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Increasing Motivation and Mathematics Learning Achievement in Sequences and Series Materials using PBL Model with *Triastra* Method

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Abstract

This research attempted to increase motivation and mathematics learning achievement in the sequences and series material. It was in the form of Classroom Action Research (CAR) and used *Triastra* method, a method which combines Problem Based Learning (PBL), interactive quiz, and structured tasks through the interactive quiz. Two cycles were done by the researcher starting from pre-cycle. Each cycle consisted of planning, implementation, observation, and reflection. 30 students, including 3 male students and 27 female students of the Class X Multimedia 2 of State Vocational High School 1 Kendal or SMK Negeri 1 Kendal in the academic year of 2019/2020 were involved. Their data were collected using test, observation, and questionnaire. To interpret the data, the researcher used descriptive analysis method. Findings showed that there was an increase in the motivation to the high category, namely from 74% in the cycle 1 to 87% in cycle II. In terms of learning achievement, it increased from 23% in the cycle 1 to 47% in cycle II, while the mean of the achievement increased from 5.95 in cycle 1 to 7.18 in cycle II. Thus, it is concluded that *Triastra* method can increase students' motivation and mathematics learning achievement.

1. Introduction

Based on (1) the Regulation of the Minister of Education and Culture Number 60 year 2014 concerning the 2013 Curriculum for Vocational High Schools, and (2) the Regulation of Minister of Education and Culture Number 34 year 2018 concerning National Education Standard of Vocational High School or Islamic Vocational High School, the subjects in Vocational High School (SMK) are grouped into group A subjects (national content), group B subjects (regional content, and vocational subjects group C.

The group A subjects belong to a curricular program aiming at developing attitude competence, knowledge competence, and skill competence of students as the basis and strengthening of abilities in the life of society, nation and state.

According to the Decree of the Director General of Primary and Secondary Education (*Kepdirjen Dikdasmen*) Number 330/D.D5/KEP/KR/2017 concerning Core Competencies and Basic Competencies of National Content Subjects (A), Regional Content (B), Basic Expertise (C1), Basic Skills Program (C2), and Expertise Competence (C3), one of the subjects that become national content in SMK (Group A) is mathematics.

For some students, mathematics is a difficult subject proved by a number of students who did not pass the minimum completeness criteria. In details, based on the results of four times daily assessment, one midterm test, and one final test in the academic year of 2019/2020, the students of class X Multimedia 2 of SMK Negeri 1 Kendal obtained the following results.

Table 1. The Mean of Learning Completeness of Class X MM 2 Students in the 2019/2020 in Odd Semester.

Indicator	Pass	Fail

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	(≥ min.score)	(< min.score)
Number of students	4	26
Percentage	13%	87%

It was assumed that the results occurred due to some reasons, such as low mastery of mathematics, low interest and motivation, including paying attention to teacher's explanation in class and willingness to learn at home. These were predicted after scoring some homework and performing assessments from informal interviews with the students.

As a reflection, a teacher is demanded to create joyful, entertaining, challenging, creative, and innovative learning atmosphere to improve students' mastery and understanding of mathematics.

To realize the above goals, the researcher was motivated to increase students' motivation and mathematics learning achievement using *Triastra* learning model by combining Problem Based Learning, interactive quiz games, and interactive assignments at home. This model was considered interesting and assumed to provide a challenge for students both in class and at home.

In the previous relevant research, it is known that the implementation of Problem Based Learning with ARCS motivational strategy can improve students' motivation and increase learning achievement (Bibit Lutfi Pratiwi, et al., 2018), results in different mathematical problem solving ability between university students who received interactive quiz method and conventional method on the subject of trigonometry (Dian Purnama Sari, et al., 2018), and give positive contribution to students' learning motivation when aided by structured learning models by giving assignments (Wulyaningsih, 2017).

1.1. Literature review

1.1.1. Motivation

Motivation is a big drive which encourages someone to behave (Hamzah, 2006:1). It can arise due to intrinsic factors, such as wish, desire to succeed, and need for learning, hopes and dreams.

Motivation and learning are interrelated. Learning is a change in behavior that is relatively permanent and potentially happens as a result of practice or reinforcement with the basis of achieving particular goals. Its intrinsic factors are such as reward, conducive learning atmosphere, and interesting learning activities (Hamzah, 2006:23).

Learning motivation indicators can be classified into: (1) drive and wish to succeed; (2) learning needs and drive; (3) hopes and dreams; (4) learning reward; (5) interesting activities in learning; (6) a conducive learning environment which enables a student to study well (Hamzah, 2006:23).

The main basis of teaching and learning success is students' motivation to learn. This can be present if students are interested or excited about knowing something.

1.1.2. Learning achievement

Learning achievement is defined as the results achieved by students in their submitted tasks or learning material in a particular period of time. It is generally measured through numbers of letters so that it is comparable to a criterion.

Learning achievement is a measure of students' learning success in mastering a number of subjects expressed in grades and attached in the report book.

According to Ngalim Purwanto (1990:107) there are two factors influencing learning achievement, namely external and internal factors. Internal factors cover (1) physiology in form of physical and five senses condition. (2) psychology in form of talents, interests, intelligence, motivation, and cognitive skills. Meanwhile, external factors cover (a) natural environment and social environment, (b) instrumentation in form of curriculum, teachers or educators, facilities, and administration.

1.1.3. *Triastra*

Triastra is the term created by the researcher to describe the learning methods implemented in this research.

Linguistically, *Triastra* is derived from the word *Tri* (Sanskrit) which means three and *Astra* (Sanskrit) which means weapon.

Terminologically, the researcher attempted to present three methods to deal with a learning problem, namely students' difficulty in understanding mathematics. Those three methods are Problem

Based Learning (PBL), interactive quiz games method, and assignment method through interactive quizzes which are used together in learning activities.

1.1.3.1 Problem Based Learning (PBL)

PBL is a learning model which trains and develops problem solving ability oriented towards authentic problems from students' actual life. It aims to stimulate higher order thinking skills (Shoimin in Sodikin, 2018). Dutch, 1994 as cited in Amir (in Sodikin 2018) states PBL is an instructional method which challenges students to "learn to learn". Cooperate in a group to seek for solutions for real problems. PBL prepares students to think critically and analytically and strive for using proper learning sources.

Based on the previous explanation, it can be concluded that PBL is a learning model that is based on problems as the learning strategy, done by stating structured conceptual problems to students to that they can find meaningful solutions. The problems presented are related to materials to study, and the obtained solutions will be new knowledge for the students (Sodikin, 2018:6).

1.1.3.2 Interactive Quiz Game

Interactive quiz is an application that contains learning materials in form of exercise or enrichment which enables students to improve their knowledge about the studied material independently by simply pressing buttons on the interface (Risqiyah, 2011). This medium is a combination of lecturing method, question and answer, and assignments packaged in a quiz game (Untari, 2015). The provision of this quiz is done during the learning process of materials that has been taught with the aim of measuring students' understanding level. One example of it is *Quizizz* from quizizz.com.

1.1.3.3 Structured Assignments via Interactive Quiz

Structured assignments are curricular activities done as a means of achieving learning objectives. These can be given to students outside the learning process with the aim of supporting intracurricular programs. By having these programs students are expected to better comprehend learning materials given and do the tasks responsibly (Wulyaningsih, 2017).

The structured assignments given in this study were in form of doing interactive online quiz about the learning materials on *quizizz* within specified deadline. It indirectly aimed at giving an alternative medium of quiz for students via smartphone.

