The International Journal of Education Management and Sociology
E-ISSN 2963-0622
Vol 3, No 6, (November-December 2024) Pages: 354-364

Relevant Mathematics Learning Models In Elementary School In The Era Of Industrial Revolution 4.0

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Abstrct

This study was conducted to find a relevant learning model in mathematic lessons in Elementary School in the Industrial Revolution 4.0 era, which is marked by rapid technological advanced. Mathematic learning as an important foundation in understanding high-level technological concept, integrating technology into the mathematics curriculum addresses inequality of access to digital resources, and engaging students in more interactive and contextual mathematics learning. The method used in this study is a qualitative method with a case study method and literature review. The result of this study are by applying several learning models such as contextual learning models, STEAM and game-based learning models, students can develop critical thinking, problem solving, creative thinking, innovation, communication and collaborating.

Keywords: Learning Model, Mathematics, Industrial Revolution 4.0

1. Introduction

Learning models are basically an important series in the teaching and learning system approach, learning models are directly related to the selection of learning activities that are

considered effective and efficient in providing learning experiences to achieve basic competences. Learning models are very useful for teachers and students in the learning process. For teachers, this learning model can be used as a guideline and reference for systematic action in implementing learning. For students, the use of learning models can facilitate the learning process and accelerate understanding of lessons. Because each learning model is designed to facilitate the learning process.

Mathematics learning is a learning process in the classroom that includes learning and teaching activities that contain material and concept in the field of mathematics (Fitriyani & Kania, 2019: 346). Students must optimize their potential so that they realize that in the classroom with the teacher they are actively thinking. One way to activate student who are studying is by providing an understanding of concepts that are in accordance with the thinking structure that students already have, so that students will find it easy to understand mathematical concepts. Mathematics is a part of science that has unique characteristic when compared to other sciences. Mathematics is one element in education that has the purpose of learning mathematics is to train thought patterns and reasoning in drawing conclusion, developing the ability to solve problems, and developing to ability to provide information or communicate ideas.

Relevant learning models in elementary schools are needed because at this time student are at a stage of cognitive development that requires concrete development to understand concept. Children at his age tend to learn through direct experience and interaction with their environment. Several learning models can be used to make students actively involved in the learning process, discuss, collaborate with friends and solve real problems. This not only improves their understanding but also builds critical and creative thinking skill, teachers can create a dynamic and interactive learning environment (Budiman, 2022:54). Students will be more motivated to learn because they see the direct relevance of what they learn to their daily lives. Overall, this mathematics learning model can not only improve conceptual understanding but also equip students with the skills needed to succeed in the future.

Based on the description of the background of the problem that has been explained, contextual learning strategies must be applied to help students understand mathematical concepts because the right learning strategy in understanding concepts is contextual learning (Siregar, et al, 2020:145). In this article, the author is interested in studying and describing relevant mathematics learning models in Elementary Schools in the industrial revolution 4.0 era.

2. Lieratur Review

2.1. Learning Model

In mathematics education in the Industrial Revolution 4.0 era, the orientation of learning objectives is highly emphasized on character development, competition and broad literacy. This is not only about understanding mathematical formulas, but also forming individuals who are able to think creatively, and become problem solvers. The following will discuss several effective learning models in mathematics learning, namely contextual learning with STEAM (Science, Technology, Engineering, Art, Mathematic) approach and Game Based Learning. This learning model helps students understand concept, develop skills in facing mathematical challenges in an increasingly complex and rapidly changing world.

2.2. Contextual Learning Model

Contextual learning strategy is a learning strategy that connects students' daily real life with the material being studied, which aims to give meaning to mathematical material in students' lives (Komalasari, 2017: 23). Contextual learning model or commonly known as contextual teaching and learning is an active teaching and learning process approach that is

centered on student (Nada, 2020: 145). Contextual learning strategies can be applied to mathematics lessons, contextual learning has advantages and disadvantages, the advantages are that learning becomes more meaningful and real and can develop students' understanding of concept through learning with experience rather than memorizing. While the weakness is that teacher-led learning management must be carried out as well as possible so that learning objectives can be achieved optimally (Surdin, 2018:57).

Contextual learning of mathematic means that mathematics learning uses a contextual approach as its learning strategy. Mathematics learning is centered on students by connecting mathematical material to everyday life that is observed an felt by students. This contextual mathematics learning is one way for student to understand the material presented by the teacher and can deepen the material being studied. The principles of contextual learning consist of 7 principles, namely: constructivism, discovering, asking, learning communities, modeling, reflection, and actual assessment. Contextual in mathematics learning can be linked to students' experiences in their lives.

