

## Application of the PAKEM learning model to improve student learning outcomes in mathematics

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**Abstrak.** This study examines the improvement of student learning outcomes using the Active, Creative, Effective, and Fun learning model. The application of the Active, Creative, Effective, and Fun learning model is closely related to other learning models. Active, Creative, Effective, and Fun learning models are helpful and can create meaningful learning. The research method used is classroom action research (CAR). This CAR research was conducted in two cycles. The research sample amounted to 22 people who were not taken at random. The data was obtained by using tests, namely the initial test, the first cycle test, and the second cycle test. They are calculating student completeness using the formula for individual mastery and classical wholeness and calculating the increase in learning outcomes using the N-Gain Normalized formula. Applying the Active, Creative, Effective, and Fun learning model can improve student learning outcomes in mathematics subjects as the subject of probability theory.

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## INTRODUCTION

Education is a process by which a person can develop abilities, attitudes, and forms of good behavior (Tibola da Rocha et al., 2020). The formation of good behavior can be applied in the life of society, nation, and state (Vučković et al., 2020; Mickovska-Raleva, 2019). A person's life is the social process in which the person is exposed to the influence of a selected and controlled environment to obtain or experience the development of social abilities and optimum individual abilities (Akcil & Bastas, 2021; Panaoura, 2017).

Education is seen as an effort to provide information and personality formation but is expanded to include efforts to realize individual desires, needs, and abilities to achieve a satisfying personal and social lifestyle (Babushkina, 2020; Golzar, 2020). Education is not merely a means for preparation for the life to come, but for the lives of children now who are experiencing development towards their maturity level (Child & Shaw, 2020; Means & Slater, 2019).

Efforts made by the government are to educate the nation's children and realize the ideals of the Indonesian nation in a better direction, namely through education development (Eko et al., 2020). Based on the Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System, the functions and objectives of national education are listed in Chapter II article 3. National education functions to develop capabilities and shape the character and civilization of a dignified nation in the context of the nation's intellectual life. Meanwhile, the purpose of national education is to develop the potential of students to become human beings who believe and fear God Almighty, have a noble character, are healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens (Suyatno et al., 2019; Setiawan et al., 2020).

According to Umami (2018), three factors greatly influence the success of education. The three factors are, 1) hardware includes study rooms, valuable equipment, laboratories, and libraries, 2) software includes curriculum, learning programs, school management, learning systems, and others, 3) thinking devices, namely teachers, principals, students, and people involved in the process. Based on this explanation, the teacher has a significant role because using the three tools above effectively and efficiently is closely related to teacher innovation to achieve learning (Zamroni, 2019; Rahmadi & Lavicza, 2021).

Likewise in learning mathematics, that success in learning mathematics cannot be separated from study rooms, laboratories, libraries, curricula, and others. Learning mathematics can be said to be a fundamental science, if mathematics is taught in elementary schools, and is useful in everyday life (McAlinden & Noyes, 2019). Once the importance of mathematics lessons, mathematics is given starting from the lowest education to the highest education "College" (Sari & Hunt, 2020). However, some students think that mathematics is a difficult subject to learn. Based on assumptions, most students say that mathematics is a science that studies concepts that are abstract, and have symbols so that some students feel bored to learn them. This is where the role of mathematics teachers is needed to innovate in the learning process to be able to believe in students about the benefits of mathematics lessons (Erbeli et al., 2021; Szczygiel, 2020).

Maurer & Shipp (2021) say that the success of education is always supported by teachers' ability in the teaching and learning process. In the learning process, teachers must develop teaching strategies that lead to optimal student learning activities. Learning optimization activities can be carried out using learning models or strategies (Kerrigan, 2018; Miller & Armour, 2021). A learning model that can increase student activity and creative learning is the PAKEM learning model (Manurung & Halim, 2021). According to Yulia & Suhendra (2017) the PAKEM learning model stands for Active, Creative, Effective, and Fun Learning. Likewise, Wijayanti & Efendi (2021) say that what is meant by active is that in the learning process, the teacher can create a learning atmosphere in such a way that students actively ask, question, and express ideas. The active role of students is vital in forming a creative generation, which can produce something for the benefit of themselves and others (Suharni, 2017). Creativity is also intended for teachers to create diverse learning activities to meet various levels of student abilities (Barber, 2020). Fun is a fun teaching-learning atmosphere so that students focus their attention entirely on learning so that their attention span is high (Ali & Mukhtar, 2017). Active and fun are not enough if the learning process is not practical. It does not produce what students must master after the learning process occurs because learning has several goals that must be achieved. If learning is only active and fun but not effective, then the learning does not change. Then it is like regular learning (Bora & Ahmed, 2018).

