

The Instructional Design of Technology and Mathematic Based Teaching for Basketball Materials Elementary School Students

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Abstract

Education is the most basic thing to build someone's character because the aim of education is changing someone towards a better way. Education is a continuous and never-ending process so that it will produce sustainable quality, which the aimed is to build a person character in the future. Learning basketball is not only helpful to improve physical skills, such as; hand-eye coordination, physical endurance, and dexterity, but also teaching the important values, such as; cooperation, communication, and discipline. It can involve strategy, analysis, and mathematical understanding. As technology advances, the integration of technology and mathematics in learning process becomes really important. This research was conducted by applying technology and mathematic-based design to learn PJOK basketball materials at Elementary School number 81 Palembang. This research used an Equivalent Time Series Samples Design which is measured using skill tests and Formative Class Evaluation (FCE) questionnaires at the end of learning. The sample was 32 students at fifth graders at the Elementary School number 81 Palembang. The results obtained by the learning design show the poor category. The Formative Class Evaluation (FCE) questionnaire shows the result with a good component category, the willingness component is in the good category, the method component is in the medium category and the cooperation component is in the medium category.

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PENDAHULUAN

Education is the most basic thing to build a person's character because the aim of education is changing someone in a better way. Education is an effort to improve the quality of a person's thinking, knowledge, personality and maturity, which is carried out formally and non-formally (Rozi, 2022). The process of education is carried out by a person throughout his life. Education is a humanistic process which is known as humanizing humans (Annisa, 2022). Learning of education is a process of the interaction between students and teachers to achieve goals and grow experiences, so that students are able to develop the ability to think creatively about the learning that have been done (Winarni et al., 2022.). Physical education is a mean to achieve goals in education through the adaptation process of physical activities such as body organs, neuromuscular, intellectual, social, cultural, emotional and ethical (Iyakrus, 2019). Physical education is a learning process through physical activity which the aim is to improve physical fitness, motor skills, knowledge, healthy and active living behavior, sportsmanship, and develop mental intelligence (Zulfikar Alfanthorik et al., 2023). The experience of training is more than just physical exercise, learning PJOK through movement and play is the aim to

increase the development and potential growth of every student (Mu'arifin & Kurniawan, 2021). Learning Physical Education at school is encourages students to move so that their bodies are fit and do not feel excessively tired so that they are able to receive the material at school very well (Olahraga et al., 2023). PJOK is the educational process that involves interaction between students and their environment which is managed through physical activity to improve motor skills and functional values which include cognitive, affective aspects and social values such as mutual respect, cooperation, a good competition, tireless and never give up (Bayu & Andrianto, 2014).

Basketball is very popular among people; basketball is a sport where a ball can be passed or thrown to friends. The ball is bounced on the floor, on the spot or while walking and the goal is to put the basketball into the opposing team's basket (Putra Taufan Reza, 2014). The basketball game is a complex game, meaning that technical skills and a thorough understanding of tactics are required. The technique in basketball game can be interpreted as an effective and efficient way of playing the ball in accordance with the suitable game rules in order to achieve the optimal results (Fitrah & Indra Bayu, 2021). There are several basic techniques in basketball game such as shooting, passing, and dribbling, the shooting technique in playing basketball is the technique of shooting the basketball into the basketball ring to get points (Kurniawan et al., 2022), passing is the technique for passing to a friend during the game (Devidson et al., 2021), dribbling is a technique for dribbling the ball and defending the ball from the opponent's attack (Susanto & Nurharsono, 2022). Basketball is not only improving physical skills, such as hand-eye coordination, physical endurance, and agility, but also teaches the important values such as cooperation, communication, and discipline while also involving strategy, analysis, and mathematical understanding. As the technology advances, the integration of technology and mathematics in the learning process becomes increasingly important. The Integrity of Technology and mathematics area part of learning using a STEM approach, where STEM is a new approaching in the development of education that integrate more than one disciplines such as; science, technology, engineering and mathematics. STEM learning is not only mean to strengthen the practical education in the STEM fields separately, but also to develop an educational approaching that integrated science, technology, engineering and mathematics, with the focus is in the education (Mulyani, 2019). One of the learning models which the process is to allow students to be able to develop, analyze and evaluate technology in terms of the elements of science, engineering and mathematics in an integrated manner in one learning process is learning through STEM (Busyairi et al., 2022). Students are

required to solve problems, become inventors, be technologically literate so that they can build the higher quality of learning. The STEM approach can be presented in the form of teaching materials (Yuanita & Kurnia, 2019).