In contextual learning mathematics, mathematics dan everyday life are closely related. Students will find it easier to relate various information if they have contextual thinking skills so that they can understand the mathematical concepts used (Jaenal Asikin & Siti Ujaedah, 2020: 29). By implementing contextual learning, students are expected to be able to understand learning and benefits in everyday life and can build the mathematical concepts they learn.

There are several steps that can be applied in implementing contextual learning strategies:

a. Material Preparation The preparation of materials in contextual learning strategies begins with identifying academic concepts to be taught and then linking them to real situations that are relevant to students' lives. Teachers need to be creative in compiling materials that are not only informative but also interesting and meaningful to students. For example, in the material the concept of fractions can be taught through cooking activities. Students learn fraction material by dividing food ingredients such as cutting cakes or pizza into certain parts. In this way, students can understand the concept of fractions more concretely and see its application in everyday life.
b. Learning activities in contextual learning strategies are designed to be interactive and collaborative. Students are invited to discuss, work in groups, and conduct experiments that allow them to apply the concepts learned. Group discussions or teamwork are an important part of the learning process, because through this interaction students can exchange ideas, develop communication skills, and learn to work together. In mathematics lessons, teachers can divide students into small groups to solve problems involving the use of fractions in everyday life, such as planning to cook or calculating the area of land.
c. Assessment in contextual strategies is carried out continuously and comprehensively. Teachers can use various assessment methods to evaluate students' understanding and ability to connect concepts to real situation. Assessment is not only limited to the final result but also includes the thinking process and effort made by students. Direct observation is one of the important assessment methods, teachers observe students' participation and interaction during learning activities, not how they solve problems and collaborate with their friends. Quizzes and short tests can be used to measure individual understanding of concept, in addition to group project and practical tasks are given to assess students' ability to apply concept academics in the real world. For

example, student can be given a project to design and calculate the cost of the dish that involves the concept of fractions.

2.3. STEAM

STEAM is a learning method that can be applied to all children's exploration activities, because in its application this method combines several disciplines that can help children understand new knowledge both of school and outside of school more easily because the STEAM method applies an active and creative learning type where children will play an active role in exploring the knowledge obtained through the surrounding environment. The STEAM approach is identified as learning that combines four disciplines namely, Science, Technology, Engineering, and Mathematic by focusing on the learning process that explores two or more fields that involve students actively in the context of solving problems in the real world (Sanders, 2009:20). In addition Roberts dan Bybee stated that the four disciplines integrated in STEAM must be a holistic unit.

STEAM is developed by adding elements of art in is learning activities. STEAM is included in the student-centered approach (Talib et al, 2019: 20). The addition of art aspects to STEAM learning is based on the need to increase motivation in learning Science, Technology, Engineering, and Mathematics. A learning environment that involves art aspects and is used as an essential aspect just like other disciplines can provide ideal condition for STEAM learning (Hunter Doniger, 2018: 22).

The addition of art aspects provides more opportunities for students to be able to do hands on learning and produce using creativity and problem solving (Katz-Buonincontro, 2018: 73). STEAM learning is about creating a classroom environment where students learn creative problems (Liao, 2016: 44). Art can help students better understand the creative process (Bequette & Bequetta, 2016: 40), the art aspect in STEAM makes learning more holistic and can encourage students to develop their creativity (Bahrum et al, 2017: 645).

STEAM learning is important because the art practices in STEAM can encourage independent learning, social responsibility and creative problem solving (Rolling, 2016:4). Art in STEAM can also facilitate transdisciplinary integrated learning that provides deeper understanding (Liao, 2016: 45). Disciplinary thinking processes can support the development of students' transdisciplinary thinking (Costantino, 2018:100). Learning with STEAM integrates learning materials transdisciplinary by involving creativity (Henriksen et al, 2019:4). Transdisciplinary integrated learning is considered important in the process of solving complex problems (Nicolescu, 2018:73).

Another study that analyzed teachers' perceptions in Korea towards STEAM (Kim & Lee, 2018:9), defined each aspect of STEAM. Science is defined as the study of nature related to physics, chemistry and biology and the treatment and application of facts, principles, concepts or practices related to it. Technology consists of the entire system starting from the people involved the organization of knowledge, the processes and devices used to load and operate the technological tools and tools themselves.

