UJME 10 (3) 2021: 222-230
UNNES JOURNAL OF MATHEMATICS EDUCATION
https://journal.unnes.ac.id/sju/index.php/ujme/
ISSN: 2252-6927 (print); 2460-5840 (online)

The development of science, technology, engineering, arts and mathematics nuanced mathematics teaching materials to improve mathematical conceptual understanding ability

Ade Arwina Andani Putri[a]*, M. Asikin[b]

[a,b]*Universitas Negeri Semarang, Kampus Sekaran Gunungpati, Semarang, 50229*

**adearwina@students.unnes.ac.id*

ARTICLE INFO

Article history:

Received October 8, 2021
Received in revised form October 23, 2021
Accepted November 30, 2021

Keywords:
Development; Teaching Materials; STEAM; Mathematical Conceptual Understanding Ability

Abstract

This research is a development research that aims to develop mathematics teaching materials related to Science, Technology, Engineering, Arts, and Mathematics (STEAM). This study uses the stages of Research and Development (R&D) covering potential and problems; data collection; product design; design validation (potential test and feasibility test); product test (readability test and attractiveness test); use trials (effectiveness test) and the final product. The results of the study indicate that teaching materials have the potential to improve the ability of mathematical conceptual understanding; valid, easy to understand, attractive in appearance, and effectively improve the ability of mathematical conceptual understanding. The test results show that teaching materials have the potential to increase the ability of mathematical conceptual understanding with a percentage of 86.5%. The results of the feasibility test show that the teaching materials are valid for use with a percentage of 86.07%. The results of the readability test showed that the teaching materials were easily understood by students with a percentage of 92.26%. The results of the response test showed that the teaching materials were attractive in appearance with a percentage of 90.15%. Then, the results of the effectiveness test showed that the teaching materials were effective in increasing the ability of mathematical conceptual understanding.

1. Introduction

Based on the Constitution Number 20 of 2003 concerning the National Education System contained in article 3 describes the purpose of national education, namely developing students' abilities to become human beings who are obedient to God, have good morals, are healthy, knowledgeable, capable, independent, creative, and become citizens, responsible and democratic. Preparing quality human resources is crucial in the world of education. The crucial stage in the world of education is learning activities so that in the learning process teachers must understand the material and are expected to master the tips for delivering material by utilizing technological developments.

A real effort made by the government in the field of education is to improve the national standard of education. In the national education standard there are standards of content, process, competency of graduates, education staff, facilities and infrastructure, management, financing and assessment of education which must be improved in a planned and periodic manner. Infrastructure is one part of the national education standard which includes educational components which include teachers, students, curriculum, materials, learning media, and learning resources. One component that has a major influence on the success of education is learning resources. Learning resources are references used to assist the learning process. One of the learning resources that implements various concepts according to the needs of standard competencies and basic competencies is teaching materials. One of the teaching materials that

To cite this article:
Putri, A.A.A., Asikin,M. (2021). The development of science, technology, engineering, arts and mathematics nuanced mathematics teaching materials to improve mathematical conceptual understanding ability. *Unnes Journal of Mathematics Education*, 10(3), 222-230. doi: 10.15294/ujme.v10i3.54143

utilizes teaching materials is mathematics. In learning mathematics, an understanding is needed that is in line with the trends that exist in the current era of globalization, such as learning using STEAM. STEAM is a learning approach that provides opportunities for students to deepen their knowledge in the fields of science and humanities and can develop skills needed in the 21st century which include communication skills, critical thinking skills creativity, and other skills at the same time. STEAM education as part of strengthening STEM education by integrating arts education (Akmal & Asikin, 2021: 198). STEAM is the brainchild of the Rhode Island School of Design by providing additional "arts" in STEM. The purpose of the addition of "arts" is to foster innovation by combining the thinking of scientists with artists.

Based on this, it is necessary to develop teaching materials that can make it easier to understand the material and can relate mathematical material to other fields, especially in STEAM. Teaching materials that can meet these needs are mathematics teaching materials with STEAM nuances with the aim of increasing interest, creativity, critical thinking, and communication in the fields of science and mathematics that are packaged in an attractive way by combining technology, engineering and art. Bybee (in Kim & Kim, 2016: 1911) states that STEAM education is built on experiential learning so that it can help in learning and focus by emphasizing logical, mathematical, experimental, and scientific thinking, increasing learning motivation and generating curiosity about learning mathematics and science related to everyday life.

