THE DEVELOPMENT OF STEAM-INTEGRATED TEXTBOOK IN STATISTICS MATERIALS

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Abstrak. This research aims to develop and determine the quality of integrated mathematics textbook for science, technology, engineering, art, and mathematics (STEAM) in statistics materials. The research method uses the modified Sugiyono development model, including, 1) potential dan problems; 2) data collection; 3) product design; 4) design validation; 5) product test (readability test); and 6) the final product. The data were collected by a questionnaire and a readability test. To determine the practicality of the textbook, the questionnaire was validated by six experts while the readability test was given to students. The result showed that the teaching materials were valid with a validity test percentage of 88,99% and a readability test percentage of 80,62%. Thus, integrated textbook for STEAM are of high quality because they meet the suitability of characteristics, valid to use, and are practical or easily understood by students.

INTRODUCTION

Education is one of the efforts to improve the quality of human resources (HR) to ensure the development of a nation (Kusjuriansah & Yulianto, 2019). Education plays an important role in facing developments in the 21st century. The 2013 curriculum as the present curriculum has been an effort to develop education in Indonesia (Milaturrahmah et al., 2017).

Mathematics is a discipline that contributes greatly to everyday life (Indrawati, 2020). Mathematics is expected to contribute towards the development of students' abilities so that they can participate in improving the quality of education. However, mathematics is often considered as a difficult subject (Fitriasari, 2017). Students will find it difficult to master further concepts if they have not mastered the basic concepts (Suherman, 2015). This is a factor in mathematics that is considered to be a difficult subject.

Mathematics should be a challenging subject so that it attracts students' interest in learning and curiosity. The results of the PISA study in 2018 states that the average math and science achievement scores of Indonesian students are far below the international average. Indonesia is ranked 72 from 78 countries with a score of 379.

21st-century learning prepares students to face future competition. The three main subjects in 21st-century learning including, 1) learning and innovation skills, 2) information, media, and technology, 3) life and career skills (Mu'minah & Suryaningsih, 2020). Teachers and students must be ready to face the development of an increasingly sophisticated era. Education with STEAM (science, technology, engineering, arts, and mathematics) learning can be an alternative to prepare students who are able to compete in the 21st century (Yuni et al., 2020).

Textbook can be a solution in developing the world of education. The success of learning, apart from depending on the method used, is also very dependent on the learning device (Utami et al., 2018). Textbook are part of the learning device. Textbook are all forms of materials used to assist teachers in carrying out the learning process (Sari et al., 2018). Textbook have 4 categories, namely, 1) printed textbook, for example,

handouts, modules, books, student worksheets, brochures, and pamphlets; 2) audio textbook, for instance, cassettes, radios, vinyl records, and audio compact disks; 3) audiovisual textbook, for example, video compact disks and films; 4) interactive textbook, for instance, compact disk interaction (Depdiknas 2008). Students can understand the concept of learning through textbook. Learning with the STEAM approach is considered to be able to make it easier for students to understand the concepts presented (Yuni et al., 2020).

STEAM is a learning approach that allows students to expand knowledge, science, and humanities at the same time to develop 21st-century skills such as communication skills, critical thinking skills, leadership, teamwork, creativity, resilience, and other skills (Zubaidah, 2019). Science, technology, engineering, art, and mathematics are similar fields of study because problem solving involves a creative process and does not involve only one method. STEAM learning strengthens student learning across all disciplines and through these disciplines, students have the opportunity to explore the relationship between science, technology, engineering, art, and mathematics (Henriksen, 2014). The 2013 curriculum is deemed appropriate to implement the STEAM approach. This is in line with the research of Mu'minah & Suryaningsih (2020) which states that, in the 2013 curriculum where learning is implemented thematically integrated, it is suitable for integrating STEAM-based learning.

The textbook developed in this study are mathematics textbook related to aspects of STEAM. STEAM integrated mathematics textbook have characteristics that distinguish them from mathematics textbook in general. STEAM integrated mathematics textbook are arranged based on problems related to science, technology, engineering, art, and mathematics by taking into account the format of student-book analysis published by the Ministry of Education and Culture, namely, 1) aspects of conformity with the scope of Basic Competencies; 2) the breadth, depth, current, and accuracy of the learning materials in each chapter of the student's book; 3) show examples of learning materials (factual, conceptual, and procedural knowledge) in each chapter of the student's book; 4) learning activities in each chapter of the student's book; 5) assessment in each chapter of the student's book. Therefore, STEAM integrated mathematics textbook cover a wider range of discussions and developments than general mathematics learning materials. This STEAM integrated teaching material is expected to be able to improve students' ability to relate mathematics materials to other fields such as science, technology, engineering, and art.

