Blended learning with schoology in mathematics: Student’s activity and their outcome

R T Wijayanti, H E Chrisnawati and L Fitriana*
Faculty of Teacher Training Education, Universitas Sebelas Maret Jl. Ir. Sutami 36.A, Jebres, Surakarta, Jawa Tengah 57126, Indonesia

*lailafitriana_fkip@staff.uns.ac.id

Abstract. The aim of this research is to determine: (1) the design of learning media based on Blended Learning Schoology in the Mathematics subject of mathematics logic material; (2) describe the validity of the product; (3) describe the practicality of the product; (4) describe the product’s effectiveness in enhancing student’s activity and their outcome. The development procedures employed were Four-D model which consisted of four phases: define, design, develop, and disseminate. In develop phase, the assessment had been conducted by two experts there were media expert and material expert to assess validity of media both in construct and content aspects. The results showed that the validities by the media expert and material expert were “very good” and “good” category. The learning media developed is practical to be use. The achievement percentage of the learning media’s practicality was 81.02 % which is appropriate to the achievement criteria. The implementation was done to 36 students of vocational school. The results from classroom implementation revealed the effectiveness of the product in enhancing student’s activity and their outcome. Moreover, 77.78% of the students are active in using the product and there were significant differences in learning outcome between Blended Learning based on Schoology and Direct Instruction.

1. Introduction
Facing the rapid development of globalization era in the 21th Century, teachers and educational institutions are demanded to be able to prepare their students to have competences or skills. Problem-solving skill, effective communication skill, decision making skill, collaborating skill, information literacy, information and communication technology (ICT) literacy are parts of the 21st Century competencies [1]. The rapid development of globalization era involved a wide range of innovations in teaching learning approach, one of which is blended. Typically, all of them basically involved in combining face-to-face and online learning. Owing to the flexibility as well as the richness in the possibility of remodeling of the approach, interest in blended learning has grown rapidly [2]. Blended learning is a format rapidly spreading in education worldwide. The idea of it looks attractive as it enables the preservation of traditional forms of learning, shaped by centuries of pedagogical experience and enjoying a lot of human loyalty, despite the temptation of handing over many educational functions to new technologies [3].

Blended is defined as the combination of best features of traditional learning and online learning [4-6]. Thus, blended learning can be considered a sort of electronic learning or its extension; its main difference is the necessity of face-to-face communication of students with each other and with the instructor [7]. One application that supported blended learning is Schoology. Schoology is a free web-
based education application which allows teachers to give lessons to students digitally. Schoology is adopting Facebook as an interface and feature for ease of use. Students simply access www.schoology.com on the computer or download Schoology at Play Store or App store on smartphone to use this application [8]. Overall, the design of Schoology encourages voluntary submission of the learners to the activities being done in and out of the classroom. Instead of relying too much in the old methods of teaching and learning, incorporating teaching in this digital age may help the students to be more involved in their studies [9]. That statement was supported by several research results which stated that blended learning can offer relevance to what students study in class, create a better foundation for the online collaboration during the course, and education was more effective; students’ achievements were better than expected in comparison to traditional education and algorithmic thinking abilities of students in blended and traditional education were very close [10,11].

Post-secondary education in Indonesia accommodates three institutions, namely Senior High School and Vocational High School. The priority of vocational high school is to make the graduates to be ready to work in industry, entrepreneurship, and creating job fields. Vocational high school becomes the Indonesia’s largest technician provider. The allocation of the lessons is more in practice than theory [12]. So that theoretical subjects such as mathematics are less noticed and the time used for learning is very lacking. Therefore, blended learning with schoology is expected to overcome these problems.

2. Methods
This research is a research and development with the design of Four-D model. This study was conducted at a vocational high school in Indonesia. The design of this research as shown in Figure 1.