With the development of mathematics teaching materials with STEAM nuances, it will have a positive impact on linking the material to the STEAM field. This is supported by Iik Nurhikmayati's research (2019) regarding the application of STEAM in mathematics learning, the explanation of the research is that the implementation of STEAM in mathematics learning provides benefits, namely developing abilities in cognitive aspects and developing other skills that are useful in facing the challenges of the globalization era.

One of the objectives of school mathematics learning delivered by BSNP is for students to have the ability to understand mathematical concepts, explain the interrelationships between concepts and apply concepts or algorithms in a flexible, accurate, efficient and precise way in problem solving. The importance of this goal in the National Council of Teachers of Mathematics (NCTM) is explained based on mathematical proficiency standards, namely conceptual understanding is the foundation of procedural fluency and problem solving so that learning with understanding will provide convenience in learning mathematics. That way, mathematical conceptual understanding needs special emphasis from educators, because these abilities are the foundation for students in learning mathematics. Understanding mathematical concepts will have meaning if it is fostered by the students themselves. Regulation of the Minister of Education and Culture Number 65 of 2013 explains that students are required to have an active role in finding out for themselves about the knowledge learned so as to obtain solutions to the problems they are facing. Therefore, the ability to understand concepts must be found by students independently with the help of the teacher. According to Duffin & Simpson, concept understanding is the ability of students to explain concepts, use concepts in different situations, and develop several consequences of the existence of a concept. Conceptual understanding is an important part of the knowledge needed to solve a problem. In mathematics, understanding mathematical concepts is very important. Because between mathematical concepts are mutually sustainable so it must be coherent in learning it.

Based on Wahyuni's research (2020) explains the average value of problem solving by 52% of students can understand the material and 48% of students do not understand the material in terms of reading questions, understanding questions, and solving problems. This is supported by Arvyaty et.al. (2018) that one of the problems felt by students in learning mathematics is that the basic knowledge of mathematics is not good, the motivation to learn is low, and the culture of learning literacy is not good. In this case, students must have a good conceptual understanding of a mathematical material (Fajar *et.al*, 2018). Thus, students must have a good understanding of concepts including mastery of material in learning. Based on this, students can recognize and know and be able to redevelop concepts in a form that is easy to understand and able to apply in various aspects.

Based on initial observations at 3 Junior High School Ungaran, the mathematics teacher stated that learning mathematics used teaching materials in the form of BSE (Electronic School Books) Mathematics, mandiri textbooks and material summaries made by the teacher. Students are encouraged to understand the material using the book. During a pandemic, students find it difficult to understand the learning material in the books used. Because in the book, the material presented requires an explanation from the teacher so that when students study independently at home it makes it difficult for students to understand the material. In addition, the books used are also not equipped with materials that can relate real life to other fields such as STEAM. This is also a problem for mathematics teachers at 3 Junior High

School Ungaran who want to develop mathematics teaching materials by adding other fields such as STEAM as a learning resource.

Based on the background explanation, it is necessary to conduct further research on "Development of Mathematics Teaching Materials with the nuances of Science, Technology, Engineering, Arts, and Mathematics to Improve Mathematical Conceptual Understanding Ability". This research is expected to be a more in depth study of the Development of Mathematics Teaching Materials with STEAM nuances to improve Mathematical Conceptual Understanding.

2. Methods

This study uses the Research and Development method. The Research and Development method is a research method used to produce certain products and test the effectiveness of these products (Sugiyono, 2017). The product developed in this research is mathematics teaching materials with STEAM nuances to improve the ability of mathematical conceptual understanding. The implementation of this research begins with the design of teaching materials which are validated by 5 validators from May 4 to May 25, 2021 to validate the potential to improve mathematical conceptual understanding skills and the feasibility of STEAM style math teaching materials on set materials. Then, it was continued with a readability test and a response test to find out the attractiveness of the product in appearance which was carried out from June 28, 2021 to July 1, 2021 at 3 Junior High School Ungaran. Followed by the effectiveness test to determine the effectiveness of teaching materials on increasing mathematical conceptual understanding skills carried out on October 5, 2021 to October 7, 2021.

