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Effect of reciprocal teaching strategy on physics student's academic self-concept

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ABSTRACT

This research determined the impact of reciprocal teaching strategies on students' academic self-concepts in physics. Reciprocal teaching is a collaborative strategy in the form of dialogue between teachers and students about a text containing eight techniques. Provide predictions, question generation, clarifications, connections, visualizations, summaries, calculations, and feedback to measure students' academic self-understanding in physics. Two groups were experimental groups (n=60) and learned physics through an interactive teaching strategy. The other group, a control group (n=60), studied physics in a traditional way, judged the effectiveness of each other's teachings, and compared the control group with a controlled trial. Results indicated that mutual education was more effective than traditional approaches in improving students' academic self-concept. The results showed that mutual teaching is a more effective strategy than traditional methods to improve students' academic self-concept. There was a significant difference between the experimental group and the control group. In this study, we proposed using the reciprocal teaching strategy in secondary school physics classes to improve students' physics learning. Teachers should also receive maintenance and maintenance training to integrate reciprocal teaching into the classroom environment.

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1. INTRODUCTION

Learning strategy is one of the numerous aspects that determine learning quality. Reciprocal teaching (RT) strategy is a cooperative activity that incorporates active reciprocal, student-to-student, and student-to-teacher engagement on reading material comprehension to develop students' knowledge [1]. Constructivist philosophy influenced the common teaching technique. In contrast to the reciprocal teaching strategy, which focuses on students. Expository learning strategy (teacher-centered approach) is a teacher-centered learning strategy [2]. Because the teacher plays a leading role in this strategy, the teacher taught the learning material directly. Physics was one of the first subjects to investigate pupils' pre-school beliefs [3]. Several studies have found that individuals have a poor conceptual grasp of science issues and that pre-instruction thoughts are classified in various ways, including misunderstandings, distinct conceptions, intuitive ideas, and naïve conceptions [4].

The standard teaching technique is a teaching strategy that encourages students to help the instructor. RT is an interactive strategy for improving student comprehension and developing metaknowledge behaviors (thinking and understanding what you know and do not know) and organizational practices for managing processes. According to Oczkus [5], reciprocal teaching is a scaffolding method for learning

challenges because it performs four functions (predictor, clarifier, questioner, and summarize). However, Palincsar and Brown [6] were the first to use RT to compensate for insufficient attention. It creates an engaging environment in which each student is included by assigning them a specific essential role, reducing the negative impacts of insufficient attention, and promoting an active environment.

Reciprocal instruction works similarly to "reading vitamins," there is evidence that students have been favorably improved by employing their four components in ways other than knowledge of reading quality [6]. The techniques presented were met with complete commitment and enthusiasm by the students. As students become aware of their poor areas of reading deficiencies, this approach provides strategic learning. This method provides students' strategic education become aware of their poor areas where they feel reading deficiencies as a result of improving understanding and learning achievement. On the other hand, Quirk [7] suggested that when students can read the text but do not have the ability to do what it implies, teachers use RT as a pedagogical method to enhance comprehension and academic self-concept (to solve the word problem).

Academic self-concept is a social science construct that is widely recognized to have a critical role in all learning contexts [8]. Self-concept belongs to self-perception, which means the descriptive or cognitive component. According to Oyserman, Elmore, and Smith [9], self-concept is a set of cognitive structures that includes content, attitudes, or evaluative judgements and helps people focus on their objectives [10]. Self-concept is defined as a broad perspective of oneself across a variety of specialized areas and perception based on self-knowledge and value appraisal based on one's experiences in his or her surroundings. It can be synthesized from the definitions proposed by the former researchers that self-concept is how one perceives him/herself, which include his/her knowledge and evaluation of his/her self.

In the academic context, self-concept's terminology is specified into a more narrowed one called academic self-concept. Academic self-concept refers to the ability to perceive oneself within a particular academic discipline. According to Kim and Sax [11], academic self-concept refers to knowledge and beliefs about oneself in the context of academic performance. Some scholars agree that academic self-concepts are related to self-evaluations of specific academic subjects and how students feel about themselves as learners, and that contextual influences They suggested that academic self-concept plays an important role in the formation of academic self-concept. This means that a student's self-concept influences their academic performance, in this case in literary subjects [12].

The government is pushing for education reform. Teaching and learning science are very valuable (physics class). Although considered a tactic in RT, it has not yet been properly implemented in Palestine [13]. Physics focuses on the eight phases of RT (prediction, question generation, clarification, connection, computation, visualization, summarization, and feedback provision), and advanced physics to explain concepts, especially numerical ones. A major scientific topic that requires competence. In secondary school, the use of defined research designs can enhance students' cognitive and metacognitive development. Vygotsky's theory of social interaction and the development of knowledge laid the foundation for mutual instruction. Vygotsky advocated clarifying ambiguous concepts, reorganizing and reorganizing learning and thinking for cognitive development, and discussing things aloud. His development proximity is critical to defining appropriate content and device interactions to improve learning and performance. This content should be delivered at a completely different level that is acceptable for learnability and comprehension. A framework for encouraging and enforcing feedback is needed to end common educational practices [5].

However, Flavell [14] considers his work to be the first of its kind, and their work suggests that the learner's reflective process and the reader's perception in different reading situations are self-regulating. Provided insight into how it affects. Despite theoretical differences from earlier frameworks, a common understanding of metacognitive methods has emerged. It is divided into his two parts (cognitive knowledge and consequent cognitive control). Metacognitive knowledge, which defined as self-awareness of aspects of a task and understanding of its application, is noted because the learner's cognitive knowledge.

Self-regulation is linked to normal behavior and thus to the reader's learning goals. The method of recording or evaluating this or ongoing state of cognitive activity is named metacognitive monitoring, and also the process of ongoing cognitive training is named metacognitive control [15], [16]. Metacognitive autoregulation includes cognitive activities like planning, testing, evaluating, testing, and changing strategies.

Physics is full of problems such as students have difficulty understanding concepts and vocabulary, which makes teaching difficult [17]. However, the force and motion (F&M) problem on which this study was based was the most effective choice, as it laid the foundation for other problems that students would encounter later in physics and other science courses) [4]. As a result, researchers apply mutual education strategies to address this issue. Physics students can use this strategy to understand other topics in physics, especially the concept of mechanics [18]. Furthermore, the issue of force and motion has allowed for deeper exploration of our understanding of a wide range of physical concepts [19].

