Can blended learning replace conventional learning in terms of mastery learning and cognitive attainment

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Abstract. Blended learning is a pedagogical approach that combines face-to-face learning with online learning. Blended learning is considered as the next conventional learning. So that education in Indonesia is not left behind, the issue of blended learning should have received an appropriate response because in many developed countries many have implemented blended learning as their conventional learning. This research aims to describe whether blended learning is able to replace face-to-face learning as conventional learning today. To describe this, this research was reviewed based on mastery learning and cognitive attainment. Mastery learning is used as a basis for reviewing because education standards in Indonesia use the standard "thorough learning". The cognitive attainment is used as a basis for reviewing because cognitive levels influence the achievement of critical thinking skills where these skills are one aspect of the basic skills of the 21st century that students must master in this century. This research uses a quasi-experimental method with a non-equivalent design. The population of this research is students of favorite Islamic private elementary schools in Mojokerto. This research concludes that blended learning is able to replace face-to-face learning and is able to influence students' cognitive attainment.

1. Introduction

Globalization is an era where relations between countries are no longer limited by distance and time. So that relations between countries can influence each other quickly. In fact, conflicts or problems that occur in one country can also affect other countries immediately. For example, countries that are members of ASEAN have inaugurated the ASEAN Economic Community (AEC) in early 2016 as a form of opening a free market in the Southeast Asian region so that capital, goods, services, and labor can freely flow into and out of the country abroad and vice versa so that they have better economic stability when China and India are building their respective economic strengths [1]. The problem as in this case is one of the impacts of globalization. This is in accordance with the description of Held et al [2] about globalization, namely (1) the breadth of the global network, (2) the intensity of global relationships or relations, (3) the speed or speed of global exchange/flow, and (4) the tendency of the impact of mutual global dependency/interconnectedness.

Education as the key to civilization, through which education human resources are prepared, must be responsive to the challenges that will be faced in the future. Therefore, P21 creates a framework of skills that must be mastered and supporting components to master these skills[3]. The skills consist of three skills and each skill has its own aspects, one of which is learning and innovation skills with 4Cs
(Critical thinking, Creativity, Collaboration, and Communication) as its aspects [4]. In one aspect of 4Cs, namely critical thinking, involves the cognitive ability to master these aspects so that the cognitive achievements of students also influence the achievement of mastery of critical thinking aspects [5]–[7]. Thus, the cognitive achievements of students after participating in learning must be considered.

In addition to the three skills mentioned by P21 in their framework, there are also four supporting components, one of which is the learning environment. The learning environment is everything that comes from external factors and can affect the implementation of learning[8]. Although the learning environment influences the implementation of learning, it doesn’t mean the implementation of learning depends on the learning environment. Because learning, when viewed as a system approach, is an interwoven input and output between learning components to achieve a goal called learning objectives [9], [10] and the learning environment functions as a supporting factor capable of helping to achieve learning objectives [4]. Therefore, the existence of a learning environment cannot be ignored.

Related to the learning environment, until now it is still an issue that blended learning is the next conventional learning. The reason why learning delivery patterns like this are predicted to be the next conventional learning is the rapid development of technology and blended learning that is able to combine the benefits of face-to-face learning with online. As for the advantages possessed by the blended learning system, namely (1) the choice of diverse types of learning resources so that students can learn according to their learning styles, (2) students can discuss with friends or teachers related to learning even though outside the classroom, (3) students can study outside face-to-face hours, but can still be controlled and managed by the teacher, (4) easily make improvements or add teaching material, material, or enrichment, and (5) students can share files with other students [11].

Responding to this, it is only natural to consider the use of blended learning as a pedagogical approach in schools in Indonesia in general. Because the education system in Indonesia refers to "complete learning", a study is needed in order to describe the completeness of learning when using blended learning as a pedagogical approach in formal schools. Based on these problems, this research is needed to describe the effect of blended learning on cognitive achievement and student learning completeness.

2. Formulation Problem

The problem formulation based on a background description can be simply illustrated as in Figure 1 below.

![Figure 1. Illustration of the problem of this research](image-url)
3. Research Objectives
This study aims to reveal: (1) the effect of blended learning on student 'cognitive level attainment, (2) the effect of face-to-face learning on student cognitive level attainment, (3) the effect of blended learning on student learning mastery, (4) the effect of face-to-face learning on student learning mastery, (5) the differences between groups of students taught blended learning and face-to-face learning on achievement of students' cognitive levels, and (6) the difference between groups of students taught blended learning and face-to-face learning on students' mastery learning.

4. Research Methods
This research is a quantitative research with a descriptive approach. The use of a descriptive approach is intended so that each research result in the form of processed data from the statistical analysis can be described and illustrated systematically, accurately, and credibly based on the facts, nature, and relationships between the events examined [12, p. 54].

