



Development of Hypercontent-Based Probability Teaching Materials with Problem-Based Learning Model

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Abstract

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Keywords: Development; Hypercontent Teaching Materials; Problem Based Learning This research focuses on developing hypercontent-based Probability teaching materials based on problem-based learning models. The purpose of this study was to determine the characteristics, feasibility, and readability of hypercontent-based teaching materials. This type of research is Research and Development (R&D). The procedure used in this research and development adopts the modified Sugiyono (2015) development model, namely (1) potential and problems, (2) data collection, (3) product design, (4) design validation, (5) design revision, (6) product trial, and (7) product revision. This research produces a hypercontent-based Probability teaching material based on a problem-based learning model that has met the suitability of characteristics. The teaching materials were declared valid and suitable for use in learning mathematics with an average feasibility score of 85.82%. Based on the readability test, it was found that the hypercontent-based Probability teaching materials were easy to understand and could be used independently by students with an average readability score of 79.91%.

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1. Introduction

The development of the digital era today has a broad impact on various fields, one of which is education. Today, the learning process no longer has to be done face-to-face in class, students are also required not to depend on the teacher as a learning resource. Along with the rapid progress of science and technology, the problems that arise are also increasingly complex. Therefore, students are required to have 21st century skills to be able to compete in this era. The Partnership for 21st Century Skills (Fadel, 2008) explained that 21st century skills include communication and collaboration, critical thinking and problem solving, and creativity and innovation.

One of the subjects that must be studied both at the elementary and secondary levels is mathematics. Mathematics has an important role in sustainable development, especially related to technological developments in the 21st century. In addition, mathematics is an excellent forum for the development of students' intellectual competencies, especially in developing numeracy, reasoning, analytical thinking, and problem solving abilities.

Problem solving ability is one of the goals in learning mathematics. Krulik and Rudnick (Carson, 2020) defines problem solving ability as an individual's ability to use previously acquired knowledge, skills, and understanding to meet the demands of unfamiliar situations. The importance of problem solving in mathematics learning was also conveyed by the National Council of Teacher of Mathematics (2000) as one of the five main standard competencies in mathematics learning. The five main competency standards in mathematics learning according to National Council of Teacher of Mathematics (2000) are problem solving skills, reasoning skills, connection skills, communication skills, and representation skills.

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However, several studies show that students' mathematical problem solving abilities are still relatively low. This is also experienced by students at SMPN 25 Semarang, where based on initial observations obtained information that teachers still use the lecture method which causes students to be less active during the learning process. In addition, problems related to everyday life are often not used as discussion material in learning mathematics in class. This results in students being unprepared and feeling difficult when faced with complex problems related to everyday life. Based on data published by Assessment and Learning Center, shows that the average achievement of the National Examination results in mathematics subjects at SMPN 25 Semarang in 2019 is still below the average for the Semarang city area. The average result of the National Examination for Mathematics at SMPN 25 Semarang is 53.04, while the average result of the National Examination for mathematics at the secondary level in the city of Semarang is 56.04. This shows that the ability of students at SMPN 25 Semarang in solving problems on the UN questions is still low.

Based on the results of a survey conducted by the Program for International Student Assessment (PISA) in 2018, it shows that the average achievement of Indonesian students in mathematics has decreased when compared to 2015, which is ranked 73rd out of 80 countries with an average score 379. According to the Education Assessment Center for Research and Development of the Ministry of Education and Culture (2018) the low ability of Indonesian students in mathematics shows that there are still many Indonesian students who have difficulty in dealing with situations that require problem solving skills using mathematics.

To overcome these problems, teachers need to innovate both in terms of teaching methods and teaching materials to be used. One of the learning models that can improve students' mathematical problem solving skills is problem-based learning. Problem-based learning model is an approach in learning that begins with giving real problems as contexts that are in accordance with the material to be studied in order to achieve critical thinking, have problem solving skills and understanding concepts, and encourage students to be able to work in groups (Permana & Sumarno, 2007). Lidinillah (2013) revealed that the concepts used in the problem-based learning model are relevant to the demands of education in the era of the industrial revolution 4.0 because in general they have the same goal, namely to improve students' problem-solving and critical thinking skills, as well as to acquire concepts and knowledge from a learning material.