The development research procedure used in this study was adopted from the R&D approach which is the result of a modification of the R&D model according to Borg and Gall (in Sugiyono, 2017). The stages in this research include potential and problems; data collection; product design; design validation (potential test and feasibility test); product test (readability test and attractiveness test); use trial (effectiveness test); and the final product. Data collection techniques used to obtain research data include a potential questionnaire, a validity questionnaire, a readability test, a response questionnaire and a test of the effectiveness of mathematics teaching materials with STEAM nuances to increase the ability of mathematical conceptual understanding.

The results of the potential level, feasibility level, readability level, response rate were analyzed using the following equation.

$$P = \frac{f}{N} \times 100\%;\ L = \frac{f}{N} \times 100\%; B = \frac{f}{N} \times 100\%;\ R = \frac{f}{N} \times 100\%$$

$(Sudijono, 2014)$

Where P is the percentage score, f is the number of scores obtained, and N is the maximum number of points. Furthermore, the results of the analysis of each test are associated with the assessment criteria. The criteria for the potential level of teaching materials are presented in Table 1 (Akbar, 2013).

Table 1 Potencial Level Criteria

Potential Level	Criteria
$1\% \leq \bar{P} \leq 50\%$	No Potential
$50\% < \bar{P} \leq 70\%$	Potential Enough
$70\% < \bar{P} \leq 85\%$	Potential
$85\% < \bar{P} \leq 100\%$	Very Potential

Where L is the percentage score, f is the number of scores obtained, and N is the maximum number of points. Furthermore, the results of the analysis of each test are associated with the assessment criteria. The criteria for the feasibility level of the teaching materials used according to Novianti (2015) are as shown in Table 2 below.

Table 2 Feasibility Level Criteria

Feasibility Level	Criteria
$0\% \leq \bar{L} < 21\%$	Very Unworthy
$21\% \leq \bar{L} < 41\%$	Not Worthy
$41\% \leq \bar{L} < 61\%$	Worthy Enough
$61\% \leq \bar{L} < 81\%$	Worthy
$81\% \leq \bar{L} \leq 100\%$	Very Worthy

Where B is the percentage score, f is the number of scores

obtained, and N is the maximum number of points. Furthermore, the results of the analysis of each test are associated with the assessment criteria. The criteria for the level of readability of teaching materials according to Rankin & Culhane as quoted by Rosmaini (2009) are shown in Table 3 below.

Table 3 Readability Level Criteria

Readability Level	Criteria
$1\% < \bar{B} \leq 40\%$	Hard To Understand
$40\% < \bar{B} \leq 60\%$	Quite Easy To Understand
$60\% < \bar{B} \leq 100\%$	Easy To Understand

Where R is the percentage score, f is the number of scores obtained, and N is the maximum number of points. Furthermore, the results of the analysis of each test are associated with the assessment criteria. The criteria for the level of attractiveness of the teaching materials used according to Novianti (2015) are as shown in Table 4 below.

Table 4 Attractiveness Level Criteria.

Attractiveness Level	Criteria
$0\% \leq \bar{R} < 21\%$	Very Unattractive
$21\% \leq \bar{R} < 41\%$	Not Attractive
$41\% \leq \bar{R} < 61\%$	Quite Interesting
$61\% \leq \bar{R} < 81\%$	Interesting Very Interesting
$81\% \leq \bar{R} \leq 100\%$	Very Interesting

The results of the level of effectiveness were analyzed using the following equation.
The effectiveness of mathematical conceptual understanding ability can be analyzed using the gain test according to Hake (1999), the formula used is:

$$N\ Gain = \frac{skor\ posttest - skor\ pretest}{skor\ ideal - skor\ pretest}$$

The criteria for the magnitude of the gain factor to be used according to Hake (1999) are shown in Table 5 below.

