Edmodo-based blended learning on mathematical proving capability

A Pertiwi, R Kariadinata, J Juariah, H Sugilar and M A Ramdhani

1Department of Mathematics Education, UIN Sunan Gunung Djati Bandung, Jl. A.H. Nasution No. 105, Bandung 40614, Indonesia
2Department of Informatics, UIN Sunan Gunung Djati Bandung, Jl. A.H. Nasution No. 105, Bandung 40614, Indonesia

Abstract. This study aims to learn the differences in terms of mathematical proving capability achievement of students using Edmodo-based blended learning model according to the levels of prior mathematical knowledge (high, medium, low), compared to those with conventional model, and the students’ attitude towards mathematics learning using Edmodo-based blended learning model. This study uses quasi-experimental method. The subjects of this study are the second graders of junior high school. The research instrument consists of tests and non-test. The results of this study show that: there is a difference in terms of the improvement of mathematical proving ability between students using Edmodo-based blended learning model and those using conventional model, there is also a difference in terms of the achievement of mathematical proving ability between students using Edmodo-based blended learning and those using conventional model based on the levels of prior mathematical knowledge (high, medium, low), and students show a positive attitude towards mathematics learning using Edmodo-based blended learning model. Edmodo-based blended learning has implications for teacher activeness by using technology for education and student self-reliance in the learning process.

1. Introduction
The ability of students in understanding learning materials is influenced by various components, including environmental factor [1], use of learning media [2], availability of learning resources [3], teaching methods, as well as evaluation and assessment techniques and procedures. One of the learning models in this digital era is e-learning, a type of learning that develops using technology, whose growth is facilitated by the internet and has great opportunities in education world to make students' understanding better [4]. Blended learning is an approach integrating face-to-face teaching and computer-based learning activities in a pedagogical environment [4]. The strategic use of technology in the teaching and learning of mathematics is the use of digital and physical tools by students and teachers in thoughtfully designed ways and at carefully determined times so that the capabilities of the technology enhance how students and educators learn, experience, communicate, and do mathematics [5].

The use of learning media or multimedia especially e-learning-based one is able to create an active, creative and not boring learning that makes mathematics learning more interesting and interactive for students or college students, and makes learning in the class not boring. In addition, a fun learning atmosphere [6], increases learning motivation [7], improves learning effectiveness [8], enhances understanding level [9], student-centered learning [10], and the investment efficiency of learning tools...
Moreover, Edmodo-based e-learning learning has the advantage of not requiring a formal class in its application [12]. Blended learning seeks multi-technology-based learning, it has some disadvantages namely, it makes less interaction between teachers and students or even among students themselves, not all sites are available for internet or networking facilities, it is hard to engage multiple students in meaningful and productive discussions, and it does not positively contribute in terms of soft skills acquired during the learning process [13,14]. The goal of blended learning development is to combine the best features of face-to-face and online learning to promote student’s active independent learning and reduce the seat time [15]. The main goal of blended learning for educational institutions is to create a positive attitude toward the learning process [16].

This study is based on the result of the observation showing that students often undergo difficulty in completing mathematical proofs because they are lack of practices in proofing problem and are not accustomed to solving the non-routine mathematical problems related to the reasoning on the indicators of proof [17]. Indicators of mathematical proof capabilities include: identifying premises and their implications and supporting conditions; organizing and manipulating facts to prove the truth of a statement; making connections between facts and elements of the conclusion to be proved [18]. A serious effort from all practitioners of mathematics education is required, especially from teachers as mentors, directors, and facilitators that have an important role in providing a mathematics learning that supports the improvement of student's mathematical proofing ability [19].