This type of research is a quasi-experimental design with non-equivalent control group. The type and design of this study were deliberately chosen by the researcher based on several considerations, namely (1) samples for both classes, experimental class, and control class, randomization cannot be carried out considering the research subjects in each class have been arranged by the school and (2) researchers are not able to control for variables that are likely to influence the results of research [13, p. 265].

The research subjects used were from the population of fifth-grade students of favorite private Islamic elementary schools in Mojokerto in the 2019/2020 Academic Year. The population is determined based on the criteria of superior schools which include (1) talent and competence of students, (2) professionalism of teaching staff, (3) curriculum that has been escalated, and (4) good facilities and infrastructure [14]. Meanwhile, sample selection is done by using a purposive cluster random sampling technique because the researcher does not have the power to arrange the experimental and control groups so we get a test sample so that the test sample obtained a number of 2 study groups, namely class 5-B from Al Akbar Islamic Elementary School as an experimental group and class 5-A from Al Anwar Integrated Islamic Elementary School as a control group with each group consisting of 25 students.

The experimental group was treated in the form of blended learning and the control group was treated in the form of face-to-face learning. Both in the experimental class and the control class there are several variables that are controlled for their existence, such as learning strategies and the material being taught, so that it does not interfere with the results of the response variable.

As for measuring the response variable, researchers used a test instrument to measure students' cognitive achievement and the score sheet owned by the institution where the study was conducted to measure student learning completeness based on their indicators. Test instruments are arranged based on Bloom's cognitive level. The test instrument is given at the time before and after the treatment is given and then an increased analysis will be carried out using the Certainty Response Index (CRI) and the n-gain test which is then categorized according to the level of improvement.

5. Result and Discussion

5.1. Result
In this research, researchers obtained two results, namely the cognitive level attainment (CLA) and student learning mastery (SLM). The results of the CLA were obtained from the results of the researchers 'analysis of students' answers on the cognitive attainment test instrument using CRI and N-Gain. The description of the results of the CLA for blended learning and face-to-face can be described as in the Table 1.
Meanwhile, the results of the SLM are obtained from the teacher's assessment of student learning outcomes after participating in learning. The assessment is carried out by the class teacher using the assessment rubric owned by the class teacher.

### Table 1. Description of Research Results to Cognitive Levels Attainment

|                          | Pretest result (CLA) BL | Posttest result (CLA BL) | Pretest result (CLA F2F) | Posttest result (CLA F2F) |
|--------------------------|-------------------------|--------------------------|--------------------------|--------------------------|
| N Valid                  | 25                      | 25                       | 25                       | 25                       |
| Missing                  | 0                       | 0                        | 0                        | 0                        |
| Mean                     | 1.8000                  | 3.8800                   | 2.2400                   | 3.3200                   |
| Std. Error of Mean       | .17321                  | .38436                   | .19391                   | .29280                   |
| Median                   | 2.0000                  | 5.0000                   | 2.0000                   | 3.0000                   |
| Std. Deviation           | .86603                  | 1.92180                  | .96954                   | 1.46401                  |
| Variance                 | .750                    | 3.693                    | .940                     | 2.143                    |
| Skewness                 | 1.255                   | -.313                    | .368                     | .430                     |
| Std. Error of Skewness   | .464                    | .464                     | .464                     | .464                     |
| Kurtosis                 | 1.632                   | -.540                    | -.689                    | -.246                    |
| Std. Error of Kurtosis   | .902                    | .902                     | .902                     | .902                     |
| Range                    | 3.00                    | 5.00                     | 3.00                     | 5.00                     |
| Minimum                  | 1.00                    | 1.00                     | 1.00                     | 1.00                     |
| Maximum                  | 4.00                    | 6.00                     | 4.00                     | 6.00                     |
| Sum                      | 45.00                   | 97.00                    | 56.00                    | 83.00                    |

SLM only covers the value of students' skills in completing assignments given by the teacher. The description of the results of the SLM can be seen in the following table.