![Flowchart](image)

**Figure 1.** Flowchart development of learning media based on blended learning with schoology.

Subject of this research were media experts, material experts, and students of vocational high school in Karanganyar region at Indonesia. There were two media experts and two materials experts who assessed the developed media. Media experts validate the product by giving an assessment, comment, suggestion,
and revision of the product from the aspects of learning design, display design, and the benefits of learning media. The material experts validate the product by giving an assessment, commentary, suggestion, and revision of the product from the aspect of the quality of the material and the benefits of the material, while the students give value about the practicality of the media and information about the effectiveness of the media. The sampling technique used is cluster random sampling technique.

Data collection techniques used are documentation methods to collect data in the form of data Semester 1 Deuteronomy, interview methods to find out the problems and potential that exist in school, questionnaire method to assess the media developed, and test methods for students' mathematics learning outcomes data on the material Mathematical logic. Data analysis techniques include testing the validity of instrument content and media validity tests. Validity tests are classified into two types, namely quantitative and qualitative data. Qualitative data in the form of comments and revision suggestions obtained from media experts and material experts through questionnaires. The data was analyzed descriptively qualitative and concluded as input to improve or revise the product developed. In addition, qualitative data was also obtained from questionnaires given to media experts and material experts with a Likert scale of 1 to 5. The questionnaire scores were then converted to the conversion reference presented in the Table 1.

Table 1. Conversion qualitative data to quantitative data.

| Value  | Criteria             | Score Interval |
|--------|----------------------|----------------|
| A      | Very Good            | $x > 4.20$     |
| B      | Good                 | $3.40 < x \leq 4.20$ |
| C      | Sufficiently Good    | $2.60 < x \leq 3.40$ |
| D      | Less                 | $1.80 < x \leq 2.60$ |
| E      | Very Less            | $x \leq 1.80$  |

3. Results and discussion
This development of learning media based on Blended Learning with Schoology refers to the Four-D model which consists of four steps as follows:

3.1. Define
Based on the results of interviews with teachers, information was obtained that the Mathematics Logic material was a material that had not been taught in vocational schools for a long time. Based on the syllabus issued by the government, this material should be 11th grade material. However, due to the large number of activities in the 11th grade of vocational school including apprenticeship activities which took almost 6 months, the mathematics teacher decided that the Mathematical Logic material was taught in the 10th grade of vocational high school. Based on interviews with teachers it is known that the media used by teachers is stories related to everyday life. Students also stated that they often open YouTube to study material independently if the material described is poorly understood. Based on a survey of the ownership of cellphones and smartphones related to the type, the completeness of the features contained therein as well as the internet usage that was carried out before the learning media was designed, data was obtained that all students already had smartphones with complete features.

Based on the observations of researchers regarding the analysis of students obtained information that the activities of vocational high school students are very dense and that many teaching materials are the driving factors why the learning media used are less varied. Task analysis relates to the mapping of core competencies and basic competencies to be used. Concept analysis is done by mapping the concepts desired by students. The results of the analysis of learning objectives is that students can explain open sentences and determine the value of truth and denial of a statement; students can determine the truth value of conjunctions, disjunctions, implications and implications and their denial; students can explain the meaning of universal and existential quant or and its denial; students can draw conclusions with
sylogism, modus ponens, and mode tollens; students can solve everyday problems related to the use of mathematical logic.

3.2. Design
According to the Four-D model, the design stage consists of 4 stages: the preparation of criteria for test criteria, media selection, format selection, and initial design. The criteria that need to be considered in the selection of media are in accordance with the objectives to be achieved; appropriately supports the contents of the lesson; practical, flexible and enduring; skilled teacher uses it; target grouping; and technical quality, a questionnaire was prepared to assess the validity of the media for media experts and material experts [13]. The media expert questionnaire consisted of 22 items and an open questionnaire. The expert questionnaire consisted of 28 items and an open questionnaire. Media experts assess based on aspects of learning design, display design, and the usefulness of learning media. Material experts assess based on aspects of material quality and material benefits.