Based on the background that has been described, it is necessary to conduct research "The Development of STEAM-Integrated Textbook in Statistics Materials". The purpose of this study was to determine the quality of STEAM integrated teaching materials based on the suitability of characteristics, validity, and readability.

RESEARCH METHODS

This research method uses a modified Sugiyono's development method including, 1) potential and problems; 2) data collection; 3) product design; 4) design validation; 5) product test (readability test); and 6) the final product. The research was carried out at SMP N 7 Semarang from March to May 2021. The subjects in this study were students of class VIII A of SMP N 7 Semarang as a readability test class. Data collection in this study used a questionnaire and a gap test. The questionnaire used at the validation stage consisted of a characteristic suitability and validity questionnaire. The design validation phase involved 1 UNNES postgraduate student, 2 teachers, and 3 UNNES mathematics lecturers. The gap test aims to measure the readability of STEAM integrated textbook.

RESULTS AND DISCUSSION

Potential and Problems

Identification of the problem in this study was obtained from the results of interviews with teachers of SMP N 7 Semarang. Learning mathematics in this school uses a book entitled "Mathematics for SMP/MTs grade VIII Semester 2" and a summary of the material that has been made by the teacher. The two learning resources do not contain the STEAM aspect as a whole. The factor of limited time and energy is a separate obstacle for teachers in providing learning resources that can provide learning about the mathematical perspective associated with STEAM.

Data collection

At the data collection stage, a literature study was conducted to obtain information related to core competencies, basic competencies, indicators of competency achievement, learning objectives, materials, and problems related to STEAM. The basic competence used in the textbook is 3.11. On the development of the STEAM integrated textbook, statistics materials in this research were obtained from several sources of student books in the Regional Library of Blora Regency.

Product Design

The STEAM integrated teaching materials for statistics materials are written in the dominant Times New Roman font, size 12-24 pt. The initial design of textbook contains 34 pages which consisted of the a front page, a preface, a table of contents, core competencies, basic competencies, indicators of achievement, learning objectives, concept maps, linkages of the material with aspects of STEAM, motivation letters, statistics materials, exercises, summaries, competency tests, glossaries, and bibliography.

The preparation of the initial draft aims to organize learning materials from a competency into a systematic whole. The textbook contain a discussion of statistics materials related to the STEAM aspect that has been adapted to the characteristics of the textbook based on the student book analysis format published by the Ministry of Education and Culture.

Design Validation

The test of the characteristics of the STEAM integrated textbook was carried out by six validators. The textbook have met the suitability of characteristics, but some revisions are still needed. Several revisions were made, such as adding instructions for the use of textbook, linking competency achievement indicators and learning objectives with STEAM, linking motivation letters with STEAM aspects, and presenting material according to data and facts. After revision, the STEAM integrated textbook in statistics materials have met the conformity of characteristics based on the format of student-book analysis published by the Ministry of Education and Culture and has been modified.

The validity test of the STEAM integrated textbook was carried out by six validators. The test consisted of 3 aspects, namely content validity, presentation validity, and linguistic validity. The validity of textbook is assessed based on the modified aspects and criteria of the National Education Standards Agency (BSNP) assessment criteria. Validity is carried out to obtain valid textbook (Nurhidayat & Asikin, 2021). Assessment of the validity of textbook can be seen in the table below.

TABLE 1
Validity Results of STEAM Integrated Teaching Materials

Aspect	Precentage score (P)	Criteria
Content Validity	87,52 %	Excellent
Presentation Validity	91,68 %	Excellent
Language Validity	87,78 %	Excellent
Average	88,99 %	Excellent

Assessment on the aspect of content validity consists of four indicators, namely, 1) the suitability of the material with competency standards and basic competencies; 2) the accuracy of the material; 3) supporting learning materials; and 4) material updates. Table 1 shows the average percentage of content validity of 87.52% with excellent criteria. This score shows that the STEAM integrated mathematics textbook in statistics materials contain the suitability of the material with SK and KD, the accuracy of the material, supporting learning materials, and the up-to-date of the material in excellent criteria.

Assessment on the aspect of presentation validity consists of four indicators, namely, 1) presentation techniques; 2) presentation support; 3) presentation of learning; and 4) completeness of presentation. Table 1 shows the average percentage of presentation validity of 91,68% with excellent criteria. This score shows that the STEAM integrated mathematics textbook in statistics materials contain presentation techniques, presentation support, learning presentations, and presentation completeness with excellent criteria.

Assessment on the aspect of language validity consists of six indicators, namely, 1) straightforward; 2) communicative; 3) dialogical and interactive; 4) conformity with the level of development of students; 5) coherence and coherence of the line of thought; 6) use of terms, symbols or icons. Table 1 shows the average percentage of presentation validity of 87,78% with excellent criteria. This score indicates that the STEAM integrated mathematics textbook in statistics materials contain straightforward, communicative, dialogical, and interactive language indicators, conformity to the level of development of students, coherence, and integration of the flow of thought, and the use of terms, symbols, or icons with excellent criteria. Submission of information in textbook to students will be easy if the textbook use effective, standard, and simple language (Rahmawati et al., 2016).