2. Method
The research design used in this study is quasi-experiment. The control variable in this study is students’ Prior Mathematical Knowledge (PMK) because the prior ability has a strong influence on the learning outcomes divided into high, medium and low categories [20]. The sampling technique used is purposive sampling technique. Types of data used are quantitative data and qualitative data. Quantitative data is obtained from students’ PMK data, and pre-test as well as post-test results. Meanwhile, the qualitative data is obtained from the observation sheet of teacher and student activities and the scale of students’ attitudes. This study is conducted in SMP Negeri 2 Cileunyi with population of all students of 2016/2017 class 7 consisting of ten classes. As for the sample, it takes two classes, namely class 7A and class 7B. The number of students in class 7A is 34 students and 7B is also 34 students. Class 7A is used as a control class that implements conventional learning while class 7B is used as an experimental class that implements blended learning using Edmodo media.

3. Results and discussion
Based on the results of student answers on the student worksheet from the first to the fourth meeting, students experience an increase indicated by the fulfilment of mathematical proof indicator when working on the problem. At the first meeting, according to their answer when doing mathematical proof problems, most students have not met the indicators of identifying the premise and its implications and making a connection between the facts and the conclusion to be proved. Then, at the second meeting, students begin to identify the premise and its implications indicated by writing down what is known and asked in the solution of the problem. At the third meeting, students begin to meet the indicators of identifying the premise and its implications and organizing facts to prove the truth of a statement, indicated by their answers that tend to be more systematic and meet the mathematical proof indicator. Furthermore, at the fourth meeting, students generally improve and meet the mathematical proof indicator when working on the problem. This students’ improvement in mathematical proof is determined using the data of pre-test and post-test calculated using a normalized gain formula. Then, the data of n-gain is used for determining the one showing a better improvement in mathematical proof between those implementing blended learning model using Edmodo media and those implementing conventional learning. N-gain statistical data can be seen in Table 1.
Table 1. N-gain descriptive statistics.

| Learning Model | N  | Minimum | Maximum | Mean   | Std. Deviation | N-Gain Criteria |
|----------------|----|---------|---------|--------|----------------|-----------------|
| Blended learning | 34 | 0.03    | 0.97    | 0.5549 | 0.25522        | Medium          |
| Conventional    | 34 | 0.03    | 0.63    | 0.2809 | 0.18624        | Low             |

Table 1 shows that according to the average n-gain, the mathematical proving ability of students implementing blended learning model using Edmodo media is better than that of those implementing conventional learning. However, the mathematical proving ability of every student in both classes improves.

The achievement of students’ mathematical proving ability is determined using post-test data. The post-test data is used to determine which one having better achievement between students implementing blended learning model using Edmodo media and those implementing conventional learning, based on the overall result and students’ PMK categories, i.e. high, medium and low. As for the descriptive statistics of post-test data based on the overall result and students’ PMK categories, it can be seen in Table 2 as follows.

Table 2. Descriptive Statistics of Post-test Data based on the overall result and Students’ PMK Categories.

| PMK       | Blended Learning | Conventional |
|-----------|------------------|--------------|
|           | Mean | SD       | Mean | SD       |
| High (T)  | 81.67 | 4,803 | 72.80 | 16,453 |
| Medium (S)| 74.00 | 17,103 | 57.62 | 11,409 |
| Low (R)   | 54.33 | 10,066 | 60.33 | 10,504 |
| Overall result | 73.62 | 16,373 | 60.09 | 12,939 |

Table 2 shows the score of students’ post-test based on the overall result and each of PMK categories (high, medium, low). In average, the data between the class implementing blended learning using Edmodo media and the one implementing conventional learning is different, the mathematical proving ability of students implementing blended learning model using Edmodo media is better than that of those implementing conventional learning. Similarly based on the PMK categories (high, medium, low), the average post-test result of the class implementing blended learning using Edmodo media is also better, namely 73.62 while that of the one implementing conventional learning is 60.09. Therefore, according to the post-test result, the achievement of the mathematical proving ability of students implementing blended learning model using Edmodo media is better than that of those implementing conventional learning.

The detail post-test score of the students’ mathematical proving ability based on PMK categories (high, medium, low) can be seen in Figure 1.

Figure 1. Diagram of the average post-test score of the students’ mathematical proving ability based on PMK categories.
Figure 2. Plot of interaction between students’ PMK and learning in terms of students’ mathematical proving ability difference.