Student worksheets are the contain information and interactions from teachers to students so that they can carry out a learning activity by themselves through the practice or the application of learning outcomes to achieve the instructional goals (Muthoharoh et al., 2017). The use learning design of technology and mathematics-based is an innovative approach that can provide a dynamic experience and relevant learning experience with the current developments nowadays. Research conducted by (Clara Aldila et al., 2014) shows that student activity sheets implemented using the STEM approach is effective in improving students' creativity thinking skills. This is also supported by the research (Izzati, 2020) that STEM-based modules developed based on the responses of each educator are categorized as an interesting and very interesting so they can be used in learning process. Research (Kurniadi & Sovensi, 2021) shows that the results of the basketball module is valid and determine in the practical category so that it can be used in learning process at the classroom. student activity sheets is a guide for creating teaching materials that are not complicated and easy to develop. The application of technology in basketball learning can be included by the use of applications or software, the use of projectors to provide immersive virtual experiences to increase knowledge for students. In addition, the integration of mathematical concepts can provide a deeper understanding of aspects of game strategy, statistics, and motion analysis in the context of basketball. Therefore, the researchers are interested in creating the student activity sheets based on technology and mathematic on basketball materials at the elementary schools. Adopting technology and mathematic is an adoption of the learning section using the STEM approach, this approach consists of science, technology, engineering and mathematics, the researcher took some of these aspects, namely technology and mathematics. Nowadays, although technology is increasingly being applied in many aspects of learning, but the use of it in the physical education context for elementary school students is still limited. This also aims to determine the effectiveness of this technology and mathematics-based student activity sheets in learning basketball in elementary schools.

METHOD

This research uses an experimental research design. According to Sugiyono (2009, hlm 107) the experimental research method can be interpreted as "a research method used to find the effect of certain treatments on others under controlled conditions" (Hasanah et al., 2018).

Quasi experimental. A quasi-experiment is an experiment that includes a treatment, effect size, and experimental unit, but does not use a random assignment to make comparisons or concluded a changing caused by the treatment (Abraham & Supriyati, 2022). The design uses the Equivalent Time Series Samples Design. The treatment of the design is not only introduced once, but also repeatedly, interspersed with periods where no treatment is given. In this design, students undergo treatment (X) and observation (O) using learning design skills sheets and Formative Class Evaluation (FCE) questionnaires at the end of learning. The Success is determined by comparing the results of the treatment of using technology and mathematics-based learning design with those that do not use this basis. Population can be understood as all elements of a study, including objects and subjects that have certain characteristics. A sample is simply defined as a portion of the population that represents the actual research data source (Amin et al., 2023). The population of this study were students at the elementary school number 81 Palembang. The sample in this study was selected from one class, namely the fifth grader with the total number of the students are 32 in one class. The instrument uses the student skills sheets and Formative Class Evaluation (FCE) questionnaires. There are four main components if this questionnaire such as; results, willingness, methods and cooperation.

The form of the skills assessment sheet on the technology and mathematics-based learning design on basketball material is as follows:

Table 1. The Worksheet of the Assessment Skill

Name : _____ Class: _____

| No | Essential Indicator | Movement description | Yes (1) | No (0) |
|---|---------------------------|----------------------|------------|-----------|
| 1. | Initial stance position | a. Feet | | |
| | | b. Body | | |
| | | c. Hand and seeing | | |
| 2. | Motion | a. Feet | | |
| | | b. Body | | |
| | | c. Army and Hand | | |
| | | d. seeing | | |
| 3. | Position and Final stance | a. Feet | | |
| | | b. Body | | |
| | | c. Hand and seeing | | |
| Acquisition/Maximum score X 100% = Score result | | | | |

Table 2. Degree of validity of the Formative Class Evaluation (FCE) questionnaire

| Question number | Validity Score | Degree |
|-----------------|----------------|---------|
| 1 | 0,83 | Special |
| 2 | 0,71 | High |
| 3 | 0,78 | High |
| 4 | 0,70 | High |
| 5 | 0,76 | High |
| 6 | 0,60 | Enough |
| 7 | 0,72 | High |
| 8 | 0,65 | Enough |
| 9 | 0,70 | High |

(Mahendrayana & Suroto, 2017)

Based on table 2 above, there are 9 questions in the questionnaire. The Formative Class Evaluation (FCE) can be stated valid.

