Study Literature: The Influence of STEAM Learning on Student's Literacy-Numeracy Ability

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Abstract

Literacy-numeracy ability is one of the competencies that is closely related to human activities in daily life in the Society 5.0 era. Based on the 2019 PISA survey, Indonesian literacy is ranked 62 out of 70 countries. From these data, it can be shown that Indonesian literacy is still very low. This study aims to determine the effect of learning that is integrated with STEAM (Science, Technology, Engineering, Art, and Mathematics) on the literacy-numeracy ability of Indonesian students which are considered to be lacking. The method used is a literature study by taking data from previous studies to answer the influence of STEAM learning on students' literacy-numeracy ability. By applying STEAM-based learning that involves literacy-numeracy activities, it turns out to have an effect on students' literacy-numeracy ability as shown by the comparison of student learning outcomes from before and after learning the STEAM model. Further research is needed regarding more varied STEAM learning innovations so that maximum learning outcomes are obtained.

Keywords:

Literacy, Numeracy, STEAM

1. Introduction

In the era of Society 5.0, literacy and numeracy ability are fundamental abilities because these abilities will later be closely related to human activities in daily life. In life, of course, we cannot be separated from numbers and data, such as trade, health, education, etc. Therefore, numeracy ability are very necessary. In addition, to face global challenges requires the ability to solve problems, make appropriate decisions, and understand nature and society which requires literacy ability. Therefore, literacy and numeracy abilities have an important role and become the basis in facing the era of Society 5.0.

Based on the 2019 PISA survey, Indonesian literacy ranks 62 out of 70 countries. This shows that Indonesian literacy is very low. Literacy is defined as an individual's ability to read, write, speak, calculate, and solve problems needed in activities such as the scope of work and society (Harvey J. Graff, 2006). Meanwhile, according to UNESCO itself, literacy is the ability in reading and writing regardless of the skill obtained and who gets it. From this definition, we can conclude that literacy ability means mastery in reading, understanding, retelling, writing, and solving problems in various situations.

In addition to low literacy ability, it turns out that numeracy ability in Indonesia are also low. Based on the 2019 PISA survey, Indonesia's numeracy ability is ranked 73rd out of 80 countries. Numerical ability according to PISA is the focus of students' competence in giving reasons, analyzing, and conveying ideas effectively in solving, interpreting, and formulating various mathematical problems. Through the application of the STEAM learning model that integrates Science, Technology, Engineering, Arts, and Mathematics, it is expected to be able to increase students' inquiry activities, communication skills, and critical thinking in learning (Starzinski, 2017).

1.1. Society 5.0

The era of society 5.0 is a concept introduced by the Prime Minister of Japan on Monday, January 21, 2019. The concept developed by Japan defines society 5.0 as a situation where society is human-centered. The concept of society 5.0 can balance economic progress which is not only limited to manufacturing

factors but also solves social problems that integrate virtual space and physical space (Skobelev & Borovik, 2017). The concept of society 5.0 was developed to meet human needs in order to live comfortably by using modern-based science in everyday life. With society 5.0, humans are required to be part of the technology itself in living life so that new values will emerge in technological development. Society 5.0 needs to be realized in developing countries like Indonesia with the hope that Indonesia's gaps can be minimized and become a technology-based country.

1.2. *Pisa Test*

The literacy-numerical ability of Indonesian students can be seen by looking at the results of the three-year international assessment held by the OECD (Organization for Economic Co-operation and Development) or also known as the PISA (Program for International Student Assessment) test. Indonesia has participated in the PISA study since 2000 with the aim of knowing the knowledge and skills of Indonesian students in the fields of science, reading, and mathematics. In 2000, Indonesia was ranked 39th with a score of 367 for mathematical literacy from 41 countries that participated in the PISA study. In 2003, Indonesia was ranked 38th with a score of 360 for mathematical literacy from 49 countries. In 2006, Indonesia was ranked 50th with a score of 391 for mathematical literacy from 57 countries. In 2009, Indonesia was ranked 60th out of 65 countries with a math score of 395 out of an average of 500 (Pangesti, 2018). In the same year, Indonesia was ranked 34th out of 45 countries based on the TIMSS (Trends in International Mathematics and Science Study) survey. In 2012, Indonesia was ranked 64th out of 65 countries participating in the PISA study. In 2015, Indonesia's literacy-numerical ability was still relatively low, with the average achievement scores of Indonesian students in the fields of science, reading, and mathematics ranked 62, 61, and 63 out of 69 countries (Hawa, 2018). Based on the results of the PISA test, it can be seen that Indonesia's literacy-numeracy ability is still relatively low below the average. Some Indonesian students have not been able to master literacy-numeracy skills well.