Referring to previous research and the researcher's experience as a 10th grade science teacher, the researchers note that some physics teachers still practice traditional teaching methods that are mostly limited to lectures and discussions. The researchers pointed out that it was also found that both genders have lacked an academic self-image of physics. This study therefore seeks to fill a gap in the literature by identifying the impact of reciprocal teaching strategies on the academic self-concept of her 10th grade students in Palestine.

Reciprocal instruction is effective in almost all subjects, not just English reading. Reciprocal education is intended as a teaching method that allows students to improve their reading skills in all subjects [20]. Reciprocal education lowers students because they feel content sharing their feelings, perspectives and perspectives in interactive sessions. Learning techniques will change your thinking and allow you to express your opinion. Areas of learning include how to raise awareness, identify misconceptions, and correct them. It has evolved into a learning community in which members adopt interactive roles, including interactive learning [21], [22]. Alemu [23] improved secondary physics teaching in content- and exam-oriented courses by combining interactive peer-her tutoring with a direct teaching approach. Researchers have found that reciprocal education is beneficial to English comprehension and can be used in science subjects to demonstrate very different scientific concepts [24]. Ahiri, Yuniarsih, and Rasto [21] examined how changes in peer learning and group study models affected students' critical thinking skills.

Using a peer studying paradigm is one preference to motivate college students to assume critically, in particular in economics. Araújo and Carneiro [25], on the contrary hand, diagnosed that reciprocal education is extraordinarily high-quality in decoding biology texts by using analyzing associate in nursing. Additionally, RT in biology has enabled a complete find out about of complicated texts moreover as an appreciation of scientific terminology methods. The interpretation of texts in biology generally displays two or greater meanings that want summary explanation. Many academically deprived college students who use the RT technique, on the contrary hand, enhance their appreciation in contrast to these beforehand subjected to the same historical methods. Biology intervention college students have been overly constructive and results-oriented. Meyer [26], on the contrary hand, believed that the interactive studying procedure encourages team effort and positioning or connects to the medium of text. The researchers used reciprocal teaching techniques for the duration of this find out about in eight steps: predict, clarify, question, visualize, connect, calculate, summarize, and provide feedback.

Reading comprehension is critical in schools and universities because comprehension - creating meaning from text - is the primary goal of reading [27]. Reading comprehension provides several benefits to pupils throughout their academic lives. Several researches have documented its benefits. Reading comprehension has several advantages. It improves student achievement [28], [29] and improves conceptual performance [30]. These two advantages are insufficient to assist students in completing their assignments on campus. When students read a text, reading becomes very significant to them in understanding the themes being examined [30].

The ultimate goal of any reading exercise is to grasp what they are reading. It necessitates the employment of higher-order cognitive abilities on the reader's part. It necessitates the employment of higher-order cognitive abilities on the reader's part. It implies that readers must deduce meaning from the text. This can be accomplished through fostering interaction between readers, text, and the reader's expertise [31]. When undertaking reading activities, this interaction is called a complicated process since it comprises multiple sub-processes that interact with one another [32]. Because reading comprehension is challenging to establish interaction between the reader, the text, and the information, readers should be taught to use reading techniques to accomplish reading comprehension. It is difficult for students to attain reading comprehension if they lack the necessary skills in using reading techniques; these reading skills should be taught and practiced in the classroom [33].

Essential knowledge for skilled readers to achieve reading comprehension is vocabulary knowledge. Vocabulary mastery is crucial for successful reading comprehension to take place. There is an increasing need for academic vocabulary instruction in academic settings. It is a communication technique in the discipline content. Teachers are supposed to provide students additional opportunities to utilize terminology. In addition, it requires students to have ample opportunities to use the vocabulary as they learn it [34].

Self-concept, or personal conceptions of one's academic talents or capabilities developed via acquaintance with and interpretation of the learning environment, is one of the essential variables in human learning [35]. The influence of people's academic self-concept on their lives has been the subject of many studies. Individuals' ideas of themselves and what is achievable for them are commonly related to “feelings of efficacy, competence, control, or optimism,” and that they give the means for global structures to exercise their enormous impact on behavior [36]. That is, how we see ourselves impacts our drive to act or give up and how possible and feasible we feel our future goals are. Intellectual self-concept is a complex construct encompassing academic, social, and emotional aspects. It is not a single notion [37]. This is because people judge themselves in several ways. However, a meta-analysis of 39 longitudinal research observed that educational self-concept was once strongly related with achievement.

Furthermore, Pinxten *et al.* [37] help a reciprocal impact model in their lookup of academic self-concept studies, which believes that academic self-concept and educational accomplishment jointly strengthen one different and that the relationship findings show a upward push in both. If practitioners enhance self-concepts without enhancing performance, the improvements in self-concept are likely to be transient; when practitioners improve performance without boosting participants' self-confidence, they will achieve a temporary benefit. Researchers in language acquisition have lately begun to pay attention to autonomy. However, this interest has been restricted and mostly related to autonomy in the context of language learning [38]. The academic community's autonomy and self-efficacy are not the same [39]. Although each construct is based totally on one's evaluation of how nicely she/he can do in a given activity, the former is extra international and preceding experience-driven, while the latter is about one's appreciation of how nicely she/he can operate in a single task.

Academic confidence is a student's belief in his or her ability to accomplish a piece of work to a specified standard to meet a particular academic objective [40]. It expresses a strong belief in or confident anticipation of academic success. Students, in general, perform tasks and activities in which they feel capable [41]. The importance of confidence in pupils' learning cannot be overstated. High achievers are students that have a high level of academic confidence. Internal motivation is critical for pupils to improve their academic confidence. It has been discovered that a child who feels himself to be confident performs well academically. A child who believes worthless is less confident and may not achieve their full potential [42]. Students with poor academic confidence have lower academic skills when they start college, are less interested and have more transition issues [43]. Academic confidence is thought to influence performance via influencing task perception. According to studies, having a high level of academic confidence produces a sense of serenity when confronting a tough assignment. On the other hand, low academic confidence may cause an individual to see a task as more complicated than it is, resulting in tension and a narrowing of options while approaching the problem's solution [44].

The academic effort is described as an aspect of getting to know pastime involvement influenced by means of attention, self-direction, and perseverance [45]. Students' self-perceptions of effort, which exhibit their self-perceived want to put out effort at school, have been the problem of the cutting-edge study. According to Trautwein and Lüdtke [45] published that academic effort is a multidimensional entity with domain-specificity. For example, it confirmed that domain-specific educational self-concepts expected educational effort in that vicinity the usage of an impartial results model (i.e., math self-concept estimated effort in math, science self-concept estimated effort in science).