The relationship between the PAKEM learning model and probability theory is that probability theory always talks about the probability of an event, where the probability of an event is obtained from several experiments, such as throwing a dice or tossing a coin. Through experiments like this, students will be asked to conduct experiments directly (Kuznetsova, 2019). This can make students active in the learning process and be able to increase student creativity so that learning becomes effective and the classroom atmosphere becomes more fun (Yeoman, 2018).

Based on the results of observations and interviews conducted by researchers with teachers and students at Madrasah Aliyah Swasta Al Khairaat Kalumpang, Ternate City, Indonesia, it can be seen that some students are still not complete in mathematics. There were some students who said that in the learning process the teacher only explained without giving practice questions, so that students were not trained to solve math problems. Students tend to feel bored because in the learning process the teacher only uses the lecture method. Based on the reasons stated, the problem in this study is whether the application of the PAKEM model can improve student learning outcomes in the material of probability theory?.

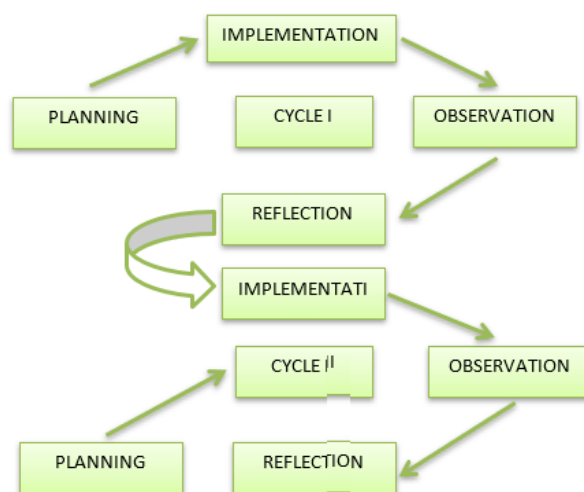
Based on the description and explanation above, the researcher is interested in researching by applying a learning model that can activate students so that learning becomes fun. The research was conducted with "Application of the Active, Creative, Effective and Fun Learning Model

(PAKEM) on the Opportunity Material for Knowing the Learning Outcomes of Class XI-IPA Madrasah Aliyah Private Al Khairaat Kalumpang, Ternate City."

## METHODS

### *Research design*

The type of this research is Classroom Action Research, which is designed using a cyclical strategy that departs from identification by the teacher, preparation of action plans, implementation of actions, observation of actions, and reflection. Nasruddin et al. (2020) said that classroom action research is a research activity that aims to improve the shortcomings of classroom learning by taking specific actions to improve and improve the quality of learning so that the expected learning objectives can be achieved. The design of this research is a cyclical model, Kemmis and Mc Taggart developed this model. In detail, it can be seen in Figure 1 below (Jainuddin, 2019):



**Figure 1.** Classroom action research implementation procedures

### *Participants*

The sample was taken at MAS Al-Khairaat Kalumpang, Ternate City, Indonesia, totaling 22 students of Class XI-IPA. This research was conducted in the 2020-2021 school year. MAS Al-Khairaat has implemented the National Curriculum (K-13).

### *Research Instruments*

The instrument in this study was an observation sheet and a test in the form of an essay: observation sheets, namely, student and teacher observation sheets during the learning process. The test is conducted to measure students' abilities. Can the application of the PAKEM model improve student learning outcomes?. The test was conducted before being given treatment. After the treatment, another test is given at the end of the cycle, forming a "score" value (Alimuddin et al., 2020).