Table 5 Effectiveness Level Criteria

Effectiveness Level	Criteria
< 40	Ineffective
$40 - 55$	Less Effective
$56 - 75$	Effective enough
> 76	Effective

3. Results & Discussions

3.1 Potential and Problems

In the first stage, researchers conducted preliminary observations at 3 Junior High School Ungaran which is one of the junior secondary education institutions. Initial observations were made to the Mathematics teacher of 3 Junior High School Ungaran. The teacher stated that learning mathematics in class so far has used teaching materials in the form of BSE (Electronic School Book) Mathematics textbooks, mandiri textbooks and material summaries made by the teacher. Students are encouraged to understand the material using the book. During a pandemic, students find it difficult to understand the learning material in the books used. Because in the book, the material is presented in an abstract way so that students find it difficult to understand the material. In addition, the books used are also not equipped with material that is able to relate the real life of students to other fields such as STEAM. This is also a problem for mathematics teachers at 3 Junior High School Ungaran who want to develop mathematics teaching materials by adding other fields such as STEAM as a source of student learning. However, there are other factors such as the limited time and staff of teachers in these schools and the government's unequal STEAM development training for teachers.

3.2 Data Collection

The second stage is data collection, researchers collect various literatures to obtain information related to the needs of learning resources for students. In this case the researcher also collects various information that supports the formation of the product as well as references and pictures related to the Association material. Based on the results of initial observations and various literatures, this is what underlies the development of mathematics teaching materials with STEAM nuances in the Association material as appropriate teaching materials and according to the needs of students and 3 Ungaran. Junior High School

At this stage, researchers describe core competencies, basic competencies, and competency achievement indicators. Next, the researcher made the preparation of the map of teaching materials to determine the order of the material in the teaching materials to be used.

3.3 Product Design

The third stage is to design a product design for mathematics teaching materials with STEAM nuances. The design of teaching materials made is a solution to the problems identified at the initial observation stage. The teaching materials are related to the STEAM field. At this stage, the researcher compiles the design of teaching materials that are equipped with material obtained from several books and reliable references. Researchers also conducted material analysis to explore knowledge about the relationship of the material to the STEAM field. Then, the researcher arranged the layout of the teaching materials as a framework for displaying the teaching materials. After that, the researchers combined the design and layout to produce a STEAM nuanced product of mathematics teaching materials in terms of material content and appearance.

Mathematics teaching materials with STEAM nuances in Set materials were created using Microsoft Word 2010 software for the purpose of compiling material texts, and assisted with Canva software for designing mathematics teaching materials. The STEAM nuanced mathematics teaching material consists of 80 pages. The text in the teaching materials is written in the dominant Cambrian font type and the font size is 11-20. This is intended so that the reader feels comfortable with the presentation of the set material. In addition, the discussion of the material for each sub-chapter on the dominant teaching material is given an image that is in accordance with the given problem. This not only serves to provide a comfortable reading room but also motivates readers by viewing the visualization of the material in the form of images. The teaching materials were made on A4 size paper (21 cm × 29.7 cm).

Mathematics teaching materials with STEAM nuances as a whole consist of three main parts, namely the initial section, the content section, and the closing section. The first part of mathematics teaching materials consists of a front cover page; foreword; table of contents; meaning of STEAM; core competencies, basic competencies, and indicators of competency achievement; concept maps; the benefits and relevance of STEAM; motivation letters; and Association figures. The content section of mathematics teaching materials consists of material descriptions, project assignments, and summaries. The final part of the mathematics teaching materials consists of a competency test, a glossary, and a references.

3.4 Design Validation

Potential of Mathematics Teaching Materials

The potential test of teaching materials is one of the validation stages which aims to determine the potential of STEAM nuanced mathematics teaching materials to improve the ability of mathematical conceptual understanding of the set material. In the assessment aspect, there are two sub-aspects that are analyzed in the potential of mathematics teaching materials with STEAM nuances, namely teaching materials according to indicators of teaching materials according to indicators of mathematical conceptual understanding and construction.

Mathematics teaching materials with STEAM nuances are considered to reach the potential of teaching materials to improve the ability of mathematical conceptual understanding if the description of the sub-aspects of the potential of teaching materials is in accordance with indicators of mathematical conceptual understanding and construction. it is known the percentage of potential of each aspect in the teaching materials, as presented in Table 6 below.