Figure 2 shows that the class implementing blended learning using Edmodo media with high PMK category is better than with medium and low category and is better than the one implementing conventional learning with high, medium, and low PMK category; similarly, the class implementing blended learning using Edmodo media with medium PMK category is also better than with medium and low categories and is better than the one implementing conventional learning with high, medium, and low PMK category; the class implementing blended learning using Edmodo media with low PMK category is not any better than the high, medium and low categories of the one implementing conventional learning with high, medium, and low PMK category;

Based on the analysis of attitude scale data divided into three aspects, it is known that students have relatively positive attitude. The average score of students’ attitude on each indicator is higher than that of student’s neutral attitude as shown in Table 3.

Table 3. Average students’ attitude.

| Aspect                                      | Average Score |
|---------------------------------------------|---------------|
| Students’ attitude towards mathematics learning | 3.21          |
| Students’ attitude towards mathematics learning using blended learning through Edmodo media | 2.5           |
| Students’ attitudes toward mathematical proving problems | 2.95          |

Table 3 shows that the scores of the aspects of students’ attitude toward mathematics learning, mathematics learning using blended learning using Edmodo media, and mathematical proofs are higher than the average score of students’ attitude, which means that the students give a positive attitude. The scale analysis of the attitude toward mathematics learning using blended learning using Edmodo media shows that the overall students’ attitude is almost all positive. It shows that the students feel happy to learn mathematics using blended learning using Edmodo media because it is user friendly and looks like Facebook that makes them easy to use it and interested in using it [21]. According to the average score of each students’ attitude aspect, the highest is the average score of the aspect of students’ attitude
towards mathematics learning, followed by that of toward mathematics learning using blended learning using Edmodo media and then that of toward mathematical proving problems.

According to the data obtained from the analysis result of teacher observation sheet in the class implementing blended learning using Edmodo media, it shows that teacher activity improves at every meeting. At the first, second and third meetings, the average teacher activity is included in adequate criteria, and then at the fourth meeting, it is included in good criteria. At the first meeting, it is still hard for the teacher to attract every student’s attention due to poor class management; meanwhile, during the application of blended learning model using Edmodo media, the teacher takes a long time to make students understand how to access Edmodo so that it takes relatively longer time for the tutorial of Edmodo. At the second meeting, the teacher begins to be able to attract students’ attention by performing an apperception out of the class by asking about the constraints during e-learning using Edmodo. At the third meeting, the teacher can guide students better in finding a solution to solve mathematical proving problems due to the help of Edmodo features such as quiz, assignment and library. At the fourth meeting, the teacher shows a good performance in executing all learning aspects because the students have been familiar with the implementation of blended learning model using Edmodo media, and the discussion of the problems but group representatives can also run smoothly.

Based on the analysis result of student observation sheet, students improve at every meeting, even though at the second, third and fourth meetings the improvement is not significant enough. From the first to the third meetings, the student activity is included in adequate category, and then at the fourth meeting it is included in good category. At the second meeting, students begin to dare to ask if there is difficulty in the material and obstacle in using Edmodo. At the third meeting, the student activity is included in adequate category. Each group regularly starts to form groups without having to debate. The involvement of students in the learning process shows a high intensity of activeness [22]. The improvement in the fourth meeting occurs because students are getting used to using Edmodo and face-to-face learning in which there is a process of discussion, in addition, they have dared to present a presentation and get used to learning using Edmodo media that can be done anywhere and anytime.

4. Conclusion
This study result of mathematics learning implementing blended learning model using Edmodo media shows that it can enhance students’ mathematical proving ability as well as its achievement. It is supported by good teacher and student activities as well as positive attitude shown by students toward mathematics learning using blended learning model using Edmodo media. According to this study result, discussion and conclusion, there are some suggestions for the future researchers namely, that the learning materials uploaded to Edmodo should be created more attractively, blended learning using Edmodo media in the next study can be implemented in other materials or subjects, and the introduction of Edmodo can be done out of the class so that the learning process can be more effective.

References
[1] Ramdhani M A 2014 Lingkungan Pendidikan dalam Implementasi Pendidikan Karakter J. Pendidik. Univ. Garut 8 27–36
[2] Ramdhani M A and Wulan E R 2012 The Analysis of Determinant Factors In Software Design For Computer Assisted Instruction Int. J. Sci. Technol. Res. 1 69–73
[3] Ramdhani M A and Muammadiyah H 2015 The Criteria of Learning Media Selection for Character Education in Higher Education Muhammad International Conference of Islamic Education: Reforms, Prospects and Challenges (Malang: UIN Maulana Malik Ibrahim Malang) pp 174–82
[4] Juariah J, Syaf A H, Rohimah I, Sugilar H and Kariadinata R 2018 MathDroid Application Development on Three-Dimensional IOP Conf. Ser. Mater. Sci. Eng. 288 012087
[5] NCTM 2015 Strategic Use of Technology in Teaching and Learning Mathematics (Virginia USA: NCTM)
[6] Aisyah R, Zakiyah I A, Farida I, Ramdhani M A, A B and C D 2017 Learning Crude Oil by Using
Scientific Literacy Comics J. Phys. Conf. Ser. 895 012011

[7] Sari, Irwansyah F S, Farida I and Ramdhani M A 2017 Using Android-Based Educational Game for Learning Colloid Material Using Android-Based Educational Game for Learning Colloid Material J. Phys. Conf. Ser. 895 012012

[8] Irwansyah F S, Lubab I, Farida I and Ramdhani M A 2017 Designing Interactive Electronic Module in Chemistry Lessons J. Phys. Conf. Ser. 895 012009

[9] Helsy I, Maryamah, Farida I and Ramdhani M A 2017 Volta-Based Cells Materials Chemical Multiple Representation to Improve Ability of Student Representation J. Phys. Conf. Ser. 895 012010

[10] Sari S, Aryana D M, Subarkah C Z and Ramdhani M A 2018 Multimedia Based on Scientific Approach for Periodic System of Element IOP Conf. Ser. Mater. Sci. Eng. 288 012137

[11] Irwansyah F S, Yusuf Y M, Farida I and Ramdhani M A 2018 Augmented Reality (AR) Technology on the Android Operating System in Chemistry Learning IOP Conf. Ser. Mater. Sci. Eng. 288 012068

[12] Hadi F R and Rulviana V 2018 Analisis Proses Pembelajaran E-Learning Berbasis Edmodo pada Mata Kuliah Geometri J. Bid. Pendidik. Dasar 2 63–8

[13] Bullen M 2001 E-Learning and the Internationalization Education Malaysian J. Educ. Technol. 1 37–46

[14] Jones M 2001 Building a Stronger Organization Through Leadership Development at Parke-Davis Research Ind. coomercial Train. 32 44–8

[15] Graham C R 2004 Blended Learning System: Definition, Current Trends and Future Directions (San Fransisco: Bringham Young University)

[16] Mayadas A and Picciano A G 2007 Blended Learning and Localness: The Means and the End J. asynchronous Learn. networks 11 162–5

[17] Wanti N, Juariah, Farlina E, Sugilar H and Kariadinata R 2017 Pembelajaran Induktif pada Kemampuan Penalaran Matematis dan Self-Regulated Learning Siswa J. Anal. 3 56–69

[18] Soemarmo U 2014 Advanced Mathematical Thinking and Habits of Mind (Bandung)

[19] Maya R 2011 Mathematical Understanding and Proving Abilities: Experiment with Undergraduate Student by Using Modified Moore Learning Approach J. Math. Educ. 2 231–50

[20] Lestari W 2017 Pengaruh Kemampuan Awal Matematika dan Motivasi Belajar Terhadap Hasil Belajar Matematika J. Anal. 3 76–84

[21] Ndibalema P 2016 Integrating Edmodo Learning Platform as a Tool for Supporting Student Centered Learning in Higher Learning Institutions Int. J. Contemp. 3 85–101

[22] Aunurrahman 2011 Belajar dan Pembelajaran (Bandung: Alfabetha)