The selection of media related to the media that will be used based on the analysis of tasks, concepts, and potential that exist in school. Based on this analysis the selected media is E-learning media, namely Schoology. Formatting selection is related to learning objectives. The format chosen is to design content, learning strategies, and learning resources. Media planning relates to designing media components and media making tools and materials. The planning phase of the media component includes the determination of the course submersion, student worksheets, quizzes, assignments, and material in the form of teaching materials. Previously made a storyboard to see the sequence of events that will be visualized. Tools and materials used are a set of PCs, guidelines for using Schoology, and literature books on Mathematical Logic material.

3.3. Develop
The purpose of the activity at this stage is to modify the media prototype (storyboard). This stage consists of two phases, namely expert validation and development testing.

3.3.1. Validation of experts. The expert validation phase consists of media expert validation and expert material validation. The results of the media expert assessment can be seen in the Table 2.

| Aspect                  | Average Score | Criteria   |
|-------------------------|---------------|------------|
| Learning Design         | 4.44          | very good  |
| Display Design          | 4.22          | very good  |
| Benefits of Learning Media | 4.5          | very good  |

Based on the Table 2, it was known that media expert’s assessment towards product was valid. In addition to providing assessments, media experts also provide suggestions for improvements to the developed media. The improvements suggested by media experts are regarding making a backup for teaching materials in Resources. In addition, the material should be made in PDF form so that it can be studied online by using Schoology or offline by downloading it first. Media experts also provide improvement suggestions regarding the appearance in the media. The type of font used by researchers is inconsistent like Times New Roman, Calibri and Simsun. Then the researchers get suggestions for improvement from media experts so that the type of font used is more consistent in one type, namely Calibri or Tahoma or Arial, and the like. The reason for the advice he gave was that he should design electronic media type fonts (fonts) used not legged like Times New Roman or complicated fonts such as Algerian. These types of letters are avoided because they make the eyes faster. Media experts also provide advice directly to choose colors that match the color blue Schoology. The results of the media expert assessment can be seen in the Table 3.
Table 3. Material expert assessment.

| Aspect               | Average Score | Criteria  |
|----------------------|---------------|-----------|
| Material Quality     | 4.16          | good      |
| Material Utilization | 4.5           | very good |

Based on the Table 3, it was known that material expert’s assessment towards product was valid. In addition to providing an assessment, material experts also provide suggestions for improvements to the material developed. The improvements suggested by material experts are about the correctness of the sentence, the writing system, and about the notion of "breaking promises" on teaching materials. He suggested that researchers should re-examine the correctness of sentences and typos. In addition, regarding the definition of "broken promises" that the researcher wants whether regarding negation / negation or so that the statement is true and converted into a statement that has a false value. Based on these suggestions, researchers made changes by changing the word "broken promises" to "not keeping promises" because the author's goal was to make the statement true value changed to be a statement that was wrong.

3.3.2. Development test. Students assess the practicality of media products based on three aspects, namely the ease of use of media, the suitability of the media with learning material, and the user's interest in the media. In the development test also assesses the effectiveness of using media in learning. The use of media is said to be effective if there is a significant difference in the test scores of learning outcomes between the experimental class and control class and the percentage of students who are active in using the media is more than or equal to 70%. So, it can be concluded that the media products that are developed effectively are used in the Mathematical Logic material in 10th grade. The Table 4 presents the results of media assessment by students in each aspect.

Table 4. Practicality of developed media.

| Aspect                             | Percentage | Criteria |
|------------------------------------|------------|----------|
| Media Usability                    | 80.12%     | achieved |
| Suitability of Media with Learning Material | 81.89%     | achieved |
| User Interest in Media             | 81.94%     | achieved |

Based on the Table 4, it was known that overall the results of student responses in the field trial stated that the developed media met the practicality criteria of 81.02%. This percentage meets the established criteria that the media is said to be practical if the percentage of student responses compared to the ideal maximum score is more than or equal to 80%. Based on these data it can be concluded that the media developed are practical media for use.