In addition to the application of appropriate learning models, the use of appropriate teaching materials can also develop students' mathematical problem solving abilities. According to Khulsum et al. (2018) teaching materials are a set of materials that have been designed by the teacher to support student learning activities in achieving the expected basic competencies. The set of materials can be in the form of computer programs, audio programs, videos, or books that cover subject matter. Teaching materials must be designed systematically by the teacher. Through teaching materials that are arranged systematically, students can effectively learn and understand knowledge (concepts, principles, facts, procedures, and processes) so that learning competency standards can be achieved.

In the development of teaching materials, of course, teachers need to pay attention to the changes that occur in the current generation. According to Marsah (Yanti et al., 2021) today's children are born in the era of digital technology, computers or gadgets such as smartphones and tablets have become everyday friends. Based on the results of a survey conducted by the Association of Indonesian Internet Service Providers (2018) information was obtained that 56.68% of Indonesians are internet users and 43.89% of them access the internet for at least 1 to 3 hours per day; Another 29.63% access the internet for 4 to 7 hours per day; and the remaining 26.48% access the internet more than 7 hours per day. In addition, based on initial observations made at SMPN 25 Semarang, information was obtained that the majority of students are internet users and already have personal smartphones. This is in line with the predictions of the digital marketing emarketer research institute (Zaini & Soenarto, 2019) which states that in 2018 there was an increase in the number of active smartphone users in Indonesia reaching more than 100 million people. Therefore, students' dependence on technology devices can be seen as an opportunity to use them as a technology-based learning resource (Herlina, 2019).

Based on the description above, the researcher assumes that the development of teaching materials that utilize students' technological devices and use appropriate teaching methods can be utilized by students in learning, especially mathematics. One of them is hypercontent-based teaching materials which refer to problem-based learning models. The concept of learning with hypercontent-based material resources is developing along with the rapid development of technology in the field of information, especially with regard to online learning. Simonson et al. (Prawiradilaga et al., 2018) explained that learning designed and

developed with the concept of hypercontent is called hypercontent-designed instruction. Hypercontent in question refers to the relationship of various content that is connected to each other through links and virtual worlds. According to Herlina (2019) hypercontent-based teaching materials can be interpreted as learning objects developed through information technology-based systems. Hypercontent-based teaching materials do not only contain text, but also contain visualizations in the form of images, animations, videos, and audio.

The development of hypercontent-based teaching materials based on problem-based learning models is one of the efforts to develop students' reasoning abilities and problem-solving skills to gain knowledge and concepts from learning materials. Hypercontent-based teaching materials will provide a clearer picture of the material. In addition, problem-based learning steps can be used as an alternative in placing students to be active in learning and giving students freedom in developing problem solving abilities. Therefore, the use of hypercontent-based teaching materials based on problem-based learning steps will lead students to develop students' reasoning skills and problem-solving skills to gain knowledge and concepts from learning materials.

Hidayat & Rusijono (2020) in his research entitled Development of Hypercontent-Based Modules Basic Principles of Making 2D Animation Subjects for 2D and 3D Animation Class XI Multimedia at SMK Muhammadiyah 2 Taman showed that multimedia learning using hypercontent-based modules could improve student learning outcomes. Nurzaelani & Septiani (2021) in his research entitled Development of HOTs-Based Hypercontent Electronic Module stated that hypercontent electronic module can also facilitate learning and improve students' critical thinking skills. According to Cahyani & Setyawati (2016) problembased learning is an appropriate learning model to improve students' problem-solving abilities. In addition, this research was chosen because the development of hypercontent-based teaching materials based on problem-based learning models, especially on Probability material, is still very rare.

The main objectives of this research are (1) to determine the suitability of the characteristics of hypercontent-based Probability teaching materials based on problem-based learning models; (2) to determine the feasibility level of hypercontent-based Probability teaching materials based on problem-based learning models; and (3) to determine the level of readability of hypercontent-based Probability teaching materials based on problem-based learning models.