### Table 2. Description of Research Results to Student Learning Mastery

|                      | SLM for aspect 1 (Experiment) | SLM for aspect 2 (Experiment) | SLM for aspect 1 (Control) | SLM for aspect 2 (Control) |
|----------------------|-------------------------------|-------------------------------|----------------------------|----------------------------|
| N Valid              | 25                            | 25                            | 25                         | 25                         |
| Missing              | 0                             | 0                             | 0                          | 0                          |
| Mean                 | 89.2000                       | 85.8000                       | 87.0200                    | 83.0000                    |
| Std. Error of Mean   | 1.36748                       | 1.45945                       | 1.82608                    | 1.22474                    |
| Median               | 88.8000                       | 88.0000                       | 87.5000                    | 87.5000                    |
| Std. Deviation       | 6.83740                       | 7.29726                       | 9.13040                    | 6.12372                    |
| Variance             | 46.750                        | 53.250                        | 83.364                     | 37.500                     |
| Skewness             | .599                          | -.627                         | -.587                      | -.621                      |
| Std. Error of Skewness| .464                          | .464                          | .464                      | .464                      |
| Kurtosis             | -.751                         | -1.100                        | .885                       | -1.762                     |
| Std. Error of Kurtosis| .902                          | .902                          | .902                      | .902                      |
| Range                | 19.00                         | 19.00                         | 37.00                      | 12.50                     |
| Minimum              | 81.00                         | 75.00                         | 63.00                      | 75.00                      |
| Maximum              | 100.00                        | 94.00                         | 100.00                     | 87.50                     |
| Sum                  | 2230.00                       | 2145.00                       | 2175.50                    | 2075.00                    |

Based on the results obtained, the researcher has six hypotheses, namely (1) There is an effect of blended learning on the students' cognitive levels attainment, (2) there is an effect of face-to-face learning on cognitive level attainment, (3) there is an effect of blended learning on student learning
mastery, (4) there is an effect of face-to-face learning on student learning mastery, (5) there are differences in cognitive levels attainment between groups of students taught by blended learning and face-to-face, (6) there are differences in mastery learning between groups of students taught by blended learning and face-to-face, which must be tested for correctness. Therefore, researchers conducted several hypothesis tests and obtained results as shown in the following tables.

### Table 3. Wilcoxon Hypothesis Test Results for Determining the Effect of BL and F2F on CLA

|                      | Post-test CLA – Pre-test CLA for Experiment Group | Post-test CLA – Pre-test CLA for Control Group |
|----------------------|--------------------------------------------------|------------------------------------------------|
| Z                    | .000                                             | -.000                                          |
| Asymp. Sig. (2-tailed)| .000                                             | .000                                           |

b. Based on negative ranks.

### Table 4. Results of Hypothesis Test for Determining the Effect of BL and F2F on SLM

| Category | N | Observed Prop. | Test Prop. | \(X^2\) | df | Exact Sig. (2-tailed) |
|----------|---|----------------|------------|--------|----|-----------------------|
| SLM on Experiment Group | Aspect 1 | Group 1 | Exceeded | 25 | 1.00 | .50 | - | - | .000 |
|          | Total |                   |           | 25 | 1.00 |       |               |               |               |
|          | Aspect 2 | Group 1 | Reached | 7 | .28 | .50 | - | - | .043 |
|          | Group 2 | Exceeded | 18 | .72 |       |               |               |               |
|          | Total |                   |           | 25 | 1.00 |       |               |               |               |
| SLM on Control Group | Aspect 1 | Group 1 | Exceeded | 16 | .64 | .50 | - | - | .230 |
|          | Group 2 | Reached | 9 | .36 |       |               |               |               |
|          | Total |                   |           | 25 | 1.00 |       |               |               |               |
|          | Aspect 2 | Group 1 | Exceeded | 16 | .64 | .50 | - | - | .230 |
|          | Group 2 | Reached | 9 | .36 |       |               |               |               |
|          | Total |                   |           | 25 | 1.00 |       |               |               |               |

### Table 5. Mann-Whitney Hypothesis Test Results for CLA and SLM

| Category | CLA | SLM Aspect 1 | SLM Aspect 2 |
|----------|-----|--------------|--------------|
| Mann-Whitney U | 207.000 | 275.000 | 287.500 |
| Wilcoxon W | 532.000 | 600.000 | 612.500 |
| Z | -2.278 | -1.768 | -.600 |
| Asymp. Sig. (2-tailed) | .023 | .077 | .548 |

### 5.2. Discussion

Based on the hypothesis test that has been done, it is known that (1) there is an effect of blended learning on cognitive level attainment, (2) there is an effect of face-to-face learning on cognitive level attainment, (3) there is an effect of blended learning on student learning mastery, (4) there is an effect of face-to-face learning on student learning mastery, (5) there is a difference on the achievement of students’ cognitive levels between groups of students taught blended learning and face-to-face learning, and (6) there is difference on learning mastery between groups of students taught blended learning and face-to-face. Therefore, the six results can be discussed as follows.

5.2.1. **How blended learning can affect students' cognitive level attainment and learning mastery.** As it is known that blended learning, is a pedagogical approach that is implemented into a learning delivery pattern that combines the benefits of face-to-face learning and online, has a variety of variants so that in its implementation can choose a pattern that suits the needs [15]. Blended learning (BL) or sometimes referred to as hybrid learning can simply be interpreted as a learning process that is delivered through multiple methods where both have been integrated and synergized with the aim of optimizing learning and skills training [16], [17]. This is also in line with the opinion of Staker et al [18, p. 5] through its definition that BL is a learning pattern that is no longer limited to space and time by integrating two learning methods. Besides having various variants, blended learning is also able to accommodate all forms of student learning characteristics/styles. So, if designed properly, it can
stimulate students to increase their learning activities and their efforts to explore and elaborate on the information they need [19], [20]. In addition, there is also the freedom and breadth given to students so that they are able to explore and elaborate on the information they need so as to be able to bring satisfaction to students where this is one of the advantages of blended learning [19], [20].

Besides being defined as the use of two learning delivery methods, BL is also interpreted as "combining instructional modalities" and "combining instructional methods" [21]. BL is meant as an effort to combine instructional modalities because the term BL has experienced an expansion so that it can cover a series of strategies and dimensions of learning including the delivery method [22]. BL can also be interpreted as an effort to combine instructional methods because in BL there are also pedagogical approaches (such as constructivism, behaviorism, cognitivism, etc.) [23], and focus on learning achievement goals so as to produce three types of methods, namely skills-driven learning, attitude-driven learning, and competency-driven learning [24]. This opinion is also supported by Dziuban et al which states that blended learning should be seen as a pedagogical approach that combines effectiveness and opportunities for class outreach with the possibility of active learning technologically enhanced from the online environment rather than the ratio of shipping modalities [25].

If reviewed based on learning theory, blended learning has the same spirit as learning theories based on constructivism. Constructivism analogizes knowledge as a building where the building is composed of blocks of knowledge so that the best learning is learning that is able to facilitate the needs of students to build their knowledge [26]–[28]. The blocks of knowledge are arranged through the process of equilibrium and disequilibrium which work simultaneously in working memory, then after the processing of these blocks of knowledge can be stored in long-term memory. In this section that makes blended learning an interesting pedagogical approach.

We can feel the blended learning clearly when we imagine students are a chef. As a chef, a student previously had basic knowledge about the ingredients he had stored in long-term memory. Then, when he receives new information about new food ingredients, they can rush to the pantry and look for these ingredients to reconfirm the information he just received. If the chef has an excessive curiosity, then he will not only stop until the confirmation but he will continue to do it by conducting trials to find matching ingredients that match the ingredients and can even create new flavors by using ingredients that have been prepared in a penny.

Another thing that can be the reason why blended learning can affect students’ cognitive level attainment because through the use of learning strategies, the process of identifying learning content to the selection of learning content delivery technology based on learning objectives, student needs, and student learning styles are able to influence the cognitive levels that students achieve real. This is indeed an important factor in learning design. If referring to the opinion that learning is a system put forward by Dick et al [9, pp. 1–2], student needs, learning objectives, student characteristics, learning content, and learning strategies are components of the learning system so that, as a system, if there are components that are not connected or synergized, to obtain the expected results will not run effectively or even cannot be fulfilled. Because the concept of the system itself explains that a system is a group of components that synergize and relate to achieving a goal [10, p. 2].

Besides being seen as a system, BL has two main components (the synchronous and asynchronous learning components) which are also able to affect students’ cognitive level attainment and learning mastery [29, p. 16]. Synchronous is a learning concept that every learning message is able to synchronize well without going through an intermediary (there is a direct interaction between the recipient and the sender) while asynchronous is learning whose transmission is mediated by learning media, such as learning videos, textbooks, slides, and so on. The integration of these two components determines the success of BL. The advantage of the presence of synchronous and asynchronous learning components in BL was also stated by Hew and Cheung [20] who also mentioned several other advantages, such as (1) BL can provide the flexibility needed by teachers/instructors and students, (2) BL can improve communication with students through computer-mediated communication tools such as asynchronous and synchronous communication technology, (3) BL can also reduce per-student
costs, and (4) BL can improve student learning outcomes. Based on this description, it is natural that by providing blended learning as a pedagogical approach is able to affect students' cognitive level attainment and learning mastery.

5.2.2. How face to face learning can affect students' cognitive level attainment and learning mastery. The most relevant thing to explain how face-to-face learning can influence the achievement of cognitive levels and student mastery learning, the problem-based learning model as a learning model for face-to-face learning. Problem-solving is a basic form of learning processes and human information that is developed through daily confrontations with various problems (Killen, 2009: 243). That is because humans are inseparable from routines that are always covered with various problems, both problems in the short term and problems in the long term.

Arends & Kilcher [30, p. 326] also believes that problem solving is a learning pattern that makes problems or situations in real life the basis for the development and implementation of learning. Learning patterns like this make the target or focus of learