Readability test for basic mathematics textbook integrated challenge based on blended learning to develop skills in the industrial revolution era

Adi Satrio Ardiansyah[*], Andika Nur Ferianto, Arum Dinasari

Department of Mathematics, Universitas Negeri Semarang, Sekaran, Gunungpati, Kota Semarang, 50229, Indonesia

* E-mail address: adisatrio@mail.unnes.ac.id

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Abstract

The development of technology and information requires education providers to keep up with the times. One of them is the implementation of blended learning which is the challenge for universities. This condition requires lecturers to make learning innovations for the continuity of learning and to achieve learning outcomes. To answer these problems, a Basic Mathematics Textbook will be developed which is integrated with the Challenge Based on Blended Learning (CB-BL) model. This study aims to assess the readability test of the Basic Mathematics Textbook integrated with the CB-BL. Development research was carried out to develop textbook products using the 4-D model where one of the stages is Develop through the readability test. The results showed that the Basic Mathematics Textbook integrated with the CB-BL model met the readability test with a score of 94 (Very Good criteria). The readability test results show that the Basic Mathematics Textbook integrated with the CB-BL model can be implemented in the classroom to develop student skills.

1. Introduction

The innovation in mathematics learning becomes something that must be viewed as a positive thing for the progress of the educational process as well as a strategic step to achieve learning outcomes. One of the challenges in developing learning innovation is the implementation of IT-based learning. Semarang State University as one of the universities in Indonesia tries to answer this challenge through a policy of implementing lectures with a blended learning strategy. In general, blended learning can be defined as the integration of face-to-face learning in class and online learning (Garrison & Kanuka, 2004). The study regarding blended learning began at the same time as the development of the era in the Industrial 4.0 era and is closely related to technological innovation, institutional practices, interaction between institutions and the impact of technology policies, so that it has an impact on policies that direct universities to carry out lectures with a blended learning approach (Castro, 2019). In its development, it is necessary to pay attention to several challenges such as (1) combining student flexibility, (2) stimulating student interaction, (3) facilitating student learning, and (4) fostering an effective learning climate (Boelens, De Wever & Voet, 2017). In its implementation, lecture activities with a blended learning approach at Semarang State University are integrated with a learning management system platform called Elena. With the implementation of lectures with a blended learning approach using Elena, it is hoped that lecture activities will continue by paying attention to learning outcomes, and answering the challenges of IT-based learning innovation.

The challenge of implementing learning in the era of the Industrial revolution lies not only in the learning process, but also on learning outcomes that must be in accordance with the times. The industrial era 4.0 requires the provision of education to be able to answer these problems by providing graduates with

the required criteria, skills and qualifications. Malik (2019) states that there are several skills that need to be possessed by workers, namely digital literacy, technology literacy, and human literacy. Hecklau, et al (2016) visualize competency models that must be met by graduates in several competencies, namely technical competencies, personal competencies, methodological competencies, and social competencies, each of which has several skills that need to be mastered. In the world of education, universities need to develop student cognitive capacities such as higher order mental skills and several other skills such as creative thinking skills, critical thinking skills, problem-solving or decision-making abilities, mastery of IT, and digital literacy (Malik, 2019; Prifti, et al. al, 2017; Benešová & Tupa, 2017; Iswan & Herwina, 2018).

Support and the role of education, in this case learning methods and models are expected to adapt to technological developments so as to increase the competitiveness of the Indonesian nation in the midst of global competition and the rapid development of information technology. Therefore it is necessary to choose strategies, approaches, methods, and techniques that involve students actively learning, both mentally, physically and socially (Suherman et al., 2003). This activity is intended to foster creative mathematics learning goals considering the main focus of developing mathematics learning in the present era is the development of thinking patterns and working in mathematics (Suherman et al., 2003; Zevenbergen, Dole, & Wright, 2004). In addition, it is necessary to pay attention to the ability of teachers to use appropriate, varied, good teaching, and good question learning models so that the spirit of mathematics as a science and a tool to develop students' thinking processes can be achieved (Suherman et al., 2003; Hudojo, 2003; Rochmad & Masrukan, 2016).