The technological aspect does not always have to know software, technology can be in the form of student skills in using tools and also in the form of products produced by the students themselves. Engineering is a knowledge of product design and creation and processes to solve problems. Engineering used concepts in mathematics, science and technology. Engineering which is not always related to electricity, the Engineering aspect focuses on design activities both in solving problems and in making products. Mathematic is defined as the study of the relationship between quantity, numbers and shapes. The science of mathematics includes theoretical mathematics and applied mathematics.

One of the theories used in STEAM learning is constructivism theory which emphasizes student centered learning, constructivism theory holds that students build the knowledge through development and sequences and cognitive frameworks and when they try to understand something from experience (Gross, 2016:36). In line with that, STEAM reflects more creative, authentic, real world, and project or problem-based education (Henriksen et al, 2019:3).

2.4. Game Based Learning

Game Based Learning is learning method if we translate it into Indonesian, it's means a game-based learning method. So, a learning that is in accordance with the teaching materials and assisted by technology and displays several achievements when completing the quiz. Game Based Learning it's a learning method that uses a game application that is specifically designed to help the learning process (Maulidina, 2018: 113). In this learning, students are required to learn but with a play approach. Games are one of the media used to hone brain in overcoming conflicts or problems in the game. The problems or conflicts created in a game are taken from real life and combined with the imaginary side. This is intended to make the flow of conflict or problems more interesting to solve (Martono, 2011: 49).

The game method is a way of presenting learning materials through various forms of games. All the potentials of games as media are very possible to be used as motivational learning media for students. It's ability to influence cognitive and emotional aspects can be a strength as a learning medium (Syahri et al, 2014: 9). In games, students learn to consider and connect cause and effect, also learn to focus and be aware of problems seen in the game and find solutions to problems in the game (Saputra et al, 2015: 11).

Game is direct learning with a learning by doing patternst. The learning that is done is a consequence of the game player to be able to go through the challenges in a game. The learning pattern is obtained from the failure factor that the player has experienced, thus encouraging not to repeat the failure in the next stage.

2.5. Mathematic Learning

Mathematics is a subject taught from Elementary School to Collage, mathematics has an important role for other subjects. The importance of mathematics lessons for education since Elementary School so it is necessary to find a way to manage the process of teaching and learning mathematics in Elementary School can be properly understood. Mathematics is a global field to science, living in a world of limitless science. It's existence in the world is very much needed and continues to develop in line with the demands of human needs.

Many applications from various branches of science use mathematics, therefore the maturity of a science is determined by whether or not the science uses mathematics in its thought patterns and application development. The goal of mathematics education is not only for students to be able to solve routine mathematics problems such as daily tests, semester exams and national exam.

However, the objectives of mathematics must be directed to more comprehensive objectives in accordance with the objectives of the curriculum: (1) Understanding mathematical concepts, (2) Using reasoning on patterns and properties to carry out mathematical manipulations in making generalizations, compiling evidence, or completing mathematical ideas and statements, (3) Solving problems that include the ability to understand problems, design mathematical models, complete models and interpret the solutions obtained, (4) Communicating ideas with symbols, tables, diagrams or other media to clarify conditions or problems, (5) Having an attitude of appreciating the usefulness of mathematics in life, namely having curiosity, attention and interest in studying mathematics, as well as a persistent and confident attitude in solving problems.

Mathematics also aims to improve students thinking so that they are able to solve problems in everyday life. This shows that mathematics has an important role in education so that it is given to all students from elementary school to college. Mathematics functions to improve problem solving skills by understanding problems, and changing problem sentences into mathematical models. In mathematics learning activities, students are expected to be able to solve problems related to everyday life (Mali & Son, 2023 :117)

2.6. Industrial Revolution Era 4.0

The development of education in the 21st century is often identified with the information society which in marked by the phenomenon of digital society. In this digital society, what is called the industrial revolution 4.0 has emerged. The changes in the world are now entering the era of the industrial revolution 4.0 or the fourth world revolution where information technology has become the basis of human life. At this time, Indonesia is entering the stage of the industrial revolution 4.0 where this stage is moving towards an information society. However, the implementation of this fourth era must be followed by the formation of a healthy ecosystem in order to move in all fields to achieve success in this digital era, a structured ecosystem and communication are needed. The industrial revolution 4.0 includes preparations for a more innovative learning system or adapting to the exiting curriculum related to the rapid development of technology so that preparations for network system must be developed continuously (Warohidah & Kusuma, 2019: 5).

In fact, Indonesian people are accustomed to using technology in their daily lives, but have not utilized it well in term of productivity. The aspect of mastery of technology is a determinant of competitiveness in the era of the industrial revolution 4.0. Artificial intelligence is increasingly showing improvement, digital mechanisms are no longer applied in various field. The role of humans is slowly being replaced by machines in carrying out various activities. As a result, many human workers are replaced by machines. The application of the industrial concept can also reduce production cost and time as well as the decreasing number of job.

2.7. Mathematics Learning in Elementary School in The Industrian Revolution 4.0 Era

Learning is process of interaction between students, teachers and learning resources in a learning environment. The teaching and learning process will run optimally if the components that are related to each other support each other. Implicitly, it can be started that the components related to the implementations of learning in Elementary School are teacher ability, student maturity of thinking, awareness of the nature of learning outcomes to achieved, method used by teachers, and learning condition that must created.

The main pillar of education is the pillar of education, the four pillar provided by UNESCO consist of:

a. Learning to know means learning to know related to how to gain knowledge through the use of existing media or equipment such as book, the internet, people and other technologies.
b. Learning to do means learning to do or create something which is inseparable from learning to know because all inseparable from knowledge.
c. Learning to be which means learning to become a person who develops completely in relation to the increasingly complex demands of life so that character in needed in each individual.
d. Learning to live together in peace which means the importance of living together regardless of ethnicity, race, religion, ethnicity, or education background. Meanwhile, to achieve the goals of national education, the four pillars are not enough, so it is added with the pillar of education, namely learning to strengthen faith, piety, and noble

morals. Likewise in today's mathematics learning process in the Industrial Revolution 4.0 era.

In the era of Industrial Revolution 4.0, mathematics learning no longer uses traditional learning but must be able to improve higher thinking skills. It is time to leave learning that is based on memorization or only finding one correct answer, we must create learning methods that hone creative, critical and innovative thinking skills. Mathematics learned in class can only learn mathematics to the surface, when you want to learn more about mathematics, then learn mathematics (Sutarto, 2018: 33).

3. Method

The method in this study is a qualitative method with a case study method to explore the mathematics learning model in Elementary Schools in the Industrial Revolution 4.0 era. This study focused on Elementary schools, especially grade 4 in fraction lessons. The students were observed during mathematics learning.

The qualitative approach was chosen because it allows researchers to dig deeperinto the experiences, perceptions, and interactions that occur during the learning process. The case study method was chosen to provide a detailed description of the appropriate mathematics learning model in Elementary Schools in the Industrial Revolution 4.0 era. Data were collected through various techniques to ensure the depth of information obtained. Classroom observations were conducted to directly observe how contextual learning strategies are applied by teachers and how students respond them. Interviews with teachers and students were conducted to gain further insight into the appropriate mathematics learning model in Elementary Schools in the Industrial Revolution 4.0 era.

The respondents in this study were grade 4 students and also mathematics teachers. This method involves identifying a number of individuals who are relevant to the research topic, then from them data is obtained. Through this approach, the researcher managed to collect 30 respondents from students and 15 respondents from mathematics teachers. Where the data obtained provides I depth insight into research topic.

Data collection was conducted by interviewing respondents, namely teachers, to gain a comprehensive understanding of the research topic and also field observations, namely students as respondents, to strengthen the interview data. In addition, in order to strengthen the primary data obtained, researchers also conducted a literature review or library study by identifying relevant sources of research journals.

The collected research data is analyzed interactively with a qualitative approach involving several important stages. The collected data will be reduced to obtain relevant information according to the focus of the research. The reduced data is used to identify the main themes in the emerging patterns. In addition, the data is presented in the form of tables or systematic narratives so that it is easier to understand the relationship between variables. Drawing conclusions is done based on in depth interpretation of the data that has been analyzed.

4. Result and Discussion

4.1. Result

The study was conducted to determine the relevant mathematics learning model in Elementary Schools in the Industrial Revolution 4.0 era. To obtain data in this study using observation data collection, interviews and documentation. After the implementation of learning using contextual learning, STEAM and game-based learning. The result of the observations were analyzed and presented in following table:

Table 1. Interview on Implementation of Learning Model

No	Indicator	Code	Presentation
1	Model learning which relevant	Contextual model, STEAM, Game based learning	55%
2	Development learning media	Learning media real in fractional material	65%
3	Increasing student creativity	The effectiveness of game-based learning and contextual models	70%
4	Increasing students understanding of concepts	Students understanding of fraction material	70%
5	Teacher skills in contextual approaches	Use of learning media such as game-based learning, STEAM, and contextual models	73%

From Table 1 it can be concluded that:

a. In the learning model indicator, several learning models such as contextual models, STEAM, and game-based learning are included in the sufficient category at 55%.
b. In the learning media development indicator, the use of real learning media for fraction material is included in the sufficient category at 65%.
c. In the indicator of increasing student creativity, the use of game-based learning and contextual methods is included in the high category at 70%.
d. In the indicator of increasing students' conceptual understanding, students' conceptual understanding is in the high category at 70%.
e. In the teacher skills indicator in the contextual approach, the use of learning media such as game-based learning, STEAM and game-based learning, STEAM and contextual models received a high category of 73%.