### *Research procedure*

Several stages of research are carried out, starting from planning actions, implementing actions, observing and evaluating processes, results of actions and reflecting, and so on until the expected improvement or improvement is achieved "Criteria for completeness" (Avcı, 2021). The implementation of this activity starts from four initial stages, described as follows (Priandoko, 2017):

#### 1. Action Planning

The planning carried out in class action activities is to prepare a design that will be carried out following the findings of problems and ideas. The activities that will be carried out at this

planning stage are:

- a. Prepare lesson plans for learning materials to determine the mean (average) value, which is by predetermined competency standards (SK) and essential competencies (KD).
- b. Preparing Student Worksheets.
- c. Prepare learning materials in the form of a teacher's handbook on probability theory.
- d. They are making questions in the first cycle test.
- e. Prepare an observation sheet, and the aim is to see the conditions and conditions of students and teachers during the learning process.

## 2. Action Implementation

In this stage, the researcher applies the PAKEM model with the planned learning. For improvement, planning is ready to make changes following what happens in the implementation process in the field, with the Learning Implementation Plan (RPP) that has been prepared as follows:

- a. The teacher explains to students about learning procedures using props in the form of coins, dice, numbered cards, picture cards, and the Qur'an.
- b. The teacher briefly explains the learning objectives, and the material being taught and motivates students in the teaching and learning process.
- c. The teacher gives direction to each group on their respective functions and responsibilities and guides students in filling out the Student Activity Sheet.
- d. The teacher gives individual test questions at the end of the lesson, which is the final test of the action, and will be given a score to determine the points for increasing individual learning outcomes on the pattern of presenting opportunity material.

## 3. Observation

The teacher or researcher-made observations; in carrying out the observations, the researcher was assisted by one of the other observers who participated in observing the learning process based on the observation guidelines that the researcher had prepared.

## 4. Reflection

Reflection is done at the end of the first cycle; the reflection results become a reference and refinement of actions in the second cycle. This stage is intended to thoroughly examine the actions taken based on the collected data and then evaluate them to perfect the following action.

### *Data analysis*

The data in this study were analyzed to find conclusions in implementing the application of the PAKEM learning model on opportunity theory material, including looking at student learning outcomes and the problems faced by students (Vogelzang & Admiraal, 2017). The data that can be analyzed are as follows: Preliminary test results, Final test results, results of observations on students, the results of observations on teachers. Calculate the level of mastery of each student in solving problems using the following formula:

- a. determine learning outcomes and student learning completeness individually calculated by the formula (Lertcharoenrit, 2020):

$$\text{Individual Completeness} = \frac{\text{total score acquisition}}{\text{maximum score}} \times 100\%$$

$$\text{Classical Completeness} = \frac{\text{number of students who completed}}{\text{several test takers}} \times 100\%$$

- b. To find out the percentage of student activity results using the following formula:

$$\text{Presentation} = \frac{\sum \text{number of indicators that appear}}{\sum \text{total indicator}} \times 100\%$$

Knowing the classification of students' ability levels used descriptive qualitative analysis

techniques, which are research methods that describe reality or facts according to the data obtained to know the process and student learning outcomes and student success with the application of the PAKEM model. According to Thoha (Duwila et al., 2019) in the reference guideline for the complete standard conversion on a scale of five, it can be shown in Table 1 as follows:

**Table 1.** Reference guideline for normal absolute normal conversion on a scale of five

Mastery level	Qualification	Letter Value
86% - 100%	Very well	A
61% - 85%	Good	B
46% - 60%	Enough	C
31% - 45%	Less once	D
0% - 30%	Failed	E

From the percentage table above, it can be seen that the process and student learning outcomes on probability material with the application of the PAKEM model can increase or not. In addition, to determine student learning outcomes, the thermalized N-Gain formula is used. The formulas and criteria for N-Gain are as follows (Hake, 1998):

$$\text{Normalized gain } (g) = \frac{\text{posttest score} - \text{pretest score}}{\text{ideal maximum score} - \text{pretest score}}$$

With gain index criteria in Table 2.