In their reciprocal impact models, Marsh *et al.* [35] incorporated effort, as well as self-concept and achievement. They also looked at how academic effort influenced self-concept, effort, and accomplishment later in life. According to the researchers, there was no indication of a reciprocal association between effort and accomplishment. Previous effort positively affected subsequent self-concept, whereas prior effort adversely influenced subsequent self-concept. Moreover, the interaction of academic effort had a positive effect on later self-concept, and past effort had a strong effect on later self-concept of high-concept students [46].

Traditional techniques of schooling include dictation, drilling, and explaining. In many developing nations, including Palestine, the teacher-led conference method's traditional methodology. It is a means of communicating the truth. Despite widespread criticism from advanced revolutionary academics, it is still relevant in form and content. Rich content, breaks, a trade in tone, and an advantageous presentation all assist an instructor's effectiveness when the use of the lecture technique. Its inherent difficulties can be addressed with a range of interventions, which include reciprocal educating and innovations. This find out about investigated the blessings and dangers of two educating methods: reciprocal and traditional. However, the purpose of this study is to use a common teaching technique to enhance academic self-concept and understanding of physics concepts, particularly force and motion concepts. Thus, the hypotheses of the study are: i) There is a statistically significant difference in mean academic self-concept scores between the experimental group of students learning physics through reciprocal instruction and the control group of students learning physics through conventional methods (H1); and ii) There is a statistically significant difference in the academic self-concept of 10th grade Physics students due to the interplay of teaching technique and gender (H2).

2. RESEARCH METHOD

2.1. Research design

The study utilized a quasi-experimental style with four teams: two experimental groups (male and female) and two management groups (male and female). As a unique (unusual) therapy, the experimental groups got the reciprocal teaching approach. The control groups were subjected to ancient methods. The six

weeks analysis intervention began in August 2020 and lasted eight weeks. As results of colleges were closed Palestine throughout the COVID-19 period, the investigator shifted the intervention founded time from March 2020 to August 2020. The researcher has solely two months to hold out the intervention or collect data, that's depleted time to indicate and learn new ways or strategies. Throughout the primary week of the intervention, all pre-tests (academic self-concept questionnaires) were administered to assess homogeneity between the experimental and management teams still as Palestine students' secondary tutorial performance level.

The experimental cluster was divided into seven groups, each with a minimum of five students. Within the second week, the intervention began, with the experimental group receiving six weeks of reciprocal teaching and also the control group receiving customary instruction. Every group had an equal sort of students. A method-specific coaching manual was wont to train two instructors in reciprocal teaching. However, reading lessons structured exploitation the RT strategy could even be accustomed develop before, during, and after-reading activities.

2.2. Sample

There were two intact classes used in this study (30 females and 30 males) serve as the experimental groups, while two other classes (30 females and 30 males) serve as the control groups. Pre-tests are used to investigate the fourth group's equality (academic self-concept questionnaire). The experimental groups learn through reciprocal teaching, while the control groups learn through traditional methods.

2.3. Instruments

Because one among the current study's goals was to increase academic self-concept among selected Palestinian physics secondary students through reciprocal training, the adopted of an instructional self-concept measure was required. In step with Hamed, Hussin, and Jam [47], the researcher adapted a tutorial self-concept questionnaire. It is divided into two subscales (academic confidence and academic effort), with ten items each designed to elicit information about the student's academic self-concept. As a result, the initial questionnaire was created with the intention of being applicable to the whole sample of 10th grade students during this study. The researcher has improved the students' performance. The researcher requested that the author use this questionnaire, including 20 Likert scale items related to academic self-concept. However, the reliability and validity are satisfactory. The validity ranged from 0.5 to 0.8, and also the reliability ranged from 0.81 to 0.70. The Likert scale was divided into five categories: strongly disagree=1, disagree=2, neither agree nor disagree=3, agree=4, and strongly agree=5.

2.4. Data analysis

The data from two different schools was tabulated to evaluate academic self-concept, descriptive statistics (mean, SD), normality and homogeneity, one-way ANCOVA, and two-way ANCOVA. The interval Likert scale might be a quantitative measurement scale with order and a meaningful and equal difference between two variables. Variables are evaluated on one scale with equal intervals. The methods for calculating the gap between variables are reasonably accurate. one in every of the foremost used interval scale inquiries is that the five-point Likert scale, within which variety represents each emotion, and also the variables span from strongly disagree to agree strongly. The approach of research questions and data structures employing various units is spoken as multi-level analysis. This was discovered through a study that tested several levels of aggregation, including persons and counties and students, classrooms, and schools.

3. RESULTS AND DISCUSSION

3.1. Difference of academic self-concept based on groups

The assumption of normalcy must be satisfied for the bulk of parametric tests. The distribution of the test results is generally distributed (or bell-shaped), with 0 means, one variance, and an asymmetric curve. Skewness and Kurtosis tests were employed in this study to judge the idea of normality to a traditional distribution. Skewness values should be within the range of ±2. Kurtosis values should be within scope of ±7. The normalcy test for the educational self-concept subconstruct is shown in Table 1.

Table 1 displays the skewness and kurtosis values, as well as the mean and variance of each component in both tests (Skewness and Kurtosis Tests). Because Skewness should be less than 2, all groups were determined to be normally distributed. Kurtosis readings on the tutorial self-concept scale should be within a 7-point range, indicating a typical distribution for both the control and experimental groups. Also, to determine whether or not the knowledge is distributable. Under the premise of variance homogeneity, the researchers used Levene's test to determine whether the groups had identical variances. To satisfy the equality of variances assumption, this test should not be significant.

The homogeneity of variances in academic self-concept revealed a result of F (1,118) =0.007, p=0.93>0.05, indicating that there is no significant difference on the tutorial self-concept scale between the control and experimental groups. While the results for the tutorial self-concept sub-skills were academic confidence F (1,118) =0.116, p=0.73>0.05, indicating that there is no significant difference between the control and experimental groups in academic confidence. The difference in academic effort between the control and experimental groups was F (1,118) =0.057, p=0.81>0.05, indicating that there was no significant difference between the two groups. Consequently, there are no significant variations within the general level and two variables for the tutorial self-concept scale between the experimental and control groups (academic confidence and academic effort). The experimental and control groups' academic self-concepts were similar before the intervention. As a result, the two groups' scores are almost equal.