One of the lessons that can be developed is Challenge Based Learning (CBL) which is described as a special form of problem-based learning where the problems are realistic and natural (Johnson & Adams, 2011). CBL provides an efficient and effective framework for learning and solving world challenges and is collaborative and direct, asking all participants (students and teachers) to identify Big Idea, ask Good Questions, find and overcome challenges, gain in-depth knowledge, develop century skills 21st, and share their thoughts with the real world (Nichols, Cator & Torres, 2016). By implementing CBL in lectures, it is hoped that it can help students find ways to present and solve problems (Yoosomboon & Wannapiroon, 2015).

Another problem that was found was the unavailability of textbooks that could answer all of these challenges and problems. A preliminary study was carried out in a library at the Faculty of Mathematics and Science, State University of Semarang on the availability of Basic Mathematics textbooks for early semester students, showing that the available textbooks are only reference books that only focus on mastering the material without considering the skills needed and adjustments to learning the expected outcome. This causes students to only do calculations or only master the material without being balanced with the skills that must be possessed to meet the needs of graduates in the era of the Industrial Revolution 4.0.

Based on the description above, it can be seen that there is no basic Mathematics textbook available that can meet the challenges of fulfilling the graduate qualifications needed in the era of the Industrial Revolution 4.0. Furthermore, IT-based learning innovations in maximizing the use of Basic Mathematics textbooks have not been implemented optimally. Therefore, it is necessary to develop a Basic Mathematics Textbook integrated with the Challenge Based on Blended Learning (CB-BL) model to answer these challenges and problems. Thus, the aim of this study is to develop a Basic Mathematics Textbook by integrating the Challenge Based on Blended Learning (CB-BL) model that meets the readability test.

Several supporting research related to the implementation of learning with the Challenge Based Learning model, Blended Learning, and its implications for some of the skills needed by students have been carried out. The Challenge Based Learning model is an effective learning model for improving learning outcomes, conceptual understanding skills, reasoning skills, problem solving skills, creative thinking skills in solving math problems and several other skills such as communication, cooperation, entrepreneurship, leadership, and decision-making (Ardiansyah, Juanedi, & Asikin, 2018; Ardiansyah & Asikin, 2020; Ardiansyah & Junaedi, 2020; Nufus, Duskri & Bahrun, 2018; Naim, Ibnu & Santoso; 2020; Junita; 2016; Haqq, 2016; Tajjudin, 2013; Cirenza , et al., 2015; Malmqvist, Radberg, & Lundqvist, 2015; Hassi, et al, 2016). Johnson & Adams (2011) added that almost 88% of students agree that the CBL experience makes them creative people. The application of blended learning itself can minimize problems in conventional learning which are unable to facilitate various student characteristics (Al Aslamiyah, Setyosari & Praherdhiono, 2019).

Furthermore, the combination of the Blended Learning approach with several learning models is also able to develop creative thinking skills in solving math problems (Wahyudi, Waluya, Suyitno & Isnarto, 2018; Wahyudi, Waluya, Suyitno & Isnarto, 2019; Wahyudi, Waluya, Suyitno & Isnarto, 2020; Syahroni, Inawati, Guswanti, Susanto & Hobri, 2020). Thus it can be assumed that the development of Basic Mathematics Textbooks by integrating CB-BL can develop creative thinking skills.

2. Methods

This research is a research and development of a product used the Thiagarajan, Semmel, and Semmel Models (in Abba, 2000: 28) namely the 4-D model, consist of define, design, develop, and disseminate. The product developed is the Basic Mathematics Textbooks integrated with CB-BL model which is expected to improve students' creative thinking skills. This research was planned until Disseminate stage, but in this article, we will discuss about the readability test which is one of the points at the Develop stage. To obtain the research data, the readability test questionnaire was conducted as the data collection technique. To find out the results of the readability test study, it is seen based on the feasibility level which is calculated by the following formula.

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

where P, f, and N are the percentage, score obtained, and maximum score, respectively. The readability criteria are presented in table 1. The Basic Mathematics Textbooks integrated with CB-BL model is considered to meet the readability test if the percentage score is $\geq 70\%$. If the percentage of the score is $< 70\%$, then the textbook needs to be revised and re-validated.

Table 1. Readability Criteria.

