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Reciprocal Teaching and Certainly of Response Index Learning Model Impact of Mastery Mathematics on Curriculum 2013

The problem and the aim of the study. In mathematics, the concept of mathematical mastery is essential. However, students' conceptual mastery of mathematics in curriculum 2013 (K-13) remains deficient. As a result, teachers must emphasize mathematical mastery in their instruction. Learning mathematics in a classroom, on the other hand, continues to face several challenges, including students' perceptions that mathematics is complex and uninteresting. Furthermore, mathematics performance scores in PISA lower than the OECD average. To tackle this phenomenon, improved mastery mathematics can be achieved using the Certainly of Response Index (CRI) and Reciprocal teaching (RT) learning models. Furthermore, this study aimed to compare the learning models of CRI and RT to mastery of mathematics, then determine which of the two learning models is more effective at improving students' mathematical mastery.

Research methods. This method used is a quasi-experiment using a nonequivalent control group design. Essay questions were used with the angles and triangles material in both the pretest and post-tests. Cluster random sampling was used in this study to select participants at Secondary School Darul 'Amal of Metro, Lampung, Indonesia, consisting of 33 students' both experimental class I (CRI learning model) and experimental class II (RT learning model). A t-test was used to test the hypothesis using statistical analysis SPSS software 25 and effect size to perform the learning model's effectiveness.

Results. To test for normality and homogeneity, a significance level (α) of 0.05 should be used when conducting hypothesis testing. The average pretest and posttest scores of 50.17 and 82.23, respectively, in experiment 1 and 2. The normality and homogeneity of the pretest and posttest in both teaching model experiment class I and experiment class II are acceptable. The application of experiment I and Experiment II with sig value was 0.220 and 0.133, respectively, this indicates that the sample was drawn from a normally distributed population with a level of significance of 0.05. Using Levene's homogeneity of variance test, the angle and triangle test data were normally distributed, with a sig value of 0.517 for pretest and post-test was 0.531, the highest value above the 0.05. Based on the hypothetical test analysis, that $t_{calculate} > t_{table}$ (3.86 > 1.99) indicates differences between the learning models used in experiments I and II. Additionally, the effect size score was 0.88 with high criteria.

In conclusion, the CRI learning model and the RT learning model differ in mathematical mastery. The Effect Size test result was 0.88 in the high category. Based on the results, the CRI model has a greater impact on math mastery than the RT models. It is concluded that the CRI model can be used as an alternative solution for teaching and learning.

Keywords: certainly of response index, curriculum, mastery of mathematics, reciprocal teaching

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Introduction

The twenty-first century is inextricably linked to the industrial revolution 4.0, which requires people to think more creatively and to accept rapid technological advancements. Therefore, the fourth industrial revolution has emerged as a major topic of discussion and has garnered attention from scholars in developed and developing worlds. The global community's various sectors, including education, have begun to address this issue. As a result, education is an important part in determining an individual's abilities [1].

A significant issue in the learning process is that classroom instruction focuses heavily on listening and memorization over-explanation and understanding and knowledge building. The active scholar believes that the think creatively and solve the problems challenges for students to have learning and innovation skills [2], promote students cognitive skills in the classroom [3], and can be imagined as articulated moments in networks of social relations and understandings [4] . This problem can be solved by implementing a learning innovation approach [5], learning environments [6], increase the learning process [7], learning more easy, joyful, and meaningful for the students [8], that makes learning more exciting and encourages students to learn more [9]. A significant effort has been made in mathematics [10], particularly in the mastery of mathematics [11].

Mathematics is an essential science that plays a critical role in everyday life and in advancing science and technology [12], connect to the other subject [13], and contribute to learning education [14]. Learning mathematics in a classroom, on the other hand, continues to face a number of challenges [15], including students' perceptions that mathematics is complicated and uninteresting [16]. Furthermore, traditional learning methods, such as the lecture method, are still in use today [17]. Students become less enthused and bored due to this situation [18]. Moreover, according to the previous research that, only one-way information is frequently provided to students [19], limiting their ability to reinforce their grasp on ongoing subject matter [20]. As a result, there is a disconnect between their expectations and the classroom learning environment [21].

In mathematics, concept of mathematical mastery is essential, that is to find out the understanding concepts in mathematics, [22], connecting to the ability on students personality [23], improving the science and mathematical concept [24], practical new mathematics subject knowledge [25], and important for academic, economic, and life success [26]. However, students' conceptual mastery of mathematics remains deficient [27]. As a result, teachers must emphasize mathematical mastery in their learning [28], more creative in the classroom [29], and making a teaching and learning goal [30], while mathematics teachers should be successful, including being a thinker and mastering the subject matter [31]. On the other hand, Indonesia has been a PISA participant since 2001. Since that time, mathematics performance has taken on the shape of a hump. Mathematics continued to score lower than the OECD average. This is more apparent when trends are adjusted for enrollment. Assuming that the excluded 15-year-olds would have performed below the 75th percentile of all 15-year-olds had they taken the assessment, the highest-achieving 25% of all 15-year-olds in Indonesia's mathematics and science performance would have improved by 11 points every three years since 2003.

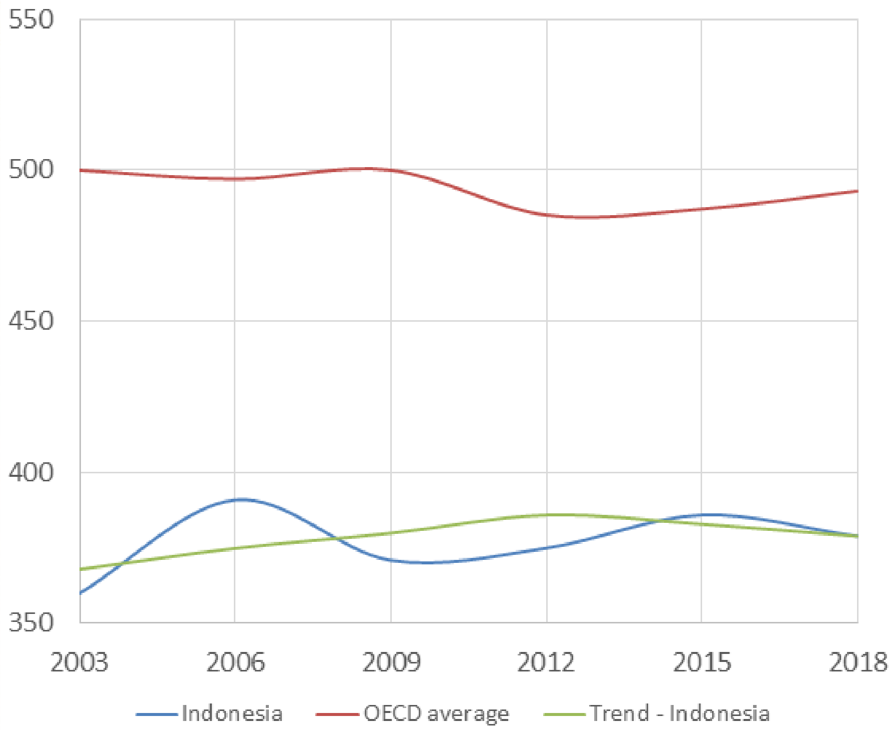

Figure 1 Trends in performance of mathematics for Indonesian Students [32]

The Curriculum 2013 promotes mathematical mastery by requiring students to solve sophisticated word problems in order to in a variety of ways. One of which is through the use of a variety of different learning models [33] (i.e., Project-based learning [34], Problem-based learning [35], Certainly of Response Index (CRI) [36], Aptitude Treatment Interaction [37], Reciprocal teaching (RT) [38]).

Improved mastery of mathematics can be achieved through the use of the CRI and RT learning models. Earlier studies have shown that the CRI learning model can reduce students' misconception of complex concepts [39]. Additionally, the RT method can improve reading-metacognitive strategy awareness [40], mathematical logic [41], mathematical connection ability [13], impact self-regulation [42], and improving the students abilities [43]. On the other hand, no research integrates CRI and RT using mastery concepts. This study is unique in that it compares CRI and RT in learning to improve mastery of mathematics concepts on the 2013 curriculum, which is in contrast to previous research.

Consequently, this study aims to compare two different learning models, namely CRI and RT, in terms of students' mastery of mathematics concepts. To benefit from CRI and RT learning models, it is expected that students will be inspired to explore and develop their love of learning. Angles and triangles are taught using the CRI and RT models, which expose students to everyday life realities to develop their understanding of the concepts of angles and triangles.