1.1.4. Sequences and Series Material

Sequences and series are mathematics materials included in the national content based on the Decree of the Director General of Education and Secondary Number 330/D.D5/KEP/KR/2017 concerning Core Competencies and Basic Competencies of National Content Subjects (A), Regional Content (B) , Basic Expertise (C1), Basic Skills Program (C2), and Expertise Competence (C3). Based on the decision, the material for sequences and series includes 2 (two) basic competencies, namely:

Table 2. Basic Competencies for Sequences and Series materials

BASIC COMPETENCIES (KI-3)	**BASIC COMPETENCIES (KI-4)**
3.5 Analyzing arithmetic sequences and series	4.5 Solving contextual problems related to arithmetic sequences and series
3.6 Analyzing geometric sequences and series	4.6 Solving contextual problems related to geometric sequences and series

1.1.5. Relevant Similar Researches

The followings are some previous researches relevant to the present research.

First, a research by Bibit Lutfi Pratiwi, et al. (2018) concerning efforts to improve students' learning motivation through Problem Based Learning model with ARCS (Attention, Relevance, Confidence, Satisfaction) motivational strategies for students class XI IPA 2 SMA Negeri Petahanan in the academic year of 2017/2018. It concludes that the implementation of Problem Based Learning with ARCS motivational strategies can improve students' learning motivation, and in turn increase learning achievement.

Second, there is a research by Dian Purnama Sari, et al. (2018) about the effect of interactive quiz method on mathematical problem solving ability in trigonometry course. It shows that there is a difference in the mathematical problem solving ability between students who received interactive quiz and conventional.

Third, a research done by Wulyaningsih (2017) focusing on structured tasks to improve motivation and increase learning achievement in recognizing the meaning of historical heritage. It was found that the structured task learning model through assignments can positively affect the students' learning motivation.

In details, the similarity of the current research with the previous researches are elaborated as follows.

Table 3. Research similarities with previous research

Researcher, year of publication, title	**Similarity**
Bibit Lutfi Pratiwi, et al., 2018, Efforts to Improve Students' Learning Motivation through Problem Based Learning Learning Model with ARCS Motivation Strategy (Attention, Relevance, Confidence, Satisfaction) in class XI IPA 2 SMA Negeri Petanahan in the academic year of 2017/2018	1. Research variables: learning motivation, learning achievement 2. Problem Based Learning (PBL) learning model
Dian Purnama Sari, et al., 2018. The Effect of the Effect of the Interactive Quiz Method on Mathematical Problem Solving Ability in Trigonometry Course	Interactive quiz method
Wulyaningsih (2017). Structured Task Learning Model to Improve Motivation and Learning Achievement in Recognizing the Meaning of Historical Heritage	1. Research variables: learning motivation, learning achievement 2. Structured Tasks learning model

The differences between this research and previous research are described in the following table.

Table 4. Differences between this research and previous researches

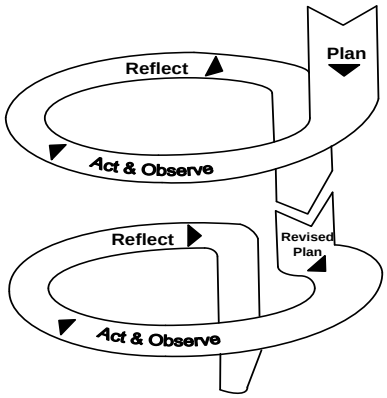
Researcher, year of publication, title, Differences in the previous researches		**Present research differences**
Bibit Lutfi Pratiwi, et al., 2018, Efforts to Improve Students' Learning Motivation through Problem Based Learning Learning Model with ARCS Motivation Strategy (Attention, Relevance, Confidence, Satisfaction) in class XI IPA 2 SMA Negeri Petanahan in the academic year of 2017/2018	ARCS Motivational Strategy	*Triastra* Method: PBL, Interactive Quiz, and Structured Tasks
Dian Purnama Sari, et al., 2018. The Effect of the Effect of the Interactive Quiz Method on Mathematical Problem Solving Ability in Trigonometry Course	Variable: mathematical problem solving ability	Variable: Learning motivation and learning achievement
Wulyaningsih (2017). Structured Task Learning Model to Improve Motivation and Learning Achievement in Recognizing the Meaning of Historical Heritage	Structured Learning Model	*Triastra* Method: PBL, Interactive Quiz, and Structured Tasks

2. Methods

This research belonged to classroom action research with the subjects of class X Multimedia (MM) students of SMK Negeri 1 Kendal in the academic year of 2019/2020 as many as 30 students consisting of 27 female students and 3 male students.