**Table 2.** Normalized gain score criteria

Normalized Gain Score (g)	Interpretation
$g \geq 0,70$	High
$0,30 \leq g < 0,70$	Medium
$g < 0,30$	Low

### *Completeness Criteria*

The completeness criteria in this research propose a reference for student learning mastery based on the Minimum Completeness Criteria (KKM) for mathematics subjects applied by the school. Each student is said to be successful if the students in the Class get a score of 67 with 70% absorption. In this case, every action is said to be successful if 70% of students in the Class get a score of 67 on the material provided (Sari & Koeswanti, 2019).

## RESULTS AND DISCUSSION

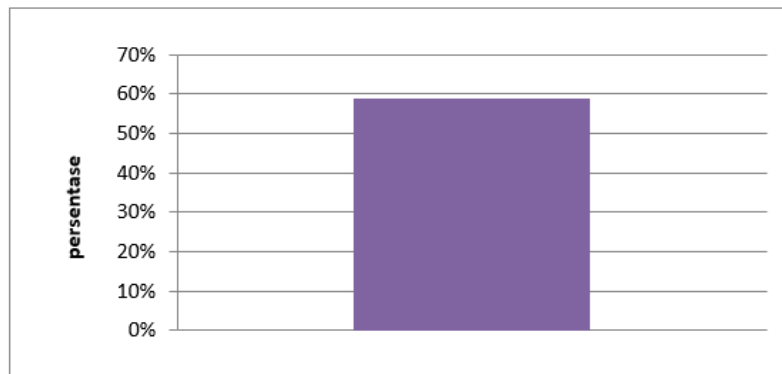
### *Pre-Cycle*

Before carrying out the research activities, the researcher first coordinated with the mathematics teacher to convey the research objectives, lesson plans, and initial test implementation. Furthermore, an initial test was carried out to know the mastery of probability material in students. The results of the initial test can be used as a benchmark to apply the PAKEM learning model.

The results obtained in the initial test are with an average value of 53, in the low category. Only 6 out of 22 students achieved the Minimum Completeness Criteria (KKM) with a percentage of 27.27%. Based on the results obtained with this, researchers need to apply the PAKEM Learning model at the following cycle stage, namely, cycle 1.

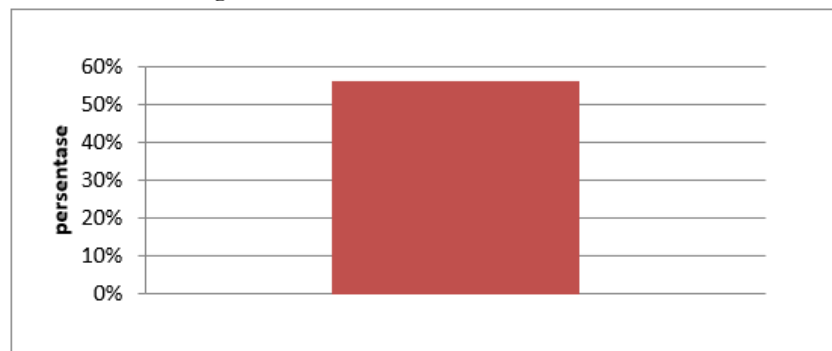
*Cycle I*

In the first cycle, based on the results of observations on the activities of students and teachers on the application of the PAKEM learning model, each with a percentage value of 59% and 56.25. This can be shown in Figure 2 and Figure 3 below;



**Figure 2.** Student activities

From figure 2 above, it can be seen that the results of observations of student activity observations in learning activities in cycle I are still low because students are not familiar with the applied model so that the average score obtained is 59%.



**Figure 3.** Teacher activities

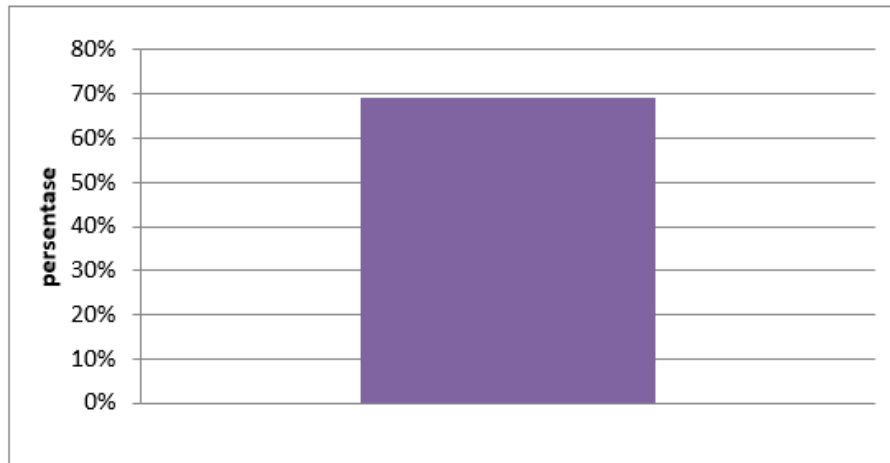
Based on figure 3 above, it can be seen that the results of observing teacher activities in teaching and learning activities in cycle I are still low, namely the average score obtained is 56.25% this is because the teacher has not been maximal in implementing the learning model used. So, it needs to be seen again in the next cycle.

