolve into self-directed learners (Morrison & McCutheon, 2019).

Within the contemporary dynamic educational milieu, pioneering pedagogical approaches contribute to the enhancement of critical thinking skills (Ramírez-Montoya et al., 2022), problem solving (Ramírez-Montoya et al., 2022) Leveraging diverse cultural insights, (Rehman et al., 2023), advocate for adept teaching methods with adaptability and effectiveness, fostering practical applications for students across diverse backgrounds in the global environment (Alam, 2022; Nadezhda, 2020). Acquire a comprehensive experience to facilitate students' adept adaptation to the imperatives of global change (Fauville et al., 2020).

Reciprocal teaching is unequivocally among the most effective instructional methods, enhancing students' reading comprehension and metacognitive knowledge, thereby contributing to the attainment of shared instructional objectives (Hayati et al., 2020). The reciprocal teaching strategy stands as an internationally acknowledged approach providing individuals with the opportunity to cultivate comprehension skills and metacognitive habits essential for academic success (Messina, 2023). RTS is derived from the paradigm of interactive learning (Chen et al., 2020). Thus, it appeals to students from diverse cultural backgrounds and fosters their active engagement in the educational process (Mafarja et al., 2022; Syakur & Azis, 2020).

The reciprocal teaching approach involves interacting with foreign reading materials by employing four strategies—predicting, clarifying, questioning, and summarizing. The application of these strategies aims to enhance the comprehension of reading material passages among participants from diverse cultural backgrounds, as elucidated in the aforementioned three passages (Oo et al., 2021; Pangaribuan, 2019).

Figure 1 is presented below to elucidate the instructional planning of reciprocal teaching. The subsequent listing delineates the four cognitive strategies constituting the reciprocal teaching framework, which is deemed suitable and universally applicable within the international community context.

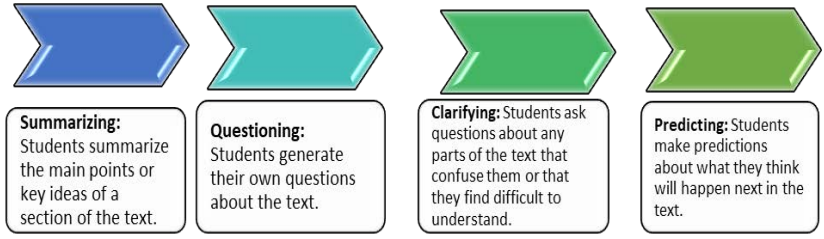

Figure 1: Four Thinking Strategies of Reciprocal Teaching Strategy.
Source: Lee et al. (2023)

Moreover, this multifaceted approach augments comprehension, facilitating students' metacognitive understanding of reading and learning processes across diverse cultures. It empowers educators worldwide to instruct students from varied international backgrounds as active, reflective, and strategic readers (Alabi, 2021; Wongdaeng, 2022). Additionally, the reciprocal teaching strategy is an inclusive pedagogical approach applicable to learners worldwide, garnering widespread support for its effectiveness in both general education and special education classes (Golla & Santos, 2023). It is also adeptly tailored for diverse curriculum domains, encompassing science, and various instructional settings (Aslam et al., 2021).

In conclusion, reciprocal teaching proves to be an effective tool for enhancing student learning with benefits that include improved comprehension and the development of skills in identifying key elements during reading. Whether in the role of a teacher or a student, engagement in reciprocal teaching activities adds an element of enjoyment to the learning process (Mafarja et al., 2023).

The reciprocal teaching strategy demonstrates efficacy within the educational instructional context (Syakur & Azis, 2020). The systematic implementation of a comprehension strategy varies among students and educators and is not contingent upon age or cultural factors (Abdelmoati Mohamed, 2023). Reciprocal Teaching Strategy plays a role in advancing and promoting global understanding through comprehension (Hogan, 2022). This research seeks to acknowledge the global perspective of the reciprocal teaching strategy within the context of international postgraduate science education programs.

The outcomes of this study are anticipated to significantly contribute to the execution of recent policies in diverse international universities. This impact extends to scholars in science education, student teachers, science educators, parents, school administrators, curriculum planners, and other stakeholders involved in science education at both local and global levels. The study is poised to provide valuable insights into the adoption of effective teaching methodologies in science education.

Furthermore, it is expected to make a meaningful contribution by informing curriculum planners, administrators, educators, and other relevant authorities about the factors influencing the popularity of such teaching-learning methods in educational systems across different countries, particularly in the field of sciences.