Table 6 Potential Test Result in The Assessment Aspect

Aspect	Avarege Potential Score	Criteria
Assesment	86.5%	Potential Enough

These results indicate that the mathematics teaching materials with STEAM nuances in the Association material contain aspects of assessing the potential of teaching materials with very feasible criteria. Thus, the teaching materials have met the requirements for the assessment of the potential aspects of STEAM-nuanced mathematics teaching materials. According to Saputro and Haryanti (2016) explained that the use of mathematics modules can be said to be effective in improving students' conceptual understanding abilities.

Feasibility of Mathematics Teaching Materials

Assessment of teaching materials consists of 3 aspects, namely aspects of content feasibility, presentation, and language. Based on the results of the validity test of teaching materials with STEAM nuances, it is known the percentage of feasibility of each aspect in the teaching materials, as presented in Table 7 below.

Table 7 Feasibility Test Result on Each Aspect

Aspect	Average Feasibility Score	Criteria
Content Feasibility	83.04%	Very Worthy
Presentation Feasibility	88.23%	Very Worthy
Language Feasibility	87%	Very Worthy

Teaching materials contain aspects of content, presentation, and language with very good criteria. Thus, the teaching materials have reached validity based on the aspects and assessment criteria of the BSNP that have been modified. Therefore, teaching materials are valid to be produced and used in learning, but need to be revised according to the validator's suggestions. The study stated that mathematics teaching materials with the STEAM approach which were compiled based on the basic competencies contained in the 2013 curriculum were valid for use in learning after going through the validation process (Utami et al., 2018).

Assessment on the aspect of content validity shows that the teaching materials have very decent criteria. Therefore, teaching materials will assist students in mastering concepts and materials according to the competencies that must be possessed (Nurichah, 2012). Evaluation of the validity aspect of the presentation shows that the teaching materials have very decent criteria because the presentation is coherent and consistent in 3 main parts, namely the beginning, content, and closing according to the BSNP criteria. The results of the development of teaching materials that refer to the BSNP are declared superior and effectively used in the learning process (Arafah et al., 2012). The assessment of the linguistic aspect shows that the teaching materials have very decent criteria. This is in accordance with research that explains the use of language in teaching materials according to the rules of the Indonesian language, the choice of words that are easy to understand, and the use of simple sentences will make it easier for students to understand the author's intent (Nugraha & Binadja, 2013).

3.5 Product Test

3.5.1 Readability of Mathematics Teaching Materials

The readability test of teaching materials is a product testing stage that aims to determine whether the text in mathematics teaching materials with STEAM nuances is easily understood by students. The readability test of teaching materials is carried out in the form of void text that must be completed by students within the allotted time. The gap text is arranged based on the excerpt of the text contained in the teaching materials which is then made up of 30 words gap words. Based on research by Rankin & Culhane as quoted by Rosmaini (2009), mathematics teaching materials with STEAM nuances are considered practical or easy to understand by students if the percentage of gap test scores obtained is above 60%. These results indicate that students can answer the reading test questions of teaching materials with an average number of correct answers about 27 questions with a percentage score of 92.26% with easy to understand criteria. These results indicate that the teaching materials are included in the criteria of being easy to understand and fostering students' reading interest according to the readability criteria scale by Rankin & Culhane. The test results show that the STEAM nuanced mathematics teaching materials can be understood. This is clarified by Dobres (2017) in his research which says that through the nature of readability, it can be measured at a glance that there is a student's interest in reading on 2 contradictory things.

3.5.2 Student Responses to Mathematics Teaching Materials

The response test of teaching materials is a product trial stage that aims to find out whether mathematics teaching materials with STEAM nuances are attractive in appearance to students. The response test of teaching materials is carried out in the form of a questionnaire that must be filled out by students within the allotted time. The questionnaire consists of 16 statements. Mathematics teaching materials with STEAM nuances are considered interesting by students if the percentage score of the questionnaire is 61%.