Students' mastery of learning materials is seen from the completeness scores achieved in cycle I. Where 12 of the 22 students who take part in the learning have reached the Minimum Completeness Criteria (KKM) with a percentage of 54.55%, and 10 of 22 students have not reached the Minimum Completeness Criteria (KKM) with a percentage of 45.45%. Based on the data obtained, there was an increase between the initial test and the test in cycle I. In the initial test students who were said to have completed according to the criteria, namely 6 people out of 22 people, while the tests in cycle I students were said to be complete, namely 12 people out of 22 people. Comparison between the initial test and the test in the first cycle there was an increase in the number of students who completed the Minimum Completeness Criteria (KKM). Even though there was an increase in the first cycle, based on the criteria for completeness, PAKEM learning in the first cycle was still not successful, therefore the researchers took action in the second cycle.

*Cycle II*

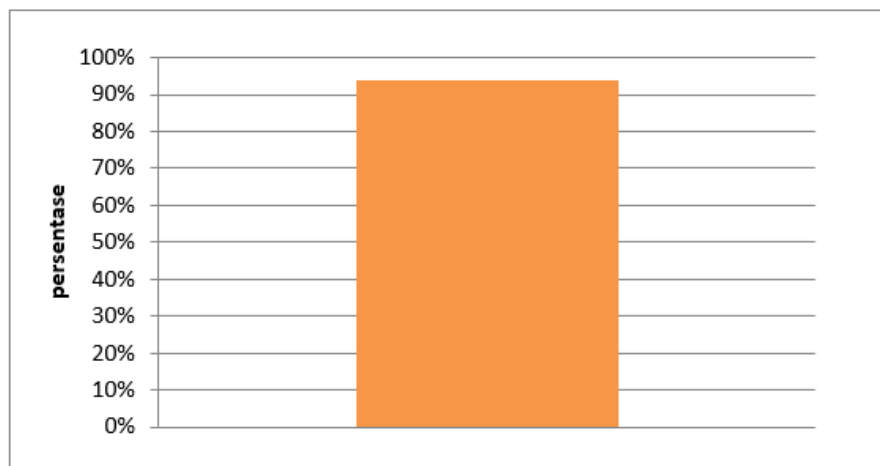


In the second cycle, based on the results of observations on the activities of students and teachers in the application of the PAKEM learning model, each with a percentage value of 69% and 93.75. This can be shown in Figure 4 and Figure 5 below;