2. Method

This type of research is Research and development (R&D). Sugiyono (2015) explains that R&D is a method used to produce a product and test the effectiveness of the product. By using the R&D method, this research is intended to develop a product in the form of hypercontent-based teaching materials on Probability materials based on problem-based learning models. The subjects used in this study consisted of 30 class IX students at SMPN 25 Semarang.

The development model used in this study is a modified development model according to Sugiyono (2015). According to Sukirno & Pratama (2018) this development model is able to produce products with a high validity value because it goes through a series of trials and validations that encourage researchers to continue to innovate without stopping. The research and development stages carried out in this study included 7 stages, namely (1) potential and problems, (2) data collection, (3) product design, (4) design validation, (5) design revision, (6) trial product, and (7) product revision.

The data collection technique used in this research is the questionnaire method. The questionnaire method is a method of collecting data through research questions specifically designed to collect study data (Mustori, 2012). The questionnaire method was used to determine the achievement of the characteristics of teaching materials, the feasibility of teaching materials, and the readability of teaching materials. The data analysis technique for the feasibility test of teaching materials is calculated using the following formula:

$$P = \frac{S}{N} \times 100\%$$

Description:

- *P* : Ideal percentage
- *S* : Number of components of research results
- *N* : Total score maximum

The eligibility criteria used refer to Putra & Anggraini (2016) as follows.

Table 1. Eligibility Criteria for Teaching Materials

Teaching Material Eligibility Score	Criteria
$0 < P \le 25\%$	Very less
$26\% < P \le 50\%$	less worthy
$51\% < P \le 75\%$	Worthy
$76\% < P \le 100\%$	Very Worthy

Based on Table 1, hypercontent-based mathematics teaching materials are feasible to use if the assessment score is more than 51%. If the score is less than or equal to 51%, the teaching materials need to be revised again.

The data analysis technique for the readability test of teaching materials is calculated using the formula according to Fatin & Yunianti (2019) as follows:

%Respon = $\frac{\text{the number of scores obtained}}{\text{the maximum number of scores}} \times 100\%$

The readability criteria used refer to Rankin and Culhane (Rosmaini, 2009) as follows.

Table 2. Criteria for Readability of Teaching Materials

Teaching Material Readability Score	Description	
$0 < P \leq 40\%$	Difficult to understand	
$40 < P \le 60\%$	Quite easy to understand, but need help from others	
$60 < P \le 100\%$	Easy to understand and can be used independently	

Based on Table 2, hypercontent-based mathematics teaching materials are included in the criteria of being easy to understand and suitable to be used independently if the assessment score is more than 60%. If the score is less than or equal to 60%, the teaching materials need to be revised again.

3. Results and Discussion

3.1. Potential and Problems

This research departs from the potential and problems that arise in the world of education. The potential obtained based on the study of literature and can be utilized in this study is the dependence of students on the use of technological devices and the growing development of online learning. This can be seen as an opportunity that can be exploited by turning it into a technology-based learning resource. The problems that arise based on the results of initial observations made at SMPN 25 Semarang are the lack of active students during the learning process and the infrequent problems related to daily life used as discussion material which causes students to feel difficult when faced with complex problems related to daily life. In addition, the average achievement of UN results in mathematics subjects at SMPN 25 Semarang in 2019 is still below the average for the Semarang city area. This shows that the ability of students at SMPN 25 Semarang in solving problems on the UN questions is still low. The unavailability of teaching materials that utilize students' technological devices, which can also facilitate students in developing problem-solving abilities, also causes students to become less active and find it difficult to study independently.

At this stage the researcher conducted a literature study to collect various information related to the needs of students' learning resources. Researchers conducted an analysis of the needs of teaching materials which included analysis of core competencies, analysis of basic competencies, analysis of competency achievement indicators, analysis of learning resources, and the selection and determination of teaching materials. Sourced on Ministery of Education and Culture of Regulation Number 37 of 2018 regarding basic competencies and basic competencies then obtained core competencies and basic competencies for the Mathematics subject of Probability material. These various sources are collected as materials that will be used to make teaching materials.