Global educational communities have demonstrated growing apprehension regarding the academic performance of science students. Numerous regions worldwide have collectively expressed concerns, issues, and challenges pertaining to the insufficient performance of students in science. Researchers on a global scale have undertaken investigations into this matter, acknowledging the magnitude of the problem (Diab & Schultz, 2021; Johnson et al., 2022).

The issue of subpar academic performance in science education is a global concern affecting students worldwide. International students, being prospective education professionals, are susceptible to encountering this challenge if the underlying academic deficiencies contributing to their weaknesses are not addressed. Recognizing the universal relevance of this concern, the present study sought to examine the impact of reciprocal teaching strategies on the academic achievement of international students enrolled in science education programs. In light of the globalization of education and the imperative to employ specialized teaching approaches that prepare students for a globalized environment, this research addresses a contemporary educational demand (Goodwin, 2020).

Study Questions

Research Question (RQ): Does the academic performance of Higher Professional Diploma (HDE) students in the "science teaching methods course" exhibit variations based on the utilized teaching strategy, specifically comparing the outcomes of Traditional Teaching Strategy (TTS) and Reciprocal Teaching Strategy (RTS)?

LITERATURE REVIEW

Previous studies highlighted on the significance of employing efficacious teaching methodologies for students of international backgrounds (Devlin & Samarawickrema, 2022; Liou, 2021). Pedagogical approaches, when more flexible, gain universality in comprehension and acceptance, effectively catering to the diverse learning needs of individuals across various cultures (Meina et al., 2021). The objective of postgraduate science education is to cultivate lifelong learners by imparting essential knowledge, concepts, and skill sets to the learners (Gajparia et al., 2021; Thwe & Kálmán, 2023). This principle extends to the application of reciprocal teaching. The utilization of the reciprocal teaching strategy has demonstrated positive outcomes not only in international educational settings but also in diverse cultural and linguistic contexts (Badakhshan et al., 2021), one among them is the discipline of Science. Hence, this alignment can be extrapolated to its application in other disciplinary domains, such as Science (Abrahams, 2021; Lin & Luo, 2023). In an

internationalized educational landscape, diverse postgraduate students with varied academic backgrounds and learning styles necessitate effective and tailored teaching strategies. This underscores the importance of instructors employing suitable methods to enhance the teaching and learning process in an international context (Tight, 2021). Mafarja et al. (2022) examining the significance of collaborative and interactive learning environments, reciprocal teaching emerges as a structured pedagogical approach fostering collaboration, facilitating differentiated instruction, and bolstering student motivation. Notably, reciprocal teaching demonstrates a global perspective aligned with the tenets of inclusive education, offering support and accommodations for a diverse spectrum of international students (Koreeda et al., 2023; Mpu & Adu, 2021).

Numerous investigations into the concept of reciprocal teaching consistently demonstrate positive effects on students' metacognition and reading comprehension. A specific study, involving 301 3rd-grade students, indicated that reciprocal teaching led to a notable improvement in reading comprehension, particularly among students with learning disabilities (Juhkam et al., 2023). Reciprocal teaching functions as a pedagogical framework meticulously designed to impart cognitive strategies conducive to heightened reading comprehension. Research efforts, including the study conducted by Shafiq et al. (2021), have delved into the impact of the reciprocal teaching strategy on science education. A study by Zubaidah et al. (2020) affirm that the implementation of the Remap RT learning model, with a focus on Reading, Concept Mapping, and Reciprocal Teaching, leads to enhanced academic achievement in the field of biology for students. Furthermore, Idris (2022) underscored the efficacy of the Reciprocal Constructivist Instructional Approach in enhancing academic achievement in basic sciences among middle school students. The research indicated that the group exposed to the properties and characteristics of sound through the reciprocal constructivist instructional approach achieved significantly higher mean performance compared to the group taught using the lecture method. In the context of the internationalization of education, there is a warranted exploration of teaching strategies that transcend cultural and geographical boundaries, especially in international postgraduate science education programs. As the pertinent literature has been reviewed, the global perspective on RTS has gained prominence, prompting an inquiry into its impact on international postgraduate students. In addition, Ashwin et al. (2020) assert that the implementation of the reflective teaching strategy in postgraduate education aligns effectively with the contemporary educational landscape. Specifically, in the pursuit of enriching education, emphasis is placed on both the dynamics and experiences that contribute to the educational value. This prioritization centres around considering the perspectives of both the learner and the educator (Cirocki & Widodo, 2019). The concept of reciprocal teaching must be adapted to a global audience (Díaz Chávez, 2022). The study conducted by Ramu and Kumar (2020) underscores the necessity of incorporating both a direct instruction model and a reciprocal teaching model in inclusion courses, thereby enhancing the strategy's effectiveness and demonstrating adaptability to diverse global cultures within the context of international student