The results of the score in the potential test of teaching materials get an average score of 90.15%. These results indicate that the teaching materials are included in the criteria of being very attractive to students. The test results show that the STEAM nuanced mathematics teaching materials are very interesting. This was clarified by Utami (2018) that the results of small group trials, field trials, and teacher trials there was a good improvement in the responses of students and teachers to modules with the STEM approach. The results of the test of student responses to mathematics teaching materials with STEAM nuances obtained an average percentage score of 90.15% with very interesting criteria. This shows that the STEAM nuanced mathematics teaching materials in the set material are very interesting for students to use. This was clarified by Utami (2018) that the results of small group trials, field trials, and teacher trials there was a good improvement in the responses of students and teachers to modules with the STEM approach.

3.6 Use Trial

The Effectiveness of Mathematics Teaching Materials

The use trial aims to determine the effective use of teaching materials to improve students' mathematical conceptual understanding abilities. The use trial phase includes working on pretest questions, delivering core material from teaching materials with STEAM nuances, and ending with working on posttest questions.

These results indicate that the pretest obtained an average N-Gain value of 40.66 or 40.66% with the criteria being less effective and the posttest obtaining an average N-Gain value of 61.90 or 61.90% with the criteria being quite effective. In line with research conducted by Pangesti (2017) and Lestari (2018) that the teaching materials developed obtained N-Gain test scores with quite effective criteria. Thus, it can be concluded that mathematics teaching materials with STEAM nuances are effective in increasing the ability of mathematical conceptual understanding of set material

3.7 Final Product

After mathematics teaching materials with STEAM nuances are in accordance with the potential to improve mathematical conceptual understanding skills, get a decent feasibility score, get readability scores that are easy to understand, get interesting response values in the display of teaching materials and are effective for improving mathematical conceptual understanding abilities. The final product of mathematics teaching materials with STEAM nuances consists of three main components, namely the beginning, the content, and the end of the teaching materials.

The first part of mathematics teaching materials consists of a front cover page; foreword; table of contents; meaning of STEAM; core competencies, basic competencies, and indicators of competency achievement; concept maps; the benefits and relevance of STEAM; motivation letters; and Association figures. The content section of mathematics teaching materials consists of material descriptions, project assignments, and summaries. The final part of the mathematics teaching materials consists of a competency test, a glossary, and a references. The final product of mathematics teaching materials with STEAM nuances on the set material.

4. Conclusion

Based on the results of the research and discussion conducted by the researchers, it was concluded that the mathematics teaching materials with STEAM nuances in the resulting set of materials can be described as follows.

It has the potential to improve mathematical conceptual understanding skills with an average potential score of 86.5%. The teaching materials contain aspects of teaching materials in accordance with the indicators of mathematical conceptual understanding in the criteria of very potential and an average score of 86.42%. The teaching materials also contain construction aspects in the criteria of very potential and an average score of 86.6%.

Very worthy to use with an average feasibility score of 86.07%. The teaching materials contain aspects of the feasibility of the content in the very worthy criteria and the average score is 83.04%. The teaching materials also contain aspects of the worthy of presenting in very decent criteria and an average score of 88.23%. Also, the teaching materials contain aspects of linguistic worthy in very decent criteria and an average score of 87

Easy to understand by students with an average readability score of 92.26%. These results indicate that students can answer the readability test questions with an average of 27 correct answers.

Very interesting in appearance by students with an average response score of 90.15%. This can be seen in the results of the large group test which got an average response score of 90.15% with very interesting criteria.

Effective enough to improve the ability of mathematical conceptual understanding. This is indicated by: 1) there is an increase in the ability to understand mathematical conceptual on set material after giving STEAM nuanced teaching materials, 2) the average mathematical conceptual understanding ability on set material using STEAM nuanced teaching materials is higher than those who do not use STEAM nuanced teaching materials .

References

Akmal, F. F., & Asikin, M. (2021, February). Why It's Important to Advance STEAM in Mathematics Classroom. In *PRISMA, Prosiding Seminar Nasional Matematika* (Vol. 4, pp. 194-199).

Arafah, S. F., S. Ridhlo, & B. Priyono. (2012). Pengembangan LKS Berbasis Berpikir Kritis pada Materi Animalia. *Unnes Journal of Biology Education*, 1(1): 47-53.