Score Percentages	Criteria
$25\% \leq P < 50\%$	Not Good
$50\% \leq P < 63\%$	Less Good
$63\% \leq P < 75\%$	Quite Good
$75\% \leq P < 88\%$	Good
$88\% \leq P \leq 100\%$	Very Good

3. Results & Discussions

The development of Basic Mathematics Textbooks integrated with CB-BL model used the Thiagarajan, Semmel, and Semmel Models (in Abba, 2000: 28) which states that the learning development model consists of four stages known as the 4-D Model. These stages include (1) Phase I: Definition, at this stage consisting of front-end analysis, student analysis, task analysis, concept analysis and formulation of objectives; (2) Phase II: Design, at this stage consisting of the preparation of tests, media selection, format selection and initial design; (3) Phase III: Development, at this stage consisting of expert assessment and limited trials; and Stage IV: Dissemination/Limited Distribution, at this stage the distribution is carried out in the field, namely a research on the application of textbook use is carried out in students participating in the Basic Material Mathematics course. The study in the article only focuses on the development stage which includes due diligence.

The Basic Mathematics Textbook integrated with CB-BL model has been developed by taking into account the review of the Curriculum by paying attention to Graduate Learning Outcomes and Subject Learning Outcomes, supporting learning theories, and developing creative thinking skills. The material to be studied in this textbook contains material on Sets, Mathematical Logic, Opportunities, Linear Equation Systems Real Number Systems, Functions, Limits, Derivatives, and Integral. Learning activities are integrated with the CB-BL model which consists of the following steps.

In addition, this textbook also accommodates the use of one of the existing learning management systems, namely Elena (elena.unnes.ac.id) so that students can carry out discussions on the provided discussion

forums, work on and collect assignments given, carry out face to face with use virtual face-to-face applications like Zoom. Textbooks are also equipped with course descriptions, learning objectives, guided activities and practice questions to develop student skills.

The readability test is carried out after the textbook has been prepared and has received validation results and input from experts. The readability test in this study includes several aspects of assessment, namely (1) the use of language that is easy to understand; (2) the use of the shape and size of the writing used to make it easier to understand the material; (3) determining the width of the space used to make reading easier; (4) errors in writing books; (5) use of charts / tables in books; (6) the presentation of the book is attractive and in accordance with the material and age of the readers; (7) the writing style used; (8) density of ideas and information in books; (9) the use of standard Indonesian grammar; and (10) the systematic presentation of the material to facilitate understanding of the material. These aspects were developed in a complete readability test questionnaire with suggestions from the assessor.

The readability test in the development of the Basic Mathematics Textbooks integrated with CB-BL model was carried out by 8 students who had passed the Basic Mathematics course or other courses that contained material in the Basic Mathematics course. The readability test results are presented in the following table.

Table 2. Result of Readability Test.

	Evaluator					Mean
	1	2	3	4	5	
1st Aspect	4	4	3	4	4	3.8
2nd Aspect	4	4	4	4	4	4
3rd Aspect	4	4	4	4	4	4
4th Aspect	3	3	3	3	3	3
5th Aspect	4	4	4	3	4	3.8
6th Aspect	4	4	3	4	4	3.8
7th Aspect	4	4	3	3	4	3.6
8th Aspect	4	4	4	4	4	4
9th Aspect	4	4	4	3	4	3.8
10th Aspect	3	4	4	4	4	3.8
Score	95	97.5	90	90	97.5	94

Based on these results, the mean readability test was 94 in the Very Good category. Furthermore, the results of the due diligence for each appraiser meet the Very Good category. If examined further, the assessment results for each indicator also meet the Very Good category. Thus it can be concluded that the Basic Mathematics Textbooks integrated with CB-BL model meets the criteria for the readability test in the Very Good category.

From these results, a statistical analysis was carried out using the Analysis of Variance (ANOVA) test to determine the difference in the results of each assessor's assessment of the readability test of Basic Mathematics Textbooks integrated with CB-BL model. The One Way ANOVA test was carried out using the help of the SPSS application so that the following results were obtained.

Table 3. ANOVA Test Results.

	Sum of Square	df	Mean Square	F	Sig.
Between Groups	0.920	4	0.230	1.262	0.299
Withing Groups	8.200	45	0.182		
Total	9.120	49			

Based on these results, the Sig. amounting to 0.299. Hence the Sig. $0.299 > 0.05$, then H_0 was accepted. So, there was no difference in the assessment of the five students on the readability test of the Basic Mathematics Textbooks integrated with CB-BL model. These results corroborate the information that the Basic Mathematics Textbooks integrated with CB-BL model meets the criteria of the readability test so that it can be implemented in the classroom to develop student skills.