inclusion. Evidently, a pedagogical approach justified for utilization with international students in the field of science is envisioned to be empowering, as corroborated by several academic authorities, researchers, and scholars (Li & Han, 2023; Sharp et al., 2020). This holds true particularly when implemented in science classrooms. With the ongoing momentum of education internationalization, there arises a imperative to offer diverse and innovative educational provisions while concurrently fostering and motivating students as learners (de Wit, 2019; Tight, 2021). Given the global disparity in resource distribution, significant emphasis must be placed on pedagogy, particularly in contexts where international students are expected to actively participate; it is imperative that their engagement is genuine.

Furthermore, a study by Alraho (2021) established that the utilization of the reciprocal teaching strategy in science education surpasses conventional methods, resulting in superior academic achievement among second-year middle school students and concurrently fostering heightened health awareness. Hayati et al. (2020) examined the efficacy of integrating an interactive approach for instructing reading comprehension. The findings revealed that the interactive approach resulted in enhanced reading scores, with students exhibiting positive responses to its application in reading instruction.

METHODOLOGY

The research design employed in this study is quasi-experimental. The test units were not randomly assigned, aligning with the typical characteristic of quasi-experimental designs, where the investigation centres on observing the effects of an intervention by providing it to one group while treating another as a control. This research design was chosen to gain a comprehensive understanding of the influence of RTS on the academic achievement of student teachers, employing a pre-test and post-test design.

Aligned with the study's investigative focus on evaluating the influence of implementing the RTS to enhance the academic achievement of HDE students in the "science teaching methods course," a quasi-experimental research methodology is employed. This methodology is deemed suitable for studies of this nature as it provides the capability to control variables affecting a phenomenon, allowing manipulation of one variable by the researcher to ascertain and measure its impact on the study subject (Gopalan et al., 2020).

Study Participants

A non-probability convenience sample of HDE students was selected from Ajman University in Ajman, United Arab Emirates during the second term of the academic year 2022–2023, comprising 80 female students. Reflecting the diverse and multicultural composition of the international student body engaged in postgraduate studies in the UAE, these participants were drawn from various nationalities, as detailed in Table 1. The cohort was stratified into two teaching strategies: the control

group (n=41, 51.3%) and the experimental group (n=39, 49.7%), ensuring a balanced distribution of participants across both instructional approaches.

Table 1: Demographic Information for Participants.

Percentage (%)	Frequency (f)	Countries of students	Group
49.7	39	China, Nigeria, India, United States	Reciprocal Strategy (RTS)
51.3	41	Germany, Saudi Arabia, South Korea, Brazil	Traditional Strategy (TTS)
100	80		Total

The international student cohort is characterized by significant diversity, with individuals hailing from various cultures and backgrounds, imbuing the study with a global perspective. The nations represented in Table 1 underscore the richness of this diversity, highlighting that international postgraduate students at Ajman University originate from highly multicultural backgrounds. This diversity is pivotal in shaping the study, conferring upon it global relevance and appeal, aligning with the evolving landscape of higher education that increasingly embraces a global orientation and values diverse perspectives from international students.

Study Variables

The ensuing variables have been incorporated within the purview of this study:

- Independent variables: Teaching Method Strategy (TTS, RTS)
- Dependent variables: The academic performance of students in the "science teaching methods course."

Study Tools/ Academic Achievement Test

The researchers devised an Academic Achievement Test to evaluate the influence of implementing the RTS strategy on students' achievement scores during their engagement in the "science teaching methods course." The test items were formulated in accordance with Bloom's cognitive domain taxonomy (Hyder & Bhamani, 2016). Furthermore, Table 2 was crafted to delineate the particulars of this examination. In its ultimate configuration, the test comprised 24 multiple-choice items, with each item assigned one point for a correct answer and zero for an incorrect response. Consequently, the maximum achievable test score was 24 points. Students were allotted a cumulative duration of 72 minutes for test completion.