Arvyaty, Salim, &. Maryanti. E. (2018). Design of Teaching Material Literacy Mathematical Nuanced in Junior High School Students. *Journal of Physics: Conference Series*, 1028(1).

BSNP. (2015). *Pedoman Penilaian Buku Teks Matematika*. Jakarta: Ristekdikti.

Buinicontro, J.K. (2018). Gathering STE(A)M: Policy, Curricular, And Programmatic Developments In Arts-Based Science, Technology, Engeneering, And Mathematics Education Introduction To Special Issue Of Art Education Policy Review: STEAM Focus. *Art Education Policy Review Journal*, 119-Issue 2.

Dobres, J., Chahine, N., & Reimer, B. (2017). Effects of ambient illumination, contrast polarity, and letter size on text legibility under glance-like reading. *Applied Ergonomics*, *60*, 68-73.

Fajar, A. P., Kodirun, Suhar & Arapu, L. (2018). Analisis Kemampuan Pemahaman Konsep Matematis Siswa Kelas VIII SMP Negeri 17 Kendari. *Jurnal Pendidikan Matematika*, *9*(2), 229-239.

Haryanti, F., & Saputro, B. A. (2016). Pengembangan Modul Matematika Berbasis Discovery Learning Berbantuan FlipBook Maker Untuk Meningkatkan Kemampuan Pemahaman Konsep Siswa Pada Materi Segitiga. Kalamatika: Jurnal Pendidikan Matematika, 1(2), 147-161.

Hasanah, H., Wirawati, S. M., & Sari, F. A. (2020). Pengembangan Bahan Ajar Matematika Berbasis STEM Pada Materi Bangun Ruang. Indonesian Journal of Learning Education and Counseling, 3(1), 91-100.

Lestari, I. (2018). Pengembangan Bahan Ajar Matematika Dengan Memanfaatkan Geogebra Untuk Meningkatkan Pemahaman Konsep. *GAUSS: Jurnal Pendidikan Matematika*, *1*(1), 26-36.

Nugraha, D. A., & Binadja, A. (2013). Pengembangan bahan ajar reaksi redoks bervisi SETS, berorientasi konstruktivistik. *Journal of Innovative Science Education*, *2*(1), 27-34.

Nurhikmayati, I. (2019). Implementasi STEAM dalam Pembelajaran Matematika. *Didactical Mathematics*, *1*(2), 41-50.

Nurichah, E. F. (2012). Pengembangan Lembar Kegiatan Siswa Berbasis Keterampilan Berpikir Kritis pada Materi Keanekaragaman Hayati. *BioEdu*, *1*(2), 45-49.

Oktaviani, W., Gunawan, G., & Sutrio, S. (2017). Pengembangan Bahan Ajar Fisika Kontekstual Untuk Meningkatkan Penguasaan Konsep Siswa. *Jurnal Pendidikan Fisika dan Teknologi*, *3*(1), 1-7.

Pangesti, K. I., Yulianti, D., & Sugianto, S. (2017). Bahan Ajar Berbasis STEM (Science, Technology, Engineering, and Mathematics) untuk Meningkatkan Penguasaan Konsep Siswa SMA. *UPEJ Unnes Physics Education Journal*, *6*(3), 53-58.

Sugiyono. (2017). *Metode Penelitian Pendidikan*. Bandung: Alfabeta.

Suraji, S., Maimunah, M., & Saragih, S. (2018). Analisis kemampuan pemahaman konsep matematis dan kemampuan pemecahan masalah matematis siswa smp pada materi sistem persamaan linear dua variabel (SPLDV). Suska Journal of Mathematics Education, 4(1), 9-16.

Utami, T.N., Jatmiko, A., & Suherman, S. (2018). Pengembangan Modul Matematika dengan Pendekatan Science, Technology, Engineering, And Mathematics (STEM) pada Materi Segiempat. *Desimal: Jurnal Matematika*, *1*(2), 165-172.

Zubaidah, S. (2019, September). STEAM (science, technology, engineering, arts, and mathematics): Pembelajaran untuk memberdayakan keterampilan abad ke-21. In Seminar Nasional Matematika Dan Sains, September (pp. 1-18).