Based on previous research conducted by [10], blended learning methods allow students to learn and access material in various modes or features. This was also evidenced in research conducted by researchers through an open questionnaire distributed to students. Students stated that it was easier to access the materials distributed, the solution on how to do the material that was given was clear and easy to understand, it was better to develop electronic learning media, and learning with Schoology could be efficient place and time. Based on the students' opinion it can be concluded that students are more interested in learning that is done by the blended learning method with schoology. In addition, researchers in this study pay attention to the activities of student groups in learning. students are given worksheets designed according to the learning model of Problem Based Learning so that students not only get subject matter but are also trained to find their own concepts. Students are also provided with practice questions so that students can find out how far they understand the material being studied.
3.4. Disseminate
In this study, researchers did not carry out the Disseminate phase because of the limited time and costs that researchers have.

4. Conclusion
Based on the test results and analysis above, it can be concluded that Development of instructional media refers to the Four-D model which includes the stages of define, design, develop, and disseminate. The define stage consists of initial analysis, student analysis, task analysis, and concept analysis. The design stage consists of the preparation of criteria for test criteria, media selection, format selection, and initial design. The develop phase consists of modification of the media design, validation by experts, and development testing. The disseminate stage is not implemented due to the limitations of the author. Learning media based on Blended Learning with Schoology on Mathematical Logic material in the 10th grade of vocational high school is a valid learning media. Learning media based on Blended Learning with Schoology on Mathematical Logic material in 10th grade of vocational high school is practically used in learning mathematics material. Learning media based on Blended Learning with Schoology on Mathematical Logic material in 10th grade of vocational high school is effective to be used in learning on the material of mathematics in 10th grade.

References
[1] Suana W, Maharta N, Nyeneng D and Wahyuni S 2017 Design and Implementation of Schoology-based Blended learning Media for Basic Physic I Course Journal Pendidikan IPA Indonesia 6 (1) 170-178
[2] Nordin A B and Alias N 2013 Learning Outcomes and Student in Using of Blended learning in History Procedia-Social and Behavioral Science 103 577-585
[3] Nazarenko A L 2015 Blended learning vs Traditional Learning: What Works? (A Case Study research) Procedia-Social and Behavioral Science 200 2015 77-82
[4] Yigit T, Koyun A, Yuksel A S and Cankaya I A 2014 Evaluation of Blended Learning Approach in Computer Engineering Education Procedia-Social and Behavioral Science 141 807-812
[5] Gaiz A and Mosawy S 2018 Educational technologies for Online and Blended Learning in Medical Science Acta Scientific Medical Sciences 2 4 50-54
[6] Bozic N H, Momar V and Boticki I 2009 A Blended Learning Approach to Course Design and Implementation IEEE Transactions on Education 52 (1) 19-30
[7] Matukhin D and Zhitkova E 2015 Implementing Blended learning Technology in Higher Profesional Procedia-Social and Behavioral Science 206 183-188
[8] Manning C, Brooks W, Diedrich A, Moser J and Zwiefelhofer A 2011 Tech Tols for Teachers, by Teacher: Bridging teachers and Students Wisconsin English Journal 53 24-28
[9] Sicat A S 2015 Enhancing College Students’ proficiency in Business Writing Via Schoology International Journal of Education and Research 3 (1) 2201-6333
[10] Kaur M 2013 Blended Learning-its challenges and future Procedia-Social and Behavioral Science 93 612-617
[11] Khlaisang J and Likhitdamrongkiat M 2015 E-learning system in blended learning environment to enhance cognitive skills for learners in higher education Procedia-Social and Behavioral Science 174 759-767
[12] Irawan V T, Sutadji E and Widiyanti 2017 Blended learning Based on Schoology: Effort of Improvement Learning Outcome and Practicum chance in Vocational SchoolCogent Education 4 1282031
[13] Thiagarajan S et al. 1974 Instructional Development for Training teachers of Exceptional Children (Washington DC: National Center for Improvement Educational System)