Table 2. Observation of Student Activities

No	Indicator	BHS	BSB	MB	BB	BSH	BSB	MB	BB
1	Think critically	8	11	7	4	27%	37%	23%	13%
2	Solution to problem	7	12	8	3	23%	40%	27%	10%
3	Creative Thinking	6	15	7	2	20%	50%	23%	7%
4	Innovation	5	20	3	2	16%	67%	10%	7%
5	Collaboration	7	13	6	4	23%	44%	20%	13%

Information:
BSB : Developing Very Well
BSH : Developing as Expected
MB : Starting Develop
BB : Not Yet Developed

From Table 2 above it can be concluded that:

a. In the critical thinking indicator, it is known that 8 students are developing very well, 11 students are developing according to expectations, 7 students are starting to develop and 4 students have not developed.
b. In the problem solving indicator, it is known that 7 students are developing very well, 12 students are developing according to expectations, 8 students are starting to develop and 3 students have not developed.
c. In the creative thinking indicator, 6 students developed very well, 15 students developed as expected, 7 students began the develop and 2 students had not yet developed.
d. In the innovation indicator, it is known that 5 students are developing very well, 20 students are developing according to expectation, 3 students are starting to develop and 2 students have not developed.
e. In the collaboration indicator, it is known that 5 students are developing very well, 20 students are developing according to expectation, 3 students are starting to develop and 2 students have not developed.

4.2. Discussion

The relevant mathematics learning model in Elementary School in the industrial revolution 4.0 era includes 5aspect namely, relevant learning models, development of learning media, increasing student creativity and teacher skills are very important so that mathematics is no longer taught with a traditional approach. The teaching and learning process is essentially a process of acquiring knowledge and science from various materials that have been studied.

Creating knowledge students is the main goal of the education process that occurs in the classroom. In the learning process, teacher act as instructors and student as teaching subject must have the skills, knowledge, attitudes, values and personalities needed to run optimally as expected. The success of a fun learning process tends to focus on activities related to real world life. The learning process must be packaged according to the needs of students, fun, comfortable, and not boring, focusing on interactions from interpersonal, cultural, individual, and human development (Almahoresya & Mardiyah, 2023: 1-13).

The mathematics learning models used in schools are very relevant. These models must not only be in accordance with the school's vision and mission, but must also promote deep understanding and strong mathematical skills (Lubis & Ritinga, 2023: 6). Effective mathematics learning not only transfers mathematical knowledge, but also the development of conceptual understanding, problem solving, critical thinking, and mathematical communication.

The implemented mathematics learning activities are felt to be able to bring out important abilities in facing the Industrial Revolution era, namely critical thinking, problem solving, creative thinking, innovation, and collaboration. These abilities are found in the process standards in mathematics subject.

Students have competency in mathematical concepts related to real problems, but only a few students are able to explain why the concept is used in the application. In the case, mathematics has a strategic role in forming human resources as expected in the rea of Industrial Revolution 4.0. In the era of the Industrial Revolution, learning models can dominate mathematics learning because the use of effective learning models allows students to think creatively, critically and innovatively.

5. Conclusion

The relevant mathematics learning model is to combine contextual models, STEAM dan Game Based Learning. In learning, mathematics can foster critical thinking skills, problem solving, creative thinking, innovation and collaboration. It can even be felt that the activities carried out are able to present knowledge and skill in a balanced way. Mathematics education is becoming increasingly important in facing the era of industrial revolution 4.0 because the ability to think analytically, solve problems, and mastery of mathematics are the keys to facing future challenges. Mathematics learning has a very large role in facing the era of industrial revolution 4.0. provides significant opportunities for mathematics educations to become more dynamic, inclusive, and relevant in facing increasingly complex world changes. This study only limited to one subject and one material, namely fractions, so it is advisable to conduct further research to identify more relevant learning models, especially in mathematics lessons so that they can be utilized optimally.

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