Table 1. Descriptive statistics

Subcontract	Mean	SD	Skewness	Kurtosis
Academic confidence	3.29	0.33	0.51	-0.32
Academic effort	3.54	0.45	-1.69	5.46
Overall	3.41	0.29	-0.25	0.03

In this section, the researcher wanted to determine if there have been any differences between the common teaching strategy and therefore the traditional method of developing academic self-concept among Palestinian 10th-graders. The educational self-concept scale was administered to any or all study samples or groups (experimental and control) after the intervention. The mean, variance, and significant value of the one-way MANCOVA for two subconstructs of the educational self-concept were calculated (academic effort and academic confidence). Table 2 compares students' norm results for the experimental group who learned physics using the reciprocal teaching strategy to students' scores who learned physics using the traditional method.

Table 2 shows the mean and average educational self-concept and subconstructs across experimental and control groups (academic confidence and academic effort). The results show that from pre-test to post-test, all academic self-concepts improved, indicating that the experiment was beneficial to the students. The tutorial confidence factor result was the reciprocal teaching group post-test mean (3.45). The traditional group post-test, on the other hand (3.30). Thus, in terms of mean gain difference, the reciprocal teaching group outperforms the traditional method group, indicating that the reciprocal teaching group improves the academic confidence subconstruct of the tutorial self-concept scale over the conventional method. The post-test mean of the reciprocal teaching group was the tutorial effort subconstruct (3.70). The post-test for the control group, on the other hand (3.49). Thus, the norm difference between the reciprocal teaching and traditional method groups favors the latter, indicating that reciprocal teaching improves the tutorial effort subconstruct of the academic self-concept scale of the reciprocal teaching group over the quality method. The reciprocal teaching group's post-test mean on the tutorial self-concept measure was (3.57). The everyday group post-test mean, on the other hand, was (3.40). As a result, the common difference between the reciprocal teaching and traditional method groups favors the reciprocal teaching group, indicating that the reciprocal teaching group's overall academic self-concept scale improves over the quality method.

Table 2. Comparison of mean value results for academic self-concept

Dependent variable	Group	Mean	Std. Error	95% Confidence interval	
				Lower bound	Upper bound
Academic confidence	Control group	3.30	0.04	3.20	3.4
	Experimental group	3.45	0.04	3.34	3.55
Academic effort	Control group	3.49	0.05	3.37	3.62
	Experimental group	3.70	0.05	3.57	3.83
Overall	Control group	3.40	0.03	3.32	3.48
	Experimental group	3.57	0.03	3.49	3.65

To examine the many differences in mean between the experimental and control groups, moreover because the influence of reciprocal teaching on improving academic self-concept among Palestinian 10th grade physics students, method of variance (One-way MANCOVA) was used to analyze the tutorial self-concept data between control and experimental groups. Wilks' Lambda was used to interpret the MANCOVA findings. The Wilks' Lambda was chosen by the researchers because it is more robust to minor assumptions violations. Table 3 summarizes the findings.

Table 3. Wilks' Lambda test of control and experimental groups in academic self-concept for post-test

Effect	Value	F	Hypothesis df	Error df	Sig	Partial η^2
Wilks' Lambda	0.87	8.59	2	117	0.001	0.13

Table 3 shows Wilks' Lambda results, comparing the control group (traditional method) and also the experimental group (reciprocal teaching strategy) in academic self-concept after the intervention, using Pillai's Trace test at the extent of significance (0.05). Wilks' Lambda=0.77, F (2,117) =8.59, p=0.001<0.05, Partial^2=0.13, indicating that there is a big difference in academic self-concept between the control and experimental groups. This demonstrates a major difference between reciprocal teaching (experimental group) and standard teaching (control group) in keeping with the Partial multivariate ŋ2 (0.13) the independent variables account for roughly 13% of total variances in academic self-concept subconstructs (instructional approaches like reciprocal teaching model). Because the results were significant, we must examine the between-subject effects or the univariate test for every variable quantity, the result obtained in Table 4.

Table 4. Test of between-subject effect for academic self-concept

Dependent variable	df	Mean square	F	Sig.	Partial ŋ2
Academic confidence	1	0.65	7.08	0.009	0.06
Academic effort	1	1.28	8.85	0.004	0.07
Overall	1	0.94	17.24	0.001	0.13

The value F (1,118) =17.24, p=0.001<0.05 Partial ŋ2=0.13 indicated that approximately 13% of the variance in overall academic self-concept score is thanks to treatment. within the results of the tutorial self-concept scale, Table 4 shows a serious difference between the mean of the experimental group and also the mean of the control group, favoring the experimental group who learned physics employing a typical teaching technique. the next were the findings for tutorial self-concept factors: for tutorial confidence, the price was F (1,118) =7.08, p=0.009<0.05, Partial 2=0.06, indicating that treatment accounts for about 6% of the variance in academic confidence subconstruct score, indicating that there is a significant difference within the mean of the experimental group and also the control group for the tutorial confidence result in favor of the experimental group. the tutorial effort was valued at F (1,118) =8.85, p=0.004<0.05, and Partial 2=0.07. this means that treatment accounted for around 7% of the tutorial effort subconstruct score variance. This also suggests a substantial difference within the mean of the experimental group and also the control group for the tutorial effort outcome in favor of the experimental group, who were chosen supported a study of previous research. this study's findings were revealed to be compatible with those of other research which demonstrated the influence of reciprocal teaching on academic self-concept enhancement. As illustrated in Figure 1, the anticipated means for overall academic self-concept could even be emphasized.

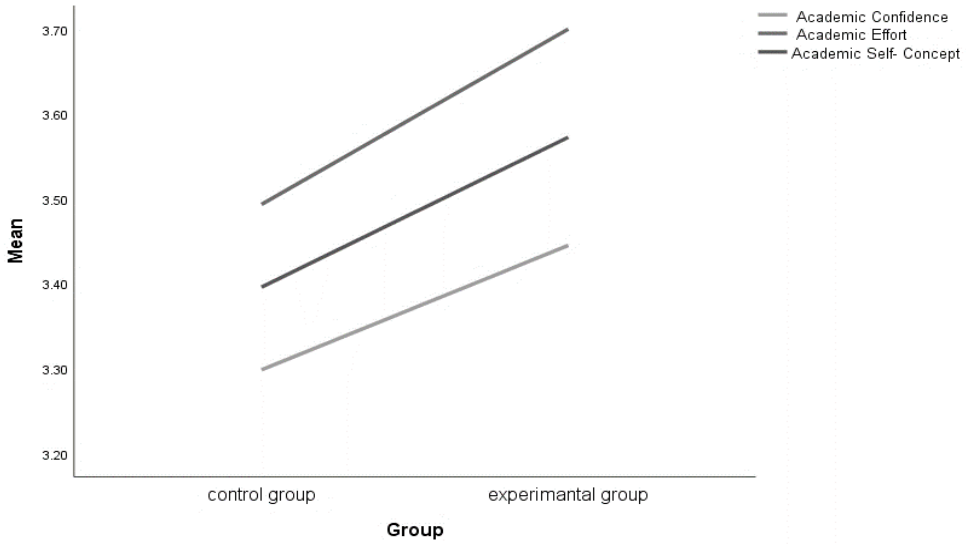

Figure 1. Estimated marginal of academic self-concept score between control and experimental groups

3.2. Difference of academic self-concept based on groups and gender

In this section, the researcher sought to discover the differences between the common teaching strategy and the traditional method in enhancing academic self-concept among 10th grade students in Palestine. After completing the intervention, the academic self-concept was administered among all research samples (male and female and the interaction between gender and method). The mean and standard deviation of the student's scores in the two subconstructs of academic self-concept were computed (academic confidence and academic effort). Table 5 compares students' "scores in the academic self-concept measure for male and female students who acquired physics using the reciprocal teaching technique to students' scores who learned physics using the standard method."

Table 5 indicates an improvement in academic self-concept for students learning physics using the reciprocal teaching strategy. Males had a median value of (3.57). within the post-test for college kids who learned physics the normal way, the norm for females was (3.57), and therefore the mean for males was (3.40). The quality teaching technique appears to possess helped both male and feminine students improve their academic self-concept, with the feminine group benefiting over the male group.

Table 6 shows that the primary subconstruct of educational self-concept, academic confidence, differed between male and feminine groups of physics students who used the reciprocal teaching strategy, with males having a mean of (3.43) and females having a mean of (3.43), (3.46). The post-test results for traditional physics students; the mean for males was (3.38), and therefore the mean for females was (3.21). Furthermore, the results for the second subconstruct of educational self-concept, academic effort, revealed a difference between the male and feminine in favor of the male who was learning physics through the reciprocal teaching strategy, with the common male value being (3.72), while the mean female value was (3.68). The post-test results for traditional physics students; the average for males was (3.41); the average for females was (3.58). When testing the effect of the reciprocal teaching strategy on attractive academic self-concept among Palestinian 10th grade students, the investigation of addition scores yields equitable finally ends up in additional extensive clusters of exploration plans. This tally compares the impact of two methods (for entire groups, upgrades from pre-test to post-test).

Table 5. Comparison of mean value results for gender and method in academic self-concept

Dependent variable	Gender	Method	Mean	Std. Error	95% Confidence interval	
					Lower bound	Upper bound
Academic confidence	Male	Traditional method	3.38	0.05	3.24	3.53
		Reciprocal teaching	3.43	0.05	3.28	3.57
	Female	Traditional method	3.21	0.05	3.07	3.36
		Reciprocal teaching	3.46	0.05	3.32	3.61
Academic effort	Male	Traditional method	3.41	0.07	3.23	3.59
		Reciprocal teaching	3.72	0.07	3.54	3.90
	Female	Traditional method	3.58	0.07	3.4	3.76
		Reciprocal teaching	3.60	0.07	3.5	3.86
Overall	Male	Traditional method	3.40	0.04	3.28	3.51
		Reciprocal teaching	3.57	0.04	3.46	3.69
	Female	Traditional method	3.40	0.04	3.28	3.51
		Reciprocal teaching	3.57	0.04	3.46	3.68

Table 6 shows the main effects of the interaction between gender and technique; no significant interaction effects were found between method and gender. Wilks' Lambda=0.95, F (2,115) =2.76, p=0.046>0.05. The Partial η^2=0.046 indicates that the interaction between teaching method and gender accounts for only 4.6% of the total variance. The current study used a within-subject contrast test for the academic self-concept scale method to determine how the common teaching strategy and the traditional method influenced the selected academic self-concept of 10th-grade physics students in Palestine.

Table 6. Wilks' Lambda test between teaching method and gender in academic self-concept

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial η^2
Gender * Method	Wilks' Lambda	0.95	2.76	2	115	0.067	0.046

Table 7 shows the test of between - subjects for all dependent variables. The value F (1,116) =0.096, p=0.76>0.05 shows that there is no significant difference within the mean of the interaction between gender (male and female) and technique (reciprocal teaching and traditional method) for the results of educational self-concept. The result for tutorial confidence was F (1,116) =3.61, p=0.06>0.05, indicating

that the mean of the interaction for tutorial confidence between gender (male and female) and technique (reciprocal teaching and standard method) was not significantly different F (1,116) =2.23, p=0.14>0.05, indicating that the mean of the interaction between gender (male and female) and technique (reciprocal teaching and standard method) for tutorial effort was not significantly different. All research samples got the tutorial self-concept scale (male and feminine and thus the interaction between gender and method). Overall, there is a serious difference in academic self-concept and subconstructs between the experimental and control groups, moreover as pre- and post-tests for the experimental and control groups in favor of the experimental group that learns physics through reciprocal teaching. However, there is not any significant difference in academic confidence, academic effort, or overall academic self-concept between the control and experimental groups for the interaction of gender (male and female) and technique (conventional method and reciprocal teaching approach). However, there was no difference between (male and female) and (reciprocal teaching and traditional technique) on the tutorial self-concept scale, favoring males who study physics using the reciprocal teaching strategy. On the other hand, Figure 2 shows that overall, the male group scored for an academic self-concept quite same with female students who's tough physics via reciprocal teaching strategy. The results were further analyzed to ensure accuracy.

Table 7. A comparison of between-subjects impacts on academic self-concept was conducted

Source	Dependent variable	Type III sum of squares	df	Mean square	F	Sig.	Partial η^2
Gender * Method	Academic confidence	0.32	1	0.32	3.61	0.06	0.03
	Academic effort	0.32	1	0.32	2.23	0.14	0.02
	Overall	8.33	1	8.33	0.096	0.76	0.001

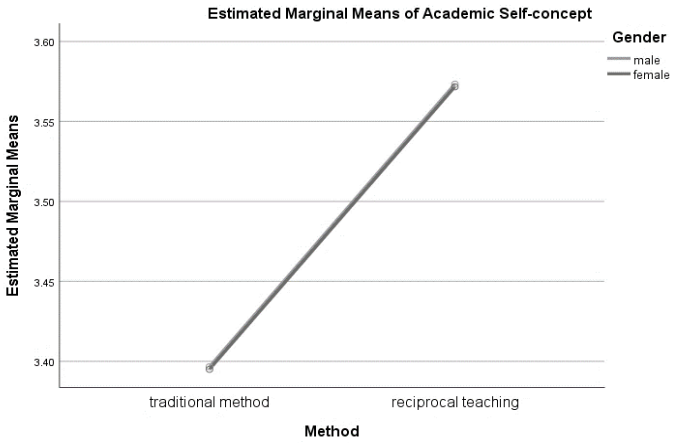

Figure 2. Comparison between the means of the gender (male and female) and method (reciprocal teaching and traditional method) in the academic self-concept

This study bears a striking resemblance to previous studies [26]. This is also in line with the findings of previous researches [19], [21] which suggested reciprocal teaching for whole-class understanding, who used RT to help students with whole-class comprehension and verbal issues. In line with Palincsar and Brown [6], teachers and peers' roles were transferred continuously from one another, allowing the prophet, the questioner, and the narrator to build a productive environment, which showed results. The experimental group's cognitive and metacognitive domains perform better because of the students' application components of knowledge, understanding, and RT involvement. The new treatment given to the experimental group has a more significant impact on students' academic self-concept. Hou [48] found that RT's new behavior led to a considerable improvement in the retention of experimental group students in physics-based on fact-based and statistical data (mechanics). Hampson-Jones [20] discovered that the favorable elements of all the different school groups and the experimental group differed significantly.

The findings for the present research in academic self-concept show there have been significantly different overall academic self-concept scores between control groups who learn physics by the normal method and experimental groups, which is learning physics by reciprocal teaching strategy in favor of experimental groups. For the academic self-concept subconstructs, first, the academic confidence subconstruct is significantly different between groups favoring the experimental group learning physics by

reciprocal teaching. Second, there is a substantial difference in academic effort across groups, with the experimental group learning physics through reciprocal instruction. However, the roles of teachers and peers were continuously shifted to each other within the type of predictor, clarifier, questioner, summarize, connecting, calculating, and providing feedback. This results in the environment that produced the results that show that experimental group students' and metacognitive scored better for knowledge, comprehension, and application components of the cognitive domain due to the incorporation of RT to boost self-concept, communication [38], [39].

In the interaction between gender (male and female) and pedagogics, there is no significant difference between the control and experimental groups in academic confidence, academic effort, and overall academic self-concept (traditional method and reciprocal teaching strategy). However, male and feminine students within the experimental group were more active and interested. They preferred the reciprocal teaching strategy to learn physics because it helps them understand physics concepts, solve word problems, and improve their academic self-concepts and subconstructs in physics more than the traditional method. As a result, the RT learning model is one of the most successful learning methods for improving students' low competence in science courses.

This study contributed to the inclusion of a new method of teaching Physics, a new strategy will be added to the strategies that improved academic self-concepts in learning physics. This study introducing teachers to the reciprocal teaching and its effects on students' academic self-concepts in learning physics. This study provided a theoretical material that contains information about the reciprocal teaching and how to apply it in the classroom, and test its effects on students' academic self-concepts in learning physics.

4. CONCLUSION

The outcome of reciprocal teaching provides an academic self-concept for both male and female successful learning; on the experimental group's side, high achievement is achieved. The experimental and control groups had different scores, but the experimental group had a more organized academic self-concept in physics than the control group (mechanics). The reciprocal teaching strategy outperformed traditional methods in physics for 10th grade students. At the secondary level, the approach has a significant impact on the intelligence component of students' cognitive and metacognitive domains. Through reciprocal instruction, the experimental group's comprehension of the cognitive and metacognitive fields was improved over the control groups. The RT method has improved experimental group students' cognitive, metacognitive, and academic self-concept in physics (mechanics). Based on the data reported in this study, various implications for stakeholders (e.g., scholars, policymakers, teachers, students) are given; there were several implications for science teachers. Many teachers (both in-service and pre-service teachers) believed that the reciprocal teaching strategy would be difficult to manage the classroom and time.

Subsequently, the specialist recommends that more exploration be finished on the impact of reciprocal teaching on the improvement of different factors (higher-request thinking capacities, disposition). Understudies from different instructive foundations and disciplines are urged to think logically, fundamentally, and inventively. Moreover, this incorporates directing a near report between the complementary Reciprocal teaching and other instructive strategies or methods for various higher-request thinking abilities (basic, innovative, logical, and intelligent reasoning, among different factors), as well as duplicating flow examination to decide the effect of the normal showing strategy at different levels, for example, grade schools, educator foundations, and tertiary level.

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REFERENCES

[1] D. Maulani, S. Suyono, and A. Noornia, "The effect of application of the reciprocal teaching model on mathematical communication ability viewed from the self-concept of students at SMAN Tambun South Bekasi," (in Indonesian), *Jurnal Penelitian dan Pembelajaran Matematika*, vol. 10, no. 2, Aug. 2017, doi: 10.30870/jppm.v10i2.2026.

[2] N. Hendracipta, A. Syachruroji, and H. Hermawilda, "Differences in student learning outcomes between using inquiry strategy and expository strategy," (in Indonesian), *Jurnal Pendidikan Sekolah Dasar*, vol. 3, no. 1, pp. 33–41, Mar. 2017, doi: 10.30870/jpsd.v3i1.1137.

[3] O. Akınoğlu, "Pre-Service Teachers' Metaphorical Perceptions Regarding the Concept of Curriculum," *International Journal of Instruction*, pp. 263–278, Apr. 2017, doi: 10.12973/iji.2017.10217a.

[4] L. Bigozzi, C. Tarchi, P. Falsini, and C. Fiorentini, "'Slow Science': Building scientific concepts in physics in high school," *International Journal of Science Education*, vol. 36, no. 13, pp. 2221–2242, Sep. 2014, doi: 10.1080/09500693.2014.919425.