Materials and methods

In the even semester of the academic year 2020/2021, the study was conducted at Secondary School Darul 'Amal of Metro, Lampung, Indonesia. The research subjects are divided into experimental class I (using the CRI learning model) and experimental class II (using the RT learning model). The demographic of the participants as follow:

Table 1

The demographic of characteristics of the participants in this study

Characteristic	Details	Percentage (%)
Gender	Male	30.26
	Female	69.74
Age	Mean	13.40
Family Status	Master of education	15.79
	Bachelor of education	84.21
Living place	City	44.74
	District	55.26

This instrument was develop by researcher and cover by Ministry of Education and Culture Republic of Indonesia [44]. The angles and triangles are the concepts covered in the mastery of mathematics in this study. The research instruments for the development studies began with a review of the Indonesian curriculum literature. We conferred with two mathematics educators who are experts in mathematics to determine whether the items were appropriate for measuring mastery of mathematics.

Cluster random sampling was used in this study to select participants [45]. The research team used a technique known as Quasi-Experimental Design for the investigation. The quasi-experiment was carried out using a Nonequivalent Control Group Design. The independent variable is the CRI learning model (X_1) and the Reciprocal Teaching model (X_2), whereas the dependent variable is Angles and Triangles Concept Mastery (Y).

The study uses a test as a method of gathering data. In both the pretest and post-tests, essay questions were used. The test is used to gather information about students' mathematical mastery as the answer to the questions posed. Validity, reliability, distinguishing power, difficulty level, and distractor were all tested before the test instrument was used. The study's data analysis used preliminary analysis tests such as normality and homogeneity tests.

A t-test was used to test the hypothesis that there is a difference between the learning models of the CRI and the RT, and an effect size test was used to determine the effectiveness of the learning model on mastery mathematics mastery mathematics. The normality and homogeneity are use both Levene's test of homogeneity and Kolmogorov-Smirnov, respectively. The hypothesis and effect size results of the experiment I and II are use SPSS Statistics.

Literature review

Indonesian Curriculum of 2013 (K-13)

The 2013 Curriculum is a set of primary and secondary school curricula. In the Indonesian educational system, primary education is comprised of primary or elementary schools referred to as Sekolah Dasar (SD) and junior secondary schools referred to as Sekolah Menengah Pertama (SMP). Secondary Education is comprised of two types of schools: General Secondary Schools known as Sekolah Menengah Atas (SMA) and Vocational Secondary Schools known as Sekolah Menengah Kejuruan (SMK). At the moment, the 2013 Curriculum is being used to develop curricula for Childhood Education (PAUD) and Higher Education (University, Diploma 3, and Diploma 4). This policy is novel in Indonesian education, and it may be novel in many other countries as well [46]. Philosophy is critical for curriculum development for at least two reasons. One, as Makaiau & Miller puts it, is that "philosophy is at the heart of educational endeavor." [47] This is perhaps more evident in the domain of curriculum than in any other, as curriculum is a response to the question of how to live a good life".

The following is the philosophy of the 2013 Curriculum: education is rooted in the nation's culture and is geared toward the betterment of the nation's present and future generations, students inherit and actively participate in the development of culture for the benefit of present and future generations. The glorious past should serve as a guide for students as they learn about the present and lay the groundwork for developing their future lives, and education aims to foster students' intellectual and academic abilities, communication skills, social attitudes, concern, and participation ability [48].

The 2013 curriculum (K-13) develops attitudes, knowledge, and skills [49]. The experience gained from applying the 2013 curriculum, particularly in the learning process, is reflected in the results' orientation, specifically the capacity to think creatively and critically. Thus, the 2013 Curriculum places a premium on study, exploration, and experimentation activities and the development of creative activities that require imagination, intuition, and discovery through divergent thinking.

Mastery Mathematics

It is critical to consider how mathematics as a subject discipline is transformed into 'school maths' in relation to this study [50]. Bernstein identified three sets of rules that govern the transfer of knowledge from its source, such as university researchers, to the classroom, where it becomes the content of school lessons. These three domains are as follows: distributive rules, which govern knowledge production; recontextualizing rules, which govern official curriculum policy and teachers' local pedagogical influence; and evaluative rules, which govern pupils' reproduction of knowledge in classrooms, tests, and examinations [25]. In the case of mathematics, this process appears to be influenced by beliefs about the subject's contentious nature.

Mastery of mathematics abilities encompass mental processes such as the capacity to frame problems, present and analyze arguments, make observations, formulate hypotheses, conduct deductions and inductions, assess and make decisions and carry out actions [51]. Students must cultivate their thinking talents throughout the educational process [52], as strong mathematics creative thinking abilities are proportional to their critical abilities [53]. Mastery of mathematics can help pupils develop logically and conceptually essential thinking skills [54]. The mastery mathematics in this perspective is regard to Angles and Triangles. This aspect was propose to the national examination in Indonesia. The Junior Secondary National Examinations cover four areas of mathematics: number; algebra; geometry and measurement; and statistics and probability.

Research results

To test for normality and homogeneity, a significance level (α) of 0.05 should be used when conducting hypothesis testing. Based on the results of Table 2, the average pretest and posttest scores of 50.17 and 82.23, respectively, indicate a statistically significant increase in the average mastery mathematics of experimental group I throughout study. The average pretest and posttest scores of 55.18 and 76.97, respectively, for experimental group II, on the other hand, indicate an increase in the average mastery of the group. Therefore, it can be concluded that experimental group I, which employs the CRI learning model, performs significantly better in terms of learning than experimental group II, which employs the RT learning model, which performs significantly worse.

Table 2

The results of Pretest and posttest scores in the experimental class I and II

Experiment Class	Instrument	Highest	Lowest	St. Dev	Variance	Mean Score
Experiment I	Pretest	45	40	9.95	99,04	50.17
	Posttest	85	90	11.26	128.81	82.23
Experiment II	Pretest	35	30	6.08	52.38	55.18
	Posttest	75	60	9.85	66.93	76.97

Furthermore, the normality and homogeneity of the pretest and posttest in both teaching model experiment class I an experiment class II are followed:

Table 3

The recapitulation of normality test results

Instruments	Teaching Methods	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Pretest	Experiment I	.145	38	.220*	.959	38	.556
	Experiment II	.154	38	.133	.925	38	.160
Posttest	Experiment I	.141	38	.310*	.957	38	.174
	Experiment II	.159	38	.112	.956	38	.165

Table 4

Variance homogeneity test results

Instruments	Student learning outcomes			
	Levene Statistic	df1	df2	Sig.
Pretest	.517	2	56	.894
Posttest	.531	2	56	.905

Based on the Table 3 of pretest, it can be seen the application of the experiment I and Experiment II with sig value was 0.220 and 0.133 respectively, this indicates that the sample was drawn from a normally distributed population with a level of significance of 0.05 or greater. In contrast, the normality test results for the post-test showed that both the teaching model in experiment I and the teaching model in experiment II were approximately 0.112, indicating that the sample came from a normally distributed population at a statistically significant level of 0.05.

Based on the Table 4, using Levene's test of homogeneity of variance, SPSS version 25 is capable for both pretest and posttest. The results in Table 5 show that data on angle and triangle test were normally distributed, with a sig value of 0.517 for pretest and posttest was 0.531 being the highest value above the 0.05 level of significance obtained. The data showed that the variance homogeneity was present in the dataset.

Table 5

Test results of hypothetical

Value	$T_{calculate}$	T_{table}	Conclusion
N-Gain	3.86	1.99	$T_{table}<T_{calculate}$ = H_0 was rejected

Table 6

Test effect size results of the experiment group I and experiment II

Mean of Experiment I	Mean of Experiment II	Effect Size	Criteria
72	63	0.88	High

Table 5 shows that $t_{calculate} > t_{table}$ (3.86 > 1.99), indicating that H_0 is rejected. As a result, it can be concluded that there are differences between the learning models used in experiments I and II when it comes to students in class VII at Metro's Secondary School Darul 'Amal's concept mastery of angle and triangle. Table 6 shows that the Effect Size score was 0.88 with high criteria.