The results of the validity test above show that STEAM integrated textbook in statistics materials get an average score percentage of 88.99%. Based on the validity category, the textbook are included in the valid category.

Product Trial

The readability test was carried out by 26 students of class VIII A of SMP N 7 Semarang. The readability test of STEAM integrated textbook on statistics materials aims to determine whether the textbook are practical or easy to understand by students. The results of the readability test get a percentage value of 80.62% with an average of 40 correct answers so that the textbook are included in practical criteria or easy to understand. The readability score that meets the criteria is caused by the material presented in the language and vocabulary that students can easily understand so that it does not cause multiple interpretations (Kusjuriansah & Yulianto, 2019). A reading with a readability level that is easy to understand will affect the readers in increasing interest in learning and memory (Khairil et al., 2017).

The final product

The final product in this research is STEAM integrated teaching materials on statistics materials in the form of a textbook that can be used in learning.

CONCLUSION

Based on the results of the research and discussion, it was found that the STEAM integrated mathematics teaching materials in statistics materials are of high quality because they meet the characteristics according to the format of student book analysis published by the Ministry of Education and Culture. Thus, the textbook are valid, practical, easy for students to understand and can be used in learning.

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REFERENCES

1. Fitriasari, P. (2017). PEMANFAATAN SOFTWARE GEOGEBRA DALAM PEMBELAJARAN MATEMATIKA Putri. *Jpmrafa*, 57–69.
2. Henriksen, D. (2014). Full STEAM Ahead: Creativity in Excellent STEM Teaching Practices. *Steam*, *1*(2), 1–7.
3. Indrawati, F. (2020). Peningkatan Kemampuan Literasi Matematika Di Era Revolusi Industri 4 . 0. *Prosiding Seminar Nasional Sains*, *1*(1), 382–386.
4. Khairil, K., Salam, S., & Junus, A. F. (2017). Keterbacaan Wacana Dalam Buku Teks Bahasa Indonesia "Ekspresi Diri Dan Akademik" Cetakan Kedua Melalui Cloze Test Siswa Kelas X Sman 1 Makassar. *RETORIKA: Jurnal Bahasa, Sastra, Dan Pengajarannya*, *9*(1), 33–39.

5. Kusjuriansah, & Yulianto, A. (2019). Pengembangan Bahan Ajar Fisika Berbasis I-SETS Terkomplementasi Karakter Pada Materi Hukum Gravitasi Newton. *Unnes Physics Education Journal*, *8*(2), 120–132.

6. Milaturrahmah, N., Mardiyana, M., & Pramudya, I. (2017). Mathematics Learning Process with Science, Technology, Engineering, Mathematics (STEM) Approach in Indonesia. *Journal of Physics: Conference Series*, *895*(1), 1–7.

7. Mu'minah, I. H., & Suryaningsih, Y. (2020). Implementasi Steam (Science, Technology, Engineering, Art and Mathematics) Dalam Pembelajaran Abad 21. *BIO EDUCATIO : (The Journal of Science and Biology Education)*, *5*(1), 65–73.

8. Nurhidayat, M. F., & Asikin, M. (2021). *Bahan Ajar Berbasis STEM dalam Pembelajaran Matematika : Potensi dan Metode Pengembangan*. *4*, 298–302.

9. Rahmawati, I. S., Roekhan, & Nurchasanah. (2016). PENGEMBANGAN MEDIA PEMBELAJARAN MENULIS TEKS FABEL DENGAN MACROMEDIA FLASH BAGI SISWA SMP. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *1*(7), 1323–1329.

10. Sari, N., Syarif Sumantri, M., & G Bachtiar, I. (2018). The Development of Science Teaching Materials Based on STEM to Increase Science Literacy Ability of Elementary School Students. *International Journal of Advances in Scientific Research and Engineering*, *4*(7), 161–169.

11. Suherman. (2015). Kreativitas Siswa Dalam Memecahkan Masalah Matematika Materi Pola Bilangan dengan. *Journal of Chemical Information and Modeling*, *6*(1), 81–90.

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

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

14. Yuni, S., Sahyar, & Bukit, N. (2020). Analysis the components of Science, Technology, Engineering, Art, and Mathematics (STEAM) in Senior High School Physics Textbook. *Journal of Physics: Conference Series PAPER*, *1811*(1), 1–6.

15. Zubaidah, S. (2019). *STEAM (Science, Technology, Engineering, Arts, and Mathematics): September*, 1–18.