Table 3. Formative Class Evaluation (FCE) score category

| Score | Score | Category |
|-----------------|-------|-----------|
| 2,77 – and more | 5 | Best |
| 2,58 – 2,76 | 4 | Good |
| 2,34 – 2,57 | 3 | Medium |
| 2,15 – 2,33 | 2 | Less |
| 2,14 – and less | 1 | Very less |

The FCE questionnaire sheet will be filled by the students, after the teacher has finished providing the learning material. Students fill out the FCE sheet by giving checklist to one of the alternative answers listed in the questionnaire without any influences from other friends (Mahendrayana & Suroto, 2017). The three alternative answers are "Yes", "No" and "Don't Know" where each answer is given a score, the score of each answer is as follows:

- a. Answer "Yes" with a score of 3
- b. Answer "No" with a score of 1
- c. Answer "Don't Know" with a score of 2

Then the results are analyzed to obtain the conclusions based on the categories of the data that will be obtained. The analysis process concludes with 4 main components are results, willingness, methods and cooperation based on table 4 as follows:

Tabel 4. Kategori Nilai Lembar Instrumen *Formative Class Evaluation* (FCE)

| Component | Question item | Category | | | | |
|-----------|----------------------------|-----------|-----------|-----------|-----------|---------------|
| | | Very good | Baik | Sedang | Very good | Kurang Sekali |
| Result | Memorable experience | 3,00-2,62 | 2,61-2,29 | 2,28-1,90 | 1,89-1,57 | 1,56-1,00 |
| | Skill | 3,00-2,82 | 2,81-2,54 | 2,53-2,21 | 2,20-1,93 | 1,92-1,00 |
| | Knowledge | 3,00-2,85 | 2,84-2,59 | 2,58-2,28 | 2,27-2,02 | 2,01-1,00 |
| | The score component | 3,00-2,70 | 2,69-2,45 | 2,44-2,15 | 2,14-1,91 | 1,90-1,00 |

| Component | Question item | Category | | | | |
|--------------------|----------------------------|------------------|------------------|------------------|------------------|------------------|
| | | Very good | Baik | Sedang | Very good | Kurang Sekali |
| Willingness | Sincerity | 3,00 | 2,99-2,80 | 2,79-2,56 | 2,55-2,37 | 2,36-1,00 |
| | Fun | 3,00 | 2,99-2,85 | 2,84-2,60 | 2,59-2,39 | 2,38-1,00 |
| | The score component | 3,00 | 2,99-2,81 | 2,80-2,59 | 2,58-2,41 | 2,40-1,00 |
| Method | Fit in learning | 3,00-2,77 | 2,76-2,52 | 2,51-2,23 | 2,22-1,99 | 1,98-1,00 |
| | Learning effort | 3,00-2,94 | 2,93-2,65 | 2,64-2,31 | 2,30-2,03 | 2,02-1,00 |
| | The score component | 3,00-2,81 | 2,80-2,57 | 2,56-2,29 | 2,28-2,05 | 2,04-1,00 |
| Cooperation | Attitude to friends | 3,00-2,92 | 2,91-1,71 | 2,70-2,46 | 2,45-2,25 | 2,24-1,00 |
| | Cooperation learning | 3,00-2,83 | 2,82-2,55 | 2,54-2,24 | 2,23-1,97 | 1,96-1,00 |
| | The score component | 3,00-2,85 | 2,84-2,62 | 2,61-2,36 | 2,35-2,13 | 2,12-1,00 |
| Nilai Akhir | | 3,00-2,77 | 2,76-2,58 | 2,57-2,34 | 2,33-2,15 | 2,14-1,00 |

The form of the Formative Class Evaluation (FCE) questionnaire that will be filled out by students at the end of learning is as follows:

Table 5. Questionnaire Sheet of *Formative Class Evaluation* (FCE)

Name : Gender :

Absent number : School :

Class : Day and date :

Fill out the questionnaire (No. 1-9) **by giving check (✓)** to one of the answer box provided

| No. | Pertanyaan | Jawaban | | |
|-----|--|------------------------------|-----------------------------|-------------------------------------|
| 1. | In PJOK class earlier, is there something make you interested? | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| 2. | In PJOK class earlier, do you get a new motion experience that you never get before? | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| 3. | In PJOK class earlier, do you understand with one of the topics that being taught? | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| 4. | In PJOK class earlier, do you do the motion truly? | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| 5. | In PJOK class earlier, do you follow the instruction happily? | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| 6. | In PJOK class earlier, do you feel that you are Learning by being forced? | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| 7. | In PJOK class earlier, do you practice very hard? | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| 8. | In PJOK class earlier, do you study with your friend in a friendly situation? | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| 9. | In PJOK class earlier, do you help each other in learning at the class? | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |

RESULT

Data results obtained from students after carrying out skills tests and filling out Formative Class Evaluation (FCE) questionnaires during 4 meetings at the end of learning. The results of the assessment of each meeting are as follows:

Table 6. The result recapitulation score of skills

| Meeting | Score |
|----------------|-------|
| Meeting-1 | 54 |
| Meeting-2 | 52,5 |
| Meeting-3 | 58,75 |
| Meeting-4 | 63,75 |
| Total | 229 |
| Average | 57,25 |

Based on Table 6, it is known that the skills test results obtained a total score of 229 with an average score of 57.25 for 32 students. At the first meeting through technology and mathematic based learning the average score was 54, at the second meeting the score was 52.5 without treatment, this was a decrease from the previous meeting. In the third week, learning was carried out using a technology and mathematics basis so that an average score of 58.75 was obtained, this shows a significant improvement from the previous meeting. Students try to understand learning by linking technology and mathematics in it. Then at the fourth meeting without treatment, an average score of 63.75 was obtained

Table 7. The score results of the *Formative Class Evaluation (FCE)*

| Meeting | Result | Willingness | Method | Cooperation | Average |
|---------|--------|-------------|----------|-------------|----------|
| First | 2,61 | 2,45 | 2,34 | 2,22 | 2,41 |
| | 4 | 3 | 3 | 2 | 3 |
| | Good | Moderate | Moderate | Less | Moderate |
| Second | 2,58 | 2,66 | 2,28 | 2,5 | 2,53 |
| | 4 | 4 | 2 | 3 | 3 |
| | Good | Good | Less | Moderate | Moderate |
| Third | 2,69 | 2,73 | 2,5 | 2,39 | 2,55 |
| | 4 | 4 | 3 | 3 | 3 |
| | Good | Good | Moderate | Moderate | Moderate |
| Fourth | 2,69 | 2,59 | 2,25 | 2,38 | 2,46 |
| | 4 | 4 | 2 | 3 | 3 |
| | Good | Good | Less | Moderate | Moderate |
| Total | 2,62 | 2,61 | 2,34 | 2,37 | 2,49 |
| | 4 | 4 | 3 | 3 | 3 |
| | Good | Good | Moderate | Moderate | Moderate |

From the data obtained through the Formative Class Evaluation (FCE) assessment questionnaire, students answered 9 questions consisting of the main components such as; results, willingness, methods, and cooperation. The scores obtained include the results component the score is 2.62 in the good category, the willingness component the score is 2.61 in the good category, the method component the score is 2.34 in the medium category, and the cooperation component the score is 2.37 in the medium category.

DISCUSSION

A STEM-based approach is a learning approach that prepares students to have the ability to support their life in the future regarding of the internet things (Budiana & Gumilang, 2023). The STEM approach learning is expected to produce a meaningful learning for students through the systematic integration of knowledges, concepts and skills (Afriana et al., 2016). In this research, we adopt a learning approach from STEM. Namely; science, technology, engineering and mathematics, a new learning approach in the development of education that integrates more than one scientific discipline (Prasadi, 2019). In this case, researchers take part of STEM, namely technology and mathematics. Technology covers a wide range of areas involving the application of knowledge, skills and computational thinking to expand human capabilities and help to support human needs and desires, mathematics equips us with the skills to interpret and analyze information, simplify and solve problems, assess risk, make decision based on information and understand more about the world around us through modeling abstract and concrete problems (Elisabeth Irma Novianti Davidi, 2021). Mathematics is a field of science that has an important role in school and everyday life (Widodo et al., 2021). The use of technology and mathematic is applied by designing a worksheet based on this which is related to basketball learning for elementary school students, the aim for the students to know and increase knowledge related to basketball learning using this technology and mathematic base.

STEM is very important in the learning process because it involves the integration of knowledge to develop the understanding and skills needed in the modern world (Muttaqiin, 2023). It Also included for elementary school students, STEM is important because it can develop students' basic skills, students can analyze the movement and analyze the data according to their knowledge, students can know the of understanding technology so that later the students can understand and follow the current developments in any field

The implementation of technology and mathematic in this learning process is by implementing a technology and mathematics-based worksheet, where the technology in the learning process uses a device and internet access and it is displayed using in focus/projector for basketball learning. In the mathematic learning process, students analyze the material presented, such as analyzing movement and analyzing data in basketball learning. Analyzing the movements in some questions such as the correct hand position when shooting the ball, hand movements when dribbling the ball. And analyzing the data in a question like calculating the score in a basketball match.

CONCLUSION

Based on the results of the research in the implementation of technology and mathematics-based learning design to basketball material for elementary school students, it can be concluded that design that have been designed based on technology and mathematics can help students understand basketball material by linking technology and mathematics so that it helps student to play an active role in the learning process. It can be known from the results of the skill tests and the assessments through Formative Class Evaluation (FCE) at the end of learning.

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