The research was carried out based on the classroom action research design by Kemmis & Taggart, namely 2 cycles with each cycle has (1) planning, (2) implementation and observation, and (3) reflection.

Figure 1. Classroom Action Research Design Chart according to Kemmis Taggart, Ministry of Education and Culture (1999).



In collecting the data, the researcher used several instruments such as (1) observation sheet, (2) student's motivation questionnaire, and (3) written test through (1) observation, (2) test, and (3) questionnaire. The students' data were analyzed statistically through the steps of (1) data reduction, (2) daily assessment analysis, (3) data presentation, and (4) conclusion drawing.

Two cycles were carried out in this study starting from pre-cycle activities. Each cycle was carried out in three meetings and ended with evaluation (daily test) in the last meeting. What was typical was that the researcher used PBL learning model through discussion and presentation followed by interactive quizzes on the learning materials as a means of measuring comprehension level and competition, not to mention there was structured tasks in the form of interactive quiz as a medium for students to study at home reviewing the materials they have learned in the class.

In the pre-cycle, the research did some planning stage, including (1) designing lesson plan based on the syllabus by inserting *Triastra* method, (2) compelling teaching materials as an addition to textbooks, (3) creating students' worksheets, (4) making test items for interactive quiz, (5) designing structured tasks, (6) creating evaluation test items, (7) preparing student's motivation observation sheets, and (8) making student's learning motivation questionnaires. Besides, the researcher also wrote a research permission letter to the principal. In the implementation, the researcher made use of PBL in scientific approach as assigned by curriculum 2013, namely conducting group discussion to solve problems in the number patterns, sequences, series, and sigma notation given, followed by a presentation on the results of the discussion. At the last meeting, a daily evaluation was carried out. At the reflection stage, the researcher collected and analyzed the data obtained during the implementation of learning in the pre-cycle, namely the data from the observations and analysis of the evaluation results as a consideration for learning planning in the next cycle.

At the planning stage of the first cycle, the researcher reviewed the lesson plan by considering the results of pre-cycle reflection. After that, action and observation were carried out, including (a) delivering the concept of arithmetic sequences and series by the teacher, (b) performing group discussion to solve problems related to the learning materials in the worksheets by the students, (c) presenting the results of the discussion, (d) giving review regarding the results of the discussion and reinforcing the materials, (e) the students were given an interactive quiz to measure their ability to solve problems about sequences and series, (f) the students were given structured tasks through an interactive quiz as a means of competition and learning the material of arithmetic sequences and series, and (g) the teachers conducted an evaluation test (daily assessment). All these activities were flexible and open to any changes based on the field condition. In addition, during the research, observation was done during the learning process. The teacher observed students' activities in the form of group discussion and presentation. At the reflection stage, the researcher collected and analyze the data obtained in cycle 1, namely those from the results of evaluation and motivation questionnaire as a consideration for learning planning in the next cycle.

The activities done in cycle II were intended to improve things in cycle I. Those were actually identical to the cycle 1, namely started with planning, action and observation, ended by reflection. What was done was reviewing the lesson plan used in the cycle I. As the core activity, the stage of action and

observation covered (a) the teacher conveyed the concept of geometric sequences and series material, (b) the students discussed in groups to solve problems about the material for geometric sequences and series through worksheets, (c) the students presented the results of group discussions in front of the class, (d) the teacher reviewed the results of the discussion and provides reinforcement on the material, (e) the students were given interactive quizzes to test their ability to solve problems about geometric sequences and series, (f) the students were given structured tasks through interactive quizzes as a means of competition as well as learning about geometric sequences and series material, and (g) the teacher carried out evaluation tests (daily assessment). The observations in this research were carried out during the learning process in the classroom. The teacher observed the activities of students in the form of group discussions and presentations of the results of the discussion. At the reflection stage, the researcher collected and analyzed the data obtained during the implementation of learning in cycle II, namely the data from the analysis of the evaluation results and motivation questionnaires.

Furthermore, the collected data were analyzed descriptively. The test results were analyzed by calculating the answer scores of each student. The analysis of the results of the motivation questionnaire was carried out by scoring each statement item in the questionnaire. For positive statements, the answer scores are strongly disagree (STS) = 1, disagree (TS) = 2, agree (S) = 3 and strongly agree (SS) = 4. Meanwhile, for negative statements the answer scores are STS = 4, TS = 3, S = 2 and SS = 1.

The category interval is obtained by the following formula.

$$\text{Interval} = \frac{\text{skor tertinggi} - \text{skor terendah}}{\text{banyak kategori}}$$

The results of the formulae were measured using 5 points of categorization, namely (1) very low, (2) low, (3) moderate, (4) high, and (5) very high. With 25 questions, the lowest score was supposed to be = 1x 25 = 25 and the highest score was = 4 x 25 = 100. Thus, that the score range and categories were 25 – 39: very low, 40 – 54: low, 55 – 69: medium, 70 – 84: high, and 85 – 100: very high.

Several weaknesses and limitations of this study include the following: (1) the researcher acted as an observer as well as a practitioner (actor) of learning so that the results of observational research observations were subjective and might not cover the unseen phenomena, and (2) there found some obstacles, namely some students had limitations on smartphones and credit/quota/internet access so that they had difficulties when accessing interactive quizzes and structured assignments online (online).

3. Results & Discussions

3.1. Results

3.1.1. Pre-cycle

The activities conducted in pre-cycle were planning, preparing research instruments, teaching and learning process, and evaluation. During the learning process, it was only PBL that was used as the scientific learning method according to the 2013 curriculum.

The students were considered pass if their score is equal or more than 75.

In details, the daily assessment scores in pre-cycle are presented as follows.

Table 5. Pre-Cycle Evaluation Results

Achievement	Total	Percentage
Pass (≥ min.score)	6	20%
Fail (< min.score)	24	80%

The mean of daily assessment evaluation in pre-cycle was 4.62.

3.1.2. Cycle I

Cycle I was done three meetings and ended with a daily assessment in the last meeting. Here, the researchers did planning, actions, observations in meetings 1-3, and daily assessment.

The results of the daily assessment and questionnaire in the first cycle are described as follows.

Table 6. The Evaluation Results in Cycle I

Achievement	Total	Percentage
Pass (≥ min.score)	7	23%

Fail (< min.score)	23	77%

The mean of the daily assessment results in the first cycle was 5.95.

Table 7. The Results of the Motivation Questionnaire in Cycle I

Range of score and category	Total	Percentage
25 – 39 (Very Low)	0	0%
40 – 54 (Low)	0	0%
55 – 69 (Medium)	8	27%
70 – 84 (High)	20	67%
85 – 100 (Very High)	2	7%
Total	30	100%

Based on the observation and data analysis done to the action in cycle 1, the students' learning achievement has increased compared to the previous condition. Similarly, teachers' observation revealed the students' motivation experienced the same thing. However, some notes for the improvement of the next learning process were recorded, namely: 1) several students seemed passive during the group discussion and presentation; 2) several students experienced difficulties in solving arithmetic sequences and series problems; 3) cheating during the test still existed; and 4) the majority of students obtained scores below 75.

Of the above reflection, the improvement plans in cycle II include: 1) asking students to be more active during group discussions and presentations; 2) providing some tips or tricks on how to remember formulas and repeating before the implementation of learning; 3) giving a more firm warning or warning to students who ask/cheat during the test; and 4) asking students to spend time studying at home.

3.1.3. Cycle II

Cycle II was done in 3 (three) meetings and ended with a daily test or cycle test in the last meeting. In terms of activities, it had planning, implementing actions, observations at meetings 1 – 3, and daily assessments. The results of the daily assessment and questionnaire in cycle II are as follows.