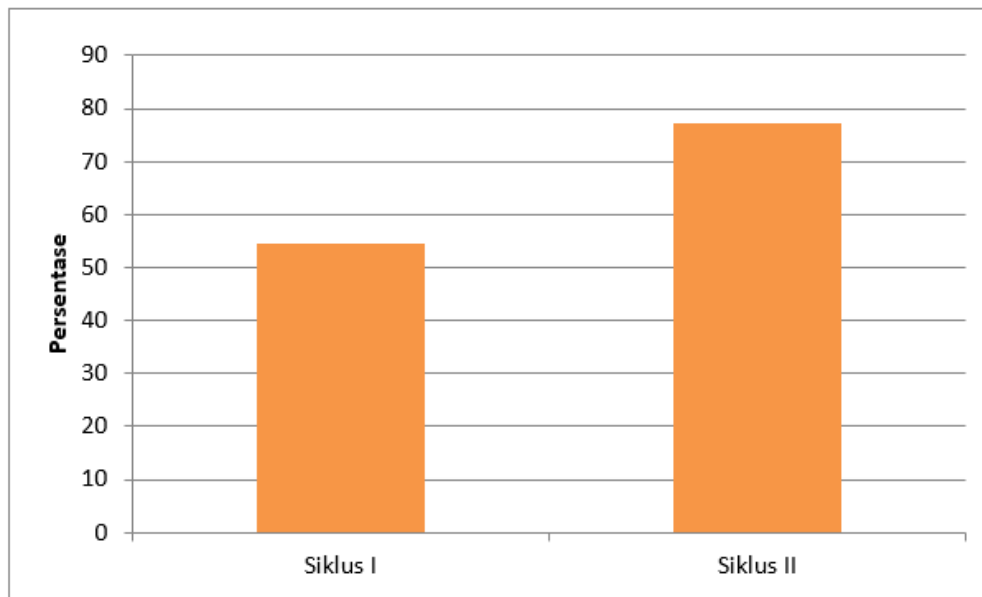
**Figure 4.** Student activities

Based on the results of observations of student activities in cycle II, it can be shown through Figure 4 above which shows that teaching and learning activities in cycle II there is an increase, namely the score obtained is 69%, this is because students are already familiar with the applied model.



**Figure 5.** Teacher activities

From Figure 5 above, it shows that the results of observations of teacher activities in cycle II in teaching and learning activities towards an increase in obtaining a percentage score of 93.75%. All this is because the teacher is able to manage the learning process. Based on the results of the evaluation of the learning materials in the second cycle has increased. Compared to the results of the evaluation in the first cycle of students who finished studying as many as 12 students with a score of 67-87 or 54.55%, while the results of the evaluation in the second cycle there were 17 students who finished studying with a score of 70-92 or 77.27%. For more details can be seen in Figure 6 below:



**Figure 6.** Comparison of learning outcomes in cycle I and cycle II

In cycle II, the application of the PAKEM learning model increased student learning outcomes. 17 of 22 students have reached the Minimum Completeness Criteria (KKM) with a percentage of 77.27%, and 5 of 22 students have not reached the Minimum Completeness Criteria (KKM) with a percentage of 22.72%. Based on the results of observations as a reflection of the actions in the second cycle, it was found that teachers can maintain student learning outcomes to achieve optimal learning outcomes by applying various learning models.

The results of observations in the first cycle show that the teacher's activity in the first cycle reaches a percentage of 56.25%. Based on the observations that have been made, there are still shortcomings obtained in the first cycle. The researchers, as a learning resource, make improvements in the second cycle. These improvements include: 1) it is expected that during the preliminary activities, the teacher conveys the learning objectives to be achieved, 2) classroom settings so that the learning atmosphere is conducive, 3) teachers lack in time management. This deficiency is then made improvements in cycle II. In contrast, the results of observing teacher activities in the second cycle obtained 93.75%. Thus, the observation of teacher activities has reached the excellent indicator criteria.

The results of observations in the first cycle showed that the student activity in the first cycle reached 59%. Based on the observations that have been made, there are still shortcomings obtained in the first cycle. The researchers, as a learning resource, make improvements in the second cycle. These improvements include, 1) students pay less attention to the teacher when delivering the material, 2) students are less active in opinion. This deficiency is then made improvements in cycle II. While observing student activities in cycle II was obtained, 69% showed an increase in student activity from the previous cycle.

## CONCLUSION

The application of the Active, Creative, Effective, and Fun Learning model can improve student learning outcomes in mathematics subject matter of probability theory, as shown in the comparison results of the first cycle and second cycle tests. The results of observations in the first cycle showed that the teacher's activity in the first cycle reached a percentage of 56.25%. Based on the observations that have been made, the results of observations in the first cycle show that the teacher's activity in the first cycle reaches a percentage of 56.25%. Meanwhile, the results of observations of teacher activities in the second cycle obtained 93.75%. Thus, the observation of teacher activities has reached the very good indicator criteria. The results of observations in the



first cycle showed student activity in the first cycle reached 59%. While the observation of student activity in the second cycle obtained 69% showed an increase in student activity from the previous cycle.

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