The researcher also made observations on student books and teacher books containing Probability material. In addition, researchers also collect various information and materials needed in the process of making teaching materials.

3.3. Product Design

At this stage, the researcher compiled the initial framework of teaching materials in the form of a flowchart as follows.

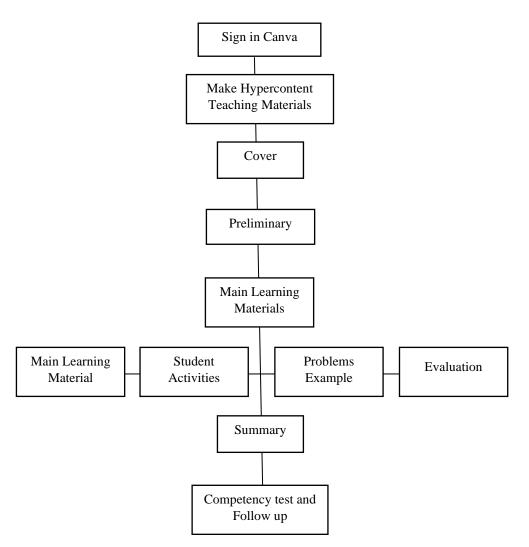


Figure 1. Hypercontent-Based Teaching Material Flowchart

Hypercontent-based Probability teaching materials are prepared based on the principles of problembased learning by taking into account the format of student book analysis published by the Ministry of Education and Culture in 2018 which includes (1) the suitability of hypercontent-based teaching materials with basic competencies coverage; (2) the flexibility, depth, current, and accuracy of learning materials in hypercontent-based teaching materials; (3) showing examples of learning materials (factual, conceptual, and procedural knowledge) in hypercontent-based teaching materials; (4) the feasibility of learning activities in hypercontent-based teaching materials; and (5) assessment feasibility in hypercontent-based teaching materials.

The design of teaching materials is made using Canva application that can be accessed online with A4 page size (21 cm x 29.7 cm). The teaching materials consist of 42 pages written with the dominant font Times New Roman and font size 12-18. This is intended so that readers feel comfortable and make it easier to understand the material in it. The teaching materials made as a whole consist of three parts, namely the preliminary, content, and closing.

The preliminary part of the teaching materials consists of a title page, an introduction to teaching materials, a table of contents, a guide to the use of teaching materials, the structure and use of icons, core competencies, basic competencies, objectives, concept maps, benefits of probability in life, motivation letters, and apperception. The content of the teaching materials consists of a description of the material, student activities, examples of problems, and practice questions as an evaluation of learning. The final part of the teaching materials consists of a competency test, answer key, scoring rubric, and bibliography.

3.4. Design Validation

Validation is the stage where hypercontent-based teaching materials are assessed regarding the feasibility and suitability of their characteristics. According to (Herlina., 2019) learning materials should at least be validated conceptually and field validation. There is no specific provision regarding how many validators will perform validation. In this study, conceptual validation was carried out by academics in the field of learning consisting of 2 mathematics education lecturers and field validation was carried out by 2 mathematics teachers.

The suitability test for the characteristics of teaching materials is one of the validation stages which is intended to determine the suitability of the characteristics of hypercontent-based Probability teaching materials based on problem-based learning models. The suitability of the characteristics of teaching materials is assessed based on aspects that are in accordance with the format of student book analysis published by the Ministry of Education and Culture in 2018. Based on the results of the assessment on the suitability test of the characteristics of teaching materials by the validator, it was found that hypercontent-based mathematics teaching materials on Probability materials based on problem-based learning models still need to be revised.

The feasibility test of teaching materials is carried out using the instrument of the feasibility of teaching materials to determine the feasibility level of hypercontent-based teaching materials. The feasibility test instrument consists of three assessment aspects, namely, content feasibility, presentation feasibility, and language feasibility adapted from BSNP. This instrument was compiled using a Likert scale with 4 score choices that refer to the assessment rubric that has been compiled. The results of the feasibility test for hypercontent-based teaching materials are presented as follows.

Aspect	P(%)	Criteria
Content Eligibility	87.00	Very Worthy
Serving Eligibility	86.87	Very Worthy
Language Eligibility	83.58	Very Worthy
Average	85.82%	Very Worthy

Table 3.	Feasibility	Test Results	of Teaching	Materials in	Each Aspect

Based on Table 3, the percentage of the average score of the feasibility test for hypercontent-based teaching materials is 85.82%. These results indicate that hypercontent-based teaching materials are categorized as very feasible both in terms of content, presentation aspects, and linguistic aspects. Furthermore, hypercontent-based teaching materials are feasible to be produced and can be used in learning after improvements have been made according to the validator's suggestions.

3.5. Product Trial

Product trials were carried out after the hypercontent-based teaching materials were revised. The product trial at this stage is in the form of a readability test of teaching materials in the form of a questionnaire. The readability test of hypercontent-based mathematics teaching materials includes (1) readability, related to the language used is easy to understand; (2) convenience, related to the form of writing, lettering (topography), width of spacing, error rate, and clarity of writing; (3) attractiveness, related to the reader's interest, the accuracy of the idea in the reading, the beauty of the writing style; (4) understanding, related to sentence length and paragraph structure.

The readability test in the development of hypercontent-based teaching materials was given to 30 grade IX students at SMPN 25 Semarang. The readability test instrument used is presented in Table 4 below.

 Table 4.
 Readability Test Instruments

No	Description
1	Using language (vocabulary, sentences, paragraphs, and discourse) that is
	easy to understand
2	The form of writing and the size of the letters used make it easier to read
	teaching materials
3	The width of the space used makes it easier to read teaching materials
4	There are no errors in writing in the teaching materials
5	Graphical aspects used in interesting teaching materials
6	Presentation of interesting teaching materials according to the material and
	age of the reader
7	Teaching materials use an attractive writing style
8	The density of ideas and information contained in the reading (short
	sentence length) is easy to understand
9	Teaching materials use standard Indonesian grammar
10	Systematic presentation of material in teaching materials facilitates reader's
	understanding

Descriptively, the results of the readability test given to 30 grade IX students of SMPN 25 Semarang can be seen in Table 5 below.

No Item	Results	
1	80.83%	
2	80.83%	
3	80.83%	
4	80.00%	
5	80.83%	
6	79.17%	
7	80.83%	
8	78.33%	
9	80.00%	
10	77.50%	
Average	79.91%	

Table 5. Readability Test Results

Based on point 1, it shows that the teaching materials developed use language that is easy to understand; based on points 2, 3, and 4 indicate that the size of the writing, the shape of the letters, and the width of the spaces used in the teaching materials are easy to read; based on points 5, 6, and 7 indicate that the graphic aspects and writing style used in the teaching materials are interesting and appropriate for the age of the reader; based on points 8, 9, and 10 indicate that the density of information and presentation of the material facilitates the reader's understanding. Thus, based on the results of the readability test, it can be concluded

used by students independently.

3.6. The final product

After the hypercontent-based Probability teaching materials based on the problem-based learning model achieve the appropriateness of characteristics, reach the appropriate category for use in learning based on the results of the feasibility test, and are classified as easy to understand and can be used independently by students based on the results of the readability test, then the teaching materials are given copyright.

The final product in this study is hypercontent-based Probability teaching materials which are arranged based on the steps of a problem-based learning model consisting of three main components, namely the beginning, the content, and the end.

4. Conclusion

Based on the results of the research and discussion that has been carried out, the hypercontent-based Probability teaching materials based on the problem-based learning model have met the conformity of characteristics based on the book analysis format guidelines published by the Ministry of Education and Culture in 2018. The results of the feasibility test for teaching materials show that the hypercontent-based Probability teaching materials belong to the category valid or very feasible to use in learning with an average percentage score of 85.82%. The results of the readability test of teaching materials showed that hypercontent-based mathematics teaching materials were easy to understand and could be used independently by students with an average score percentage of 79.91%.

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