Table 8. The Completeness of Evaluation Results in Cycle II

Achievement	Total	Percentage
Pass (≥ min.score)	14	47%
Fail (< min.score)	16	53%

The mean of the daily assessment evaluation results in the second cycle was 7.18.

Table 9. The Results of the Motivation Questionnaire in Cycle II

Range of score and category	Total	Percentage
25 – 39 (Very Low)	0	0%
40 – 54 (Low)	0	0%
55 – 69 (Medium)	4	13%
70 – 84 (High)	20	67%
85 – 100 (Very High)	6	20%
Total	30	100%

In this cycle, 87% of students answer to the questionnaire indicated high and very high category, while their achievement got 47%. Thus, the students' learning motivation and achievement have increased compared to the previous cycle.

3.2. Discussion

Regarding the evaluation as presented in table 10, students who passed the minimum criteria were 6 people (20%) in the cycle I, 7 people (23%) in cycle 2, and 14 people (47%) in cycle 2.

Table 10. The Completeness of Evaluation Results

Indicator	Pre-Cycle	Cycle I	Cycle II
Pass (≥ min.score)	6 (20%)	7 (23%)	14 (47%)
Fail (< min.score)	24(80%)	23 (77%)	16 (53%)

In table 11, the mean of evaluation results increased by 4.62 in the pre-cycle, 5.95 in the cycle I, and 7.18 in the cycle II.

Table 11. The Mean of Evaluation Results

Indicator	Pre-Cycle	Cycle I	Cycle II
Daily assessment mean	4,62	5,95	7,18

Table 12 shows the students' motivation based on the answers to the questionnaire. Each student was given 25 statements consisting of 20 statements with positive values and 5 statements with negative values. The percentage of students who had very low and low category motivation was 0% in both cycles. Meanwhile, students who had moderate category motivation decreased from 8 respondents (27%) in the first cycle to 4 respondents (13%) in the second cycle. On the other hand, students with high and very high motivation increased from 22 respondents (high category = 20, very high category = 2) or 74% in the first cycle to 26 respondents (high category = 20, very high category = 6) or 87% in the second cycle.

Table 12. The Results of Motivation Questionnaire

Range of score and category	Cycle I	Cycle II
25 – 39 (Very Low)	0 (0%)	0 (0%)
40 – 54 (Low)	0 (0%)	0 (0%)
55 – 69 (Medium)	8 (27%)	4 (13%)
70 – 84 (High)	20 (67%)	20 (67%)
85 – 100 (Very High)	2 (7%)	6 (20%)
Total	30 (100%)	30 (100%)

With regard to the above findings, *Triastra* method has been proved to increase the students motivation and learning achievement. The students' with high and very high motivation increased from 22 respondents (high = 20, very high = 2) or 74% in the cycle I to 26 respondents (high = 20, very high = 6) or 87% in the cycle II. Accordingly, the number of students how passed the minimum score increased from pre-cycle, cycle I, and cycle II, namely 6 people (20%), 7 (23%), and 14 people (47%) respectively. Also, the mean of evaluation results from pre-cycle, cycle I, and cycle II increased, namely 4.62, 5.95, and 7.18.

4. Conclusion

The findings of this research indicate that *Triastra* method can increase the motivation and learning achievement of mathematics with the topic of sequences and series of the students class X MM 2 SMK Negeri 1 Kendal in the academic year of 2019/ 2020. The students' learning motivation increased from 74% in the cycle I to 87% in the cycle II, and can be categorized as high. In terms of learning objectives, the students achieved 20% in the pre-cycle, increased to 23% in the cycle I, and 47 in the cycle II. Moreover, the mean of evaluation scores increased from 4.62 in the pre-cycle, to 5.95 in the cycle I and to 7.18 in cycle II.

Regarding the students who did not achieve the minimum score, future researches need to be done to discover reasons or factors influencing such phenomenon objectively.

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