Readability study is completeness in implementing the development of textbook product in addition to the feasibility test or expert validity. This stage needs to be done in order to obtain a Textbook that is ready for limited testing and dissemination to the class until it is published. As previously section, this stage assesses several points such as (1) the use of language that is easy to understand; (2) the use of the shape and size of the writing used to make it easier to understand the material; (3) determining the width of the space used to make reading easier; (4) errors in writing books; (5) use of charts / tables in books; (6) the presentation of the book is attractive and in accordance with the material and age of the readers; (7) the writing style used; (8) density of ideas and information in books; (9) the use of standard Indonesian grammar; and (10) the systematic presentation of the material to facilitate understanding of the material. This step needs to be done through an assessment of students who have taken basic mathematics courses so that readability results will be obtained that are in accordance with the level of student understanding. Adjustment of a textbook based on the level of understanding of students is one of the aspects of assessment in the feasibility test according to the Ministry of Education and Culture (2018). This indicates the importance of legibility testing in textbook development.

Another thing that is no less important in the process of developing this textbook is the integration of the CB-BL model in order to improve students' skills on the industrial revolution era. The CB-BL model framework which provides realistic and natural problems has been well integrated through the CB-BL model syntax, from Big Idea to Guiding Resources, Guiding Questions, and Guiding Activities as well as the problems tested in the Assessment section. Students will be given a big idea (Big Idea) which will be solved by students complete with a discussion of questions related to the idea (Essential Question). This is intended to trigger students to be motivated in learning. Furthermore, students will carry out online lectures that are integrated with the LMS, namely Elena in order to carry out core activities, namely completing the challenges given. In this stage, students in groups conduct self-exploration and indirectly receive direction through several questions, directed activities and learning resources such as learning videos that have been uploaded on the Youtube platform as their guide in solving challenges. Each solution given must be clearly articulated and then published in class. The final stage of this learning is the publication of the results of solving challenges, completion of assessments, and self-reflection based on the learning experiences they have carried out.

One of the impacts of this activity was that it can develop several skills in the era of the industrial revolution 4.0. The implementation of the CBL learning model itself has proven effective in improving creative thinking (Ardiansyah & Asikin, 2020; Nufus, et al., 2018; Junita, 2016; Naim, et al., 2020), critical thinking (Nawawi, 2017), problem-solving skills (Kaniawati, 2020), collaboration skills (Tajuddin & Jailani, 2013; Johnson, 2011), information management skills (Yoosomboon & Wannapiroon, 2015), and several other mathematical thinking skills such as the ability to understand mathematical concepts (Haqq, 2016); reasoning skills (Haqq, 2017) and thinking skills statistics (Susilawati, et al., 2019). Furthermore, blended learning itself provides a different nuance where students can explore themselves anywhere, anytime and with any learning resources during the learning process. This activity has an impact on several skills in the era of the industrial revolution 4.0 such as creative thinking (Mulyono, et al., 2020; Candra, et al., 2019), critical thinking (Sholikh, et al., 2019), problem-solving skills (Dwiyogo, 2018; Pitaloka & Suyanto, 2019), and several other skills such as self-confidence, responsibility, and self-control (Al Aslamiyah, 2019). Thus, the application of Basic Mathematics Textbooks integrated with CB-BL model needs to be implemented in order to develop several skills in the era of the industrial revolution 4.0.

4. Conclusion

Based on the results of the study, it can be concluded that the development of Basic Mathematics Textbooks integrated with CB-BL model with the 4-D Model meets the readability test with a score of 94 or meets the readability test with Very Good criteria. With these results obtained, the Basic Mathematics Textbook by

integrating CB-BL can then be tested in class with the hope of developing student skills needed in the era of the Industrial Revolution 4.0. It is hoped that with the application of this textbook in lectures, the competence of prospective professional teachers according to the times can be fulfilled. The implementation of this textbook can also be an alternative in the implementation of online learning during New Normal, seeing that its implementation can be integrated with a learning management system.

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