1.3. *STEAM*

STEAM (Science, Technology, Engineering, Arts, and Mathematics) is a learning approach that emphasizes the relationship of knowledge and skills in science, technology, engineering, art, and mathematics to solve problems. STEAM (Science, Technology, Engineering, Arts, and Mathematics) education emerged as a new pedagogy during the Americans for the Arts-National Policy Roundtable discussion in 2007. STEAM combines the arts in STEM with the aim of increasing student participation, creativity, innovation, problem solving abilities, and other cognitive benefits (Hetland & Winner, 2004). In addition, STEAM also aims to improve students' abilities in teamwork, communication, adaptability needed for career advancement and economics (Colucci-Gray et al., 2017). By applying the STEAM learning model in the learning process involving numeracy literacy activities, it is expected to strengthen the ability students' numeracy literacy is still lacking. The STEAM Learning Model integrating several lessons can enrich students' insight. Students can feel the benefits and apply directly the theory learned. In terms of literacy, through STEAM students receive various information which can then create ideas and creativity. Students are also trained to read and write. In terms of numeracy, students are always used to doing calculations and analyzing data in the form of numbers or graphs.

1.4. *Literacy Ability*

This literacy ability in the fifth generation is referred to as multiliteracy. Multiliteracy can be defined as a skill to understand information from symbols, text, and multimedia using various ways (Abidin, 2019). Based on the opinion of Ojose (2011), in everyday life, the use of the basics of mathematics is more emphasized in literacy skills. Ojose said "mathematics literacy is the knowledge to know and apply basic mathematics in our everyday living". Based on some opinions of experts about mathematical literacy, it can be concluded that mathematical literacy is the ability of individuals to use their mathematical knowledge effectively, meaning that in solving problems, an individual must be coherent in accordance with the mathematical way of thinking, namely starting with identifying the problems that are happening, formulating problems, using knowledge mathematics in solving them, and interpreting in solving problems in everyday life. Some aspects of mathematics involved in mathematical literacy, namely, (1) numeracy, relating to counts and numbers. (2) spatial literacy, related to understanding the (three-dimensional) world in which we live and move. (3) quantitative literacy, related to quantity, change and relationships, and uncertainty.

1.5.   *Numeracy Ability*

Mathematical knowledge and numeracy skills are two different things. Knowledge of mathematics only emphasizes solving a problem using a formula or understanding a mathematical concept. Meanwhile, numeracy ability is the ability, skill, and willingness to apply mathematical concepts and rules in real everyday problems. This numeracy ability is not only the skill of counting and processing numbers, but also the ability to reason, analyze, interpret, and manipulate language or mathematical concepts found in everyday life and then applied to predict and make decisions (Mahmud & Pratiwi, 2019). Number sense or also called sensitivity or mastery of numbers has a relationship with numeracy abilities (Setyaningsih and Ekayanti 2019). Therefore, students who have the ability in mathematical knowledge do not necessarily have good numeracy skills. However, students with good numeracy skills must have good mathematical knowledge.

1.6.   *Literacy-Numeracy Ability*

Literacy-numeracy ability are knowledge and skills to (1) obtain, interpret, and communicate various kinds of mathematical numbers and symbols to solve practical problems in everyday life; (2) analyze the information displayed in various forms (graphs, tables, charts, etc.) to make decisions. Literacy-numeracy skills are related to skills to apply mathematics in daily life (EU Skills Panorama, 2014). In order to have this ability, one must have sensitivity to the presentation of data, understand patterns, and rows of numbers; as well as being able to recognize situations where mathematical reasoning can be used to solve problems.

2.   **Discussion**

Application of the STEAM (Science, Technology, Engineering, Art, and Math) Learning Model for Strengthening Student Literacy-Numeration (Sari & Ekayanti, 2021). The results of this study conclude that students' literacy-numeracy skills can be strengthened by applying a STEAM-based learning model that involves literacy-numeracy activities. This is indicated by an increase in student learning outcomes after the application of the STEAM learning model. Before the STEAM model was applied, most of the students' learning outcomes scored very low categories. Meanwhile, after the STEAM model was applied, student learning outcomes increased in the medium, high, and very high categories. In addition, students also gave a positive response of 97% to the learning provided.