Table 2: Specification Table for Academic Achievement Test Per Bloom 'S Cognitive Domain Taxonomy.

Topics	Bloom 's cognitive domain taxonomy			
	Remembering (20%)	**Understanding (30%)**	**Application (50%)**	**Total**
Science Education Standards	0.01	0.02	0.02	0.05
Next Generation Science Standards	0.03	0.04	0.04	0.11
STEM Approach in learning Science	0.02	0.03	0.05	0.1
Inquiry based learning	0.03	0.05	0.08	0.16
differentiation instruction	0.03	0.05	0.08	0.16
Blended Learning	0.03	0.04	0.07	0.14
Teaching through Problem solving	0.02	0.03	0.08	0.13
Cooperative Collaborative	0.03	0.04	0.08	0.15
Total	**0.20**	**0.30**	**0.50**	**1 (100%)**

Validity and Reliability

The validation process for the academic achievement test in the "science teaching methods course" involved the administration of the test to four experts in the field—professors specializing in curricula and methods of teaching science, along with science educational supervisors. Their feedback led to the deletion and modification of certain items. Additionally, the construct validity was established by administering the test to a sample of 27 students and computing Pearson correlation coefficients between each item's score, the overall test score, and the test category it pertained to. The correlation coefficients ranged from 0.85 (maximum) to 0.74 (minimum), with non-statistically significant items being removed. The reliability of the test was determined by calculating a stability coefficient using Cronbach's alpha, yielding a stability coefficient of 0.85, signifying a high level of test stability.

Equivalence of the Two Groups: Control and Experimental on The Pretest

In order to establish the comparability of the control (TTS) and experimental (RTS) groups on the pre-test, the means and standard deviations for the academic achievement test in the "science teaching methods course" were computed for students in both groups. The outcomes are presented in Table 3.

Table3: The Arithmetic Means and Standard Deviations of Students' Pretest Academic Achievement Scores on The Groups.

Std. Deviation	Mean	Frequency (f)	Method
1.43	3.49	39	Reciprocal Teaching Strategy (RTS)
1.78	3.29	41	Traditional Teaching Strategy (TTS)

As indicated in Table 3, the mean academic achievement for the control group TTS is 3.49 with a standard deviation of 1.43, contrasting with the experimental group RTS with a mean of 3.29 and a standard deviation of 1.78. To ascertain the statistical significance of these disparities, an independent samples t-test was conducted to assess the means of the academic achievement test variable before the implementation, based on the teaching method variable. The outcomes of the independent samples t-test are delineated in Table 4.

Table 4: Independent Sample T-Test to Identify the Source of Differences in Groups (Traditional and Reciprocal).

Method	f	Mean	Std. Deviation	t	df	sig
Reciprocal Teaching Strategy (RTS)	39	3.49	1.43	.537	78	.593
Traditional Teaching Strategy (TTS)	41	3.29	1.78			

As depicted in Table 4, the statistical examination indicated the absence of significant differences (at $\alpha = 0.05$) between the mean academic achievement scores of the control and experimental groups preceding the intervention. The computed t-value of 0.537 did not attain statistical significance at the 0.05 level. This implies that, before the implementation of teaching methods, the academic achievement of the two groups was comparable. In essence, the control and experimental groups commenced the study with equivalent academic performance.

RESULTS

To address the research question posited, which inquired: "Do the academic achievements of HDE students in the 'science teaching methods course' vary based on the employed teaching strategy (TTS), RTS?," an Independent Sample t-test was employed. Seeking to discern any significant disparities between the control and experimental groups regarding the academic achievement post-test factor in the "science teaching methods course," the results of the independent sample t-test, comparing the means and standard deviations of post-test scores in the aforementioned course for students in the control and experimental groups, are detailed in Table 5.

Table 5: The Arithmetic Means and Standard Deviations of Students' Post-Test Academic Achievement Scores on The Groups.

Std. Deviation	Mean	f	Method
1.60	15.18	39	Reciprocal Teaching Strategy (RTS)
1.73	12.73	41	Traditional Teaching Strategy (TTS)

As evident in Table 5, the mean academic achievement for the control group TTS is 15.18 with a standard deviation of 1.60, contrasting with the experimental group RTS with a mean of 12.73 and a standard deviation of 1.73. To assess the statistical significance of the intergroup differences in post-test academic achievement mean scores, considering the teaching method variable, before the program implementation, an independent samples t-test was conducted. The outcomes of the t-test are outlined in Table 6.

Table 6: Independent Sample T-Test to Identify the Source of Differences in Groups (Traditional and Reciprocal).

Method	f	Mean	Std. Deviation	t	df	sig
Reciprocal Teaching Strategy (RTS)	39	15.18	1.60	6.56	77.95	$< .001^{**}$
Traditional Teaching Strategy (TTS)	41	12.73	1.73			

As depicted in Table 6, there is a statistically significant difference ($\alpha = 0.05$) in post-test academic scores attributable to the teaching method, evident by a t-statistic value of (6.56) at the 0.05 significance level. This substantiates that the experimental group experienced a more pronounced impact compared to the control group, signifying noteworthy distinctions between the two groups.

DISCUSSION

Findings from the current study reveal a significant difference ($p < 0.05$) in the mean score of the post-test achievement test between the experimental group, employing the RTS, and the control group, employing the TTS, with a favourable outcome for the group utilizing RTS in the instruction of the Science teaching methods course for HDE student-teachers. The study's outcomes align with a positive influence attributed to the utilization of RTS on academic science achievement. This aligns with the findings of Shafiq et al. (2021) at the elementary level, Idris (2022) and Alraho (2021) at the middle school level, and the results of Mehmood and Alvi (2017) and Zubaidah et al. (2020) at the secondary level.

RTS functions as an effective instructional approach for guiding students in discerning critical concepts throughout the learning process, generating ideas and

questions, and summarizing information (Mafarja et al., 2023). Viewing RTS as a global paradigm, the findings of this research study hold significant implications for international student teachers, offering them a valuable perspective for enhancing their teaching and instructional practices on a global scale. The outcomes of this research serve as a valuable resource for students, teachers, and educational leaders worldwide, aiming to explore the potential benefits of incorporating reciprocal teaching strategy in science education contexts. The study's impact extends beyond geographical confines, serving as a reference point for educators and researchers globally. Consequently, this research holds greater value than studies confined to specific geographical areas, as it addresses the diverse needs of teachers, researchers, and student teachers across the globe. By emphasizing the suitability and appropriateness of reciprocal teaching strategy at the international level, the study contributes significantly to the broader discourse on effective science education within diverse cultural and educational settings.

Moreover, the outcomes of the inquiry were also assessed in relation to the efficacy of reciprocal teaching strategies with mainstream students, encompassing both those of typical ability and those with lower cognitive capacities (Zubaidah et al., 2020). RTS demonstrates applicability across a diverse spectrum of curricula, indicating that its implementation does not necessitate modification based on the specific content area under consideration, such as science (Capanzana & Avilla, 2017; Zubaidah et al., 2020), and many other subjects. The present study's outcomes are in concurrence with the positive influence attributed to the reciprocal teaching strategy on academic achievement at the university level, aligning with the findings reported by Smeplass (2023) in the context of pre-service science teachers. This implies that reciprocal teaching strategy serves as an effective study technique within higher education. In light of these observations, the researchers affirm the efficacy of implementing RTS in the teaching methods course for Higher Professional Diploma student-teachers (HDE). Consequently, it is imperative to foster student engagement in extracurricular reading to enhance information gathering and the development of teaching strategies. Moreover, educators are encouraged to prioritize reciprocal teaching strategy activities, fostering an environment conducive to elevated academic achievement and emphasizing questions that stimulate higher-order thinking skills. Additionally, the promotion of active learning strategies is advocated.

The implications derived from this study suggest that curriculum planners and educators should incorporate teaching strategies in science with a heightened awareness of cultural sensitivity, considering the dynamic changes within the international student population. Furthermore, while the outcomes of this study offer valuable insights into suitable teaching strategies for science education, it underscores the importance of accounting for the diverse cultural contexts inherent in international higher education. To deepen understanding, future research should delve into the interplay between teaching strategies and cultural diversity within international student cohorts, aiming to formulate pedagogical approaches that align with the intricate, global, and interconnected nature of contemporary higher education.

STUDY DELIMITATIONS

Subject Limits: The investigation was exclusively centred on the subject of RTS
Human Limits: The study specifically targeted the female student population enrolled at Ajman University in Ajman, United Arab Emirates.
Spatial Limits: The research centred on female students affiliated with Ajman University in Ajman, United Arab Emirates.
Time Limits: The study was conducted in the second semester of the academic year 2022-2023.

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