[5] L. Oczkus, "Reciprocal Teaching: Powerful Hands-on Comprehension Strategy," *The Utah Journal of Literacy*, vol. 16, no. 1, pp. 34–38, 2013, [Online]. Available: https://utahliteracy.org/uploads/journal/spring-2013/07-reciprocal-teaching-powerful-hands-on-comprehension-strategy.pdf
[6] A. S. Palinscar and A. L. Brown, "Reciprocal Teaching of Comprehension-Fostering and Comprehension-Monitoring Activities," *Cognition and Instruction*, vol. 1, no. 2, pp. 117–175, Mar. 1984, doi: 10.1207/s1532690xci0102_1.
[7] P. J. Quirk, "Using reciprocal teaching and learning to enhance comprehension in mathematics word problems," Master Thesis, Massey University, 2010. [Online]. Available: https://muir.massey.ac.nz/bitstream/handle/10179/2247/02_whole.pdf
[8] M. Seaton, P. Parker, H. W. Marsh, R. G. Craven, and A. S. Yeung, "The reciprocal relations between self-concept, motivation and achievement: juxtaposing academic self-concept and achievement goal orientations for mathematics success," *Educational Psychology*, vol. 34, no. 1, pp. 49–72, Jan. 2014, doi: 10.1080/01443410.2013.825232.
[9] D. Oyserman, K. Elmore, and G. Smith, "Self, self-Concept, and Identity," in *Handbook of Self and Identity*, Guilford, 2012, pp. 69–104.
[10] D. Prince and P. S. Nurius, "The role of positive academic self-concept in promoting school success," *Children and Youth Services Review*, vol. 43, pp. 145–152, Aug. 2014, doi: 10.1016/j.childyouth.2014.05.003.
[11] Y. K. Kim and L. J. Sax, "The Effects of Student–Faculty Interaction on Academic Self-Concept: Does Academic Major Matter?" *Research in Higher Education*, vol. 55, no. 8, pp. 780–809, Dec. 2014, doi: 10.1007/s11162-014-9335-x.
[12] D. Sewasew and U. Schroeders, "The developmental interplay of academic self-concept and achievement within and across domains among primary school students," *Contemporary Educational Psychology*, vol. 58, pp. 204–212, Jul. 2019, doi: 10.1016/j.cedpsych.2019.03.009.
[13] A. N. Alimat, M. M. Al-Shanaq, and W. H. Al-Omari, "The effectiveness of reciprocal teaching strategy in improving critical thinking skills in mathematics among students of a class teacher at The Hashemite University," (in Arabic), *Al-Manara Journal for Research and Studies*, vol. 24, no. 4, pp. 498–528, 2018, [Online]. Available: http://repository.aabu.edu.jo/jspui/handle/123456789/1708.
[14] J. H. Flavell, "Metacognitive aspects of problem-solving," in L. B. Resnick, Ed. *The nature of intelligence*, Hillsdale, NJ: Lawrence Erlbaum, 1976, pp. 231–235.
[15] M. Miarsyah, R. H. Ristanto, P. Lestari, and S. Rahayu, "Metacognitive on Pteridophyte: A Unification of Cooperative Integrated Reading and Composition and Guided Inquiry (CirGI)," *International Journal of Instruction*, vol. 14, no. 3, pp. 481–500, Jul. 2021, doi: 10.29333/iji.2021.14328a.
[16] G. Stephanou and M.-H. Mpiontini, "Metacognitive Knowledge and Metacognitive Regulation in Self-Regulatory Learning Style, and in Its Effects on Performance Expectation and Subsequent Performance across Diverse School Subjects," *Psychology*, vol. 08, no. 12, pp. 1941–1975, 2017, doi: 10.4236/psych.2017.812125.
[17] L. Bigozzi, C. Tarchi, C. Fiorentini, P. Falsini, and F. Stefanelli, "The Influence of Teaching Approach on Students' Conceptual Learning in Physics," *Frontiers in Psychology*, vol. 9, Dec. 2018, doi: 10.3389/fpsyg.2018.02474.
[18] C. Becerra-Labra, A. Gras-Martí, and J. M. Torregrosa, "Effects of a Problem-based Structure of Physics Contents on Conceptual Learning and the Ability to Solve Problems," *International Journal of Science Education*, vol. 34, no. 8, pp. 1235–1253, May 2012, doi: 10.1080/09500693.2011.619210.
[19] S. Syuhendri, "A learning process based on conceptual change approach to foster conceptual change in Newtonian mechanics," *Journal of Baltic Science Education*, vol. 16, no. 2, pp. 228–240, 2017, doi: 10.33225/jbse/17.16.228.
[20] F. E. Hampson-Jones, "Reciprocal Teaching: Investigation of its effectiveness as a method of whole class reading comprehension instruction at Key Stage Two," Unpublished Dissertation, University of London, 2014.
[21] Y. Ahiri, T. Yuniarsih, and Rasto, "The Effect of Reciprocal Teaching and Group Investigation Toward Students' Critical Thinking Skill," *International Journal of Education, Learning and Development*, vol. 6, no. 3, pp. 37–46, 2018.
[22] L. Ashegh Navaie, "The Effects of Reciprocal Teaching on Reading Comprehension of Iranian EFL Learners," *Advances in Language and Literary Studies*, vol. 9, no. 4, p. 26, 2018, doi: 10.7575/aiac.alls.v.9n.4p.26.
[23] M. Alemu, "Improving Secondary School Students Physics Achievement Using Reciprocal Peer Tutoring: A Multi-level Quasi-Experimental Study," *EURASIA Journal of Mathematics, Science and Technology Education*, vol. 16, no. 4, Jan. 2020, doi: 10.29333/ejmste/115164.
[24] M. Maysara and H. Habiddin, "The Implementation of Reciprocal Teaching Model to Improve Students' Achievement on Acid-Base Concepts," *Jurnal Pembelajaran Kimia*, vol. 4, no. 1, pp. 14–17, 2019, doi: 10.17977/um026v4i12019p014.
[25] S. Paixão Araújo and M. H. Silva Carneiro, "Reading in Biology Classes—A Different Teaching Activity," *Creative Education*, vol. 07, no. 07, pp. 1044–1050, 2016, doi: 10.4236/ce.2016.77108.
[26] K. Meyer, "Making meaning in mathematics problem-solving using the Reciprocal Teaching approach," *Literacy Learning: The Middle Years*, vol. 22, no. 2, pp. 7–14, 2014.
[27] J. L. Luckner and C. M. Handley, "A Summary of the Reading Comprehension Research Undertaken with Students Who Are Deaf or Hard of Hearing," *American Annals of the Deaf*, vol. 153, no. 1, pp. 6–36, 2008, doi: 10.1353/aad.0.0006.
[28] Y. Law, C. K. K. Chan, and J. Sachs, "Beliefs about learning, self-regulated strategies and text comprehension among Chinese children," *British Journal of Educational Psychology*, vol. 78, no. 1, pp. 51–73, Mar. 2008, doi: 10.1348/000709907X179812.
[29] H. Savolainen, T. Ahonen, M. Aro, A. Tolvanen, and L. Holopainen, "Reading comprehension, word reading and spelling as predictors of school achievement and choice of secondary education," *Learning and Instruction*, vol. 18, no. 2, pp. 201–210, Apr. 2008, doi: 10.1016/j.learninstruc.2007.09.017.
[30] J. G. Cromley, L. E. Snyder-Hogan, and U. A. Luciw-Dubas, "Reading comprehension of scientific text: A domain-specific test of the direct and inferential mediation model of reading comprehension.," *Journal of Educational Psychology*, vol. 102, no. 3, pp. 687–700, 2010, doi: 10.1037/a0019452.
[31] W. Handayani *et al.*, "Physics student teachers' reading comprehension skills of science and physics texts," *Jurnal Inovasi Pendidikan IPA*, vol. 4, no. 2, pp. 203–211, 2018, doi: 10.21831/jipi.v4i2.21633.
[32] M. M. L. Muijselaar, N. M. Swart, E. G. Steenbeek-Planting, M. Droop, L. Verhoeven, and P. F. de Jong, "Developmental Relations Between Reading Comprehension and Reading Strategies," *Scientific Studies of Reading*, vol. 21, no. 3, pp. 194–209, May 2017, doi: 10.1080/10888438.2017.1278763.
[33] W. Nagy and D. Townsend, "Words as Tools: Learning Academic Vocabulary as Language Acquisition," *Reading Research Quarterly*, vol. 47, no. 1, pp. 91–108, Jan. 2012, doi: 10.1002/RRQ.011.
[34] H. W. Marsh and A. J. Martin, "Academic self-concept and academic achievement: Relations and causal ordering," *British Journal of Educational Psychology*, vol. 81, no. 1, pp. 59–77, Mar. 2011, doi: 10.1348/000709910X503501.
[35] H. W. Marsh, R. Pekrun, S. Lichtenfeld, J. Guo, A. K. Arens, and K. Murayama, "Breaking the double-edged sword of effort/trying hard: Developmental equilibrium and longitudinal relations among effort, achievement, and academic self-concept.," *Developmental Psychology*, vol. 52, no. 8, pp. 1273–1290, Aug. 2016, doi: 10.1037/dev0000146.

[36] G. Szumski and M. Karwowski, "Exploring the Pygmalion effect: The role of teacher expectations, academic self-concept, and class context in students' math achievement," *Contemporary Educational Psychology*, vol. 59, p. 101787, Oct. 2019, doi: 10.1016/j.cedpsych.2019.101787.
[37] M. Pinxten, S. Wouters, F. Preckel, C. Niepel, B. De Fraine, and K. Verschueren, "The formation of academic self-concept in elementary education: A unifying model for external and internal comparisons," *Contemporary Educational Psychology*, vol. 41, pp. 124–132, Apr. 2015, doi: 10.1016/j.cedpsych.2014.12.003.
[38] M. Jansen, U. Schroeders, and O. Lüdtke, "Academic self-concept in science: Multidimensionality, relations to achievement measures, and gender differences," *Learning and Individual Differences*, vol. 30, pp. 11–21, Feb. 2014, doi: 10.1016/j.lindif.2013.12.003.
[39] F. Preckel, I. Schmidt, E. Stumpf, M. Motschenbacher, K. Vogl, and W. Schneider, "A Test of the Reciprocal-Effects Model of Academic Achievement and Academic Self-Concept in Regular Classes and Special Classes for the Gifted," *Gifted Child Quarterly*, vol. 61, no. 2, pp. 103–116, Apr. 2017, doi: 10.1177/0016986216687824.
[40] J. M. Ackerman, S. E. Hill, and D. R. Murray, "The behavioral immune system: Current concerns and future directions," *Social and Personality Psychology Compass*, vol. 12, no. 2, Feb. 2018, doi: 10.1111/spc3.12371.
[41] Y.-C. Chen, B. Hand, And L. Mcdowell, "The Effects of Writing-to-Learn Activities on Elementary Students' Conceptual Understanding: Learning About Force and Motion Through Writing to Older Peers," *Science Education*, vol. 97, no. 5, pp. 745–771, Sep. 2013, doi: 10.1002/sce.21067.
[42] Jusuf Blegur, M. Rambu P. Wasak, and Poho Pabala, "Students' Academic Self-Concept: A Founding Strategy in Learning Process," *International Journal of Indian Psychology*, vol. 6, no. 4, Nov. 2018, doi: 10.25215/0604.046.
[43] J. R. Cohen, K. M. Spiegler, J. F. Young, B. L. Hankin, and J. R. Z. Abela, "Self-Structures, Negative Events, and Adolescent Depression," *The Journal of Early Adolescence*, vol. 34, no. 6, pp. 736–759, Aug. 2014, doi: 10.1177/0272431613503217.
[44] J. Guo *et al.*, "Probing the Unique Contributions of Self-Concept, Task Values, and Their Interactions Using Multiple Value Facets and Multiple Academic Outcomes," *AERA Open*, vol. 2, no. 1, 2016, doi: 10.1177/2332858415626884.
[45] U. Trautwein and O. Lüdtke, "Students' self-reported effort and time on homework in six school subjects: Between-students differences and within-student variation.," *Journal of Educational Psychology*, vol. 99, no. 2, pp. 432–444, May 2007, doi: 10.1037/0022-0663.99.2.432.
[46] J. Xu, R. Yuan, B. Xu, and M. Xu, "Modeling students' interest in mathematics homework," *The Journal of Educational Research*, vol. 109, no. 2, pp. 148–158, Mar. 2016, doi: 10.1080/00220671.2014.928252.
[47] S. Hamed, F. Hussin, and S. Jam, "Academic self-concept among the pre diploma students," *International Academic Research Journal of Social Science*, vol. 3, no. 1, pp. 128–134, 2017.
[48] Y-J. Hou, "Reciprocal Teaching, Metacognitive Awareness, and Academic Performance in Taiwanese Junior College Students," *International Journal of Teaching and Education*, Vol. III, no. 4, pp. 15–32, 2015, doi: 10.20472/TE.2015.3.4.003.

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