Discussion

The pretest and post-test results reveal whether or not students have mastered mathematics. Prior to the introduction of the angle and triangle materials, a pretest is administered at the beginning of class. The study results in experimental class I yielded the lowest score of 40 and the highest score of 45, with an average score of 50.17. The lowest score of 40 and the highest score of 45 were obtained from the study results in experimental class II. While in experimental class II, the lowest score obtained was 30 and the highest score obtained was 35, with an average of 55.18 points, the lowest score obtained was 30 and the highest score obtained was 35. In both experimental classes I and II, students' mathematical mastery of angle and triangle materials remains low, according to the pretest average scores, and both classes begin with the same initial capability for angle and triangle materials.

Learning activities are conducted in a conducive manner in order to accomplish learning objectives. At the first meeting, what was accomplished in experimental class I and the experiment was to communicate the activities that will take place during the learning process and the methods that will be used to ensure that students understand what to do and how to do it. In experimental groups I and II, the learning that is provided will be tailored to each step of the two learning models that will be used, specifically the CRI and the RT learning models.

Students who learn using the CRI learning model achieve a higher level of concept mastery as a result of their increased interest and motivation. Additionally, the CRI learning model enables students to observe and comprehend their own past and future experiences in their environment.

Learning the CRI is meaningful because students gain direct experience of what they are learning rather than simply watching and memorizing. Direct experience can assist students in solving problems and communicating the material they are studying. Additionally, the CRI model produces superior mathematical cognitive abilities to the RT model.

Students' sensitivity to real-world problems and their ability to provide a variety of answers or solutions with justification can both be improved through CRI learning. CRI learning can improve students' sensitivity to real-world problems and their ability to provide a variety of answers or solutions with justification for a variety of phenomena encountered in the everyday life environment that are related to concept mastery abilities can both be improved through CRI learning. There are only a limited number of resources available when searching for information, so RT learning without discussion will significantly slow the process. This has resulted in an increase in concept mastery abilities as a result of CRI learning.

In the course of their studies, students' motivation develops into curiosity, self-confidence, and a desire to improve their mathematical mastery of the angle and triangle materials they are studying. Learning becomes more engaging, enjoyable, and effective when using this model of learning, which increases students' mastery of the material. This is consistent with the findings of Ramadhan research [39].

According to the steps for developing metaphorical thinking through CRI learning, there are stages for developing ideas and creativity with the assistance of cycle sharing material, namely the analysis of the teacher's questions and the collection of facts from other students, followed by discussion to find solutions to the given problems. Angle and triangle concept mastery can also be enhanced during the stage of forming new ideas in CRI learning. As a means of enhancing students' concept mastery during the learning process, CRI refers more to the discussion stage that provides students new experiences.

The experimental group I with the CRI learning model demonstrates a higher level of concept mastery than the experimental group II with the RT model. In line with the findings of two studies, Putri and Ramadhan which indicate that the CRI learning model can assist students in improving their learning outcomes [36], the CRI learning model is being implemented in more schools [39]. Using a CRI learning model, according to other findings, can help students improve their problem-solving and process skills [55], as well as their misconceptions about mastery of subject [56]. The previous researcher argued that that the CRI learning model is effective at increasing students' participation in class and improving their academic performance and identify misconception in subject mastery [57].

Additionally, found that the CRI learning method effectively improves misconceptions regarding concept mastery [58], which is consistent with their findings. The variables in this study are different from those in other studies because they are centered on students' concept mastery rather than on other factors. A previous research lends credence to this one's findings.

This study has some limitations, including the fact that the implementation of learning using the CRI and the RT learning models is not optimal, and the sample size is limited to students aged 11-13 years old in secondary school. The presentation of research findings by researchers has fallen short of expectations. Less than optimal class control impacted the classroom atmosphere, disrupting students' concentration.

Conclusion

The study's findings indicate that the CRI model has an effect on the concept of angle and triangle mastery. Students demonstrate greater mastery of mathematical concepts when the CRI model is used instead of the RT learning model.

According to the study's findings, there was an unsatisfactory level of conceptual understanding, as evidenced by students who were still collaborating with other students when working on test questions. As a result, some students continue to receive low grades. Thus, several improvements should be made to the learning process, including applying the CRI model to other materials, ensuring that students take an active role, communicate effectively, and improve their problem-solving abilities. Future research is recommended to be more creative and innovative in applying the CRI model, particularly in selecting the optimal time to conduct the research.

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