The effect of STEAM learning on students' literacy-numeracy skills is evidenced by the differences in student learning outcomes in the research conducted by Sari & Ekayanti (2021). There is an increase in student learning outcomes during the pretest compared to student learning outcomes during the posttest which is based on aspects of student knowledge. After STEAM learning is implemented, students get a maximum score of 95 and a minimum score of 70. Students who get the maximum score are categorized as very good and perfect. Students who belong to this category are able to know, remember, analyze, apply and evaluate all basic competencies. Meanwhile, students who get a minimum score are categorized as sufficient. Students who belong to this category can remember, know some basic competencies, but are still unable to apply, analyze and evaluate some basic competencies.

According to Arsy & Syamsurizal (2021), STEAM learning is an approach that can be implemented in learning at school by integrating skills and abilities in the fields of science, technology, engineering, art, and mathematics. The acronym STEM was originally introduced by the NSF (National Science Foundation) as an embodiment of an education system that integrates Science, Technology, Engineering, and Mathematics (Zaher & Hussain, 2020). However, in its development, the contribution of the arts in STEM-based education provides a new perspective by exposing students to see the world in a different way. With the addition of Art elements in STEM learning, students are able to learn through different pedagogical modalities by involving their other interests (Watson, A. & Watson, G., 2013).

STEAM learning emphasizes integrating perspective-taking skills, creative and problem-solving skills, transfer of knowledge across disciplines, and/or encouraging students to explore and provide experiences in new ways that are related to real problems. Students will be actively involved in STEAM learning because the learning is based on five interconnected ways of knowledge, namely cultural knowledge, relational knowledge, critical knowledge, visionary and ethical knowledge, and knowledge in action. At the same time, the five aspects of STEAM will create an active learning to solve problems by bringing together abstract concepts from all aspects. With the application of STEAM in the learning process, students can build and develop their abilities and knowledge so that they not only memorize concepts but are also guided to be able to integrate science, technology, engineering, art, and mathematics which in turn can improve student learning outcomes (Ulfayani, Jeranah, & Asrawati, 2022).

The application of STEAM learning is in line with literacy-numeracy skills that are important for students to master to face the challenges of the 21st century and the era of society 5.0. Indonesian students need to prepare their abilities to increase students' competitiveness and struggle to face the challenges of the 21st century and the era of society 5.0. Therefore, Indonesian students must master six basic literacy skills, namely language literacy, numeracy literacy, scientific literacy, digital literacy, financial literacy, and cultural literacy and citizenship. Mastery of students' literacy-numeracy skills can be improved with STEAM-based learning integrated with literacy-numeracy activities.

The integration of literacy-numeracy activities can be done at the grade level and at the school level. At the classroom level, the mathematics learning process must use contexts that are close to the students' daily experiences and always relate various mathematical topics to situations and conditions in real life or everyday life. In addition, understanding concepts, especially reasoning in context, must be emphasized more than only emphasizing on arithmetic or computational skills. As a manifestation of STEAM learning, the learning process must also bring up the concept of non-mathematical learning by inserting numeracy elements in the discussion of other subjects (Han, W., et al., 2021). It is intended that students have more opportunities to practice their mathematical knowledge and skills in the context of other subjects.

At the school level, this literacy-numeracy activity can be realized by developing supporting facilities as numeracy learning media and displaying various numeracy information in various contexts. In addition, schools can also provide various numeracy facilities or displays in school gardens that allow and encourage students to play numeracy. Schools can also provide mathematical tools and traditional games as well as board games that can train students' numeracy literacy skills. Various literacy-numeracy activities, both at the grade level and at the school level, along with the application of STEAM learning can improve students' literacy-numeracy skills.   (3)

3.   Conclusions

This study literature was conducted to determine the influence of the application of STEAM learning on students' literacy numeracy ability. Based on the reference article entitled "Penerapan Model Pembelajaran STEAM (Science, Technology, Engineering, Art, and Mathematics) untuk Penguatan Literasi-Numerasi Siswa" we can draw the conclusion that by applying the STEAM learning model can strengthen students' literacy-numeracy ability. This is based on reference article research that shows an increase in student learning outcomes after the implementation of the STEAM learning model. It is recommended to the next teacher to be able to increase innovation in STEAM learning which is more varied so that the abilities needed in the era of society 5.0 can improve and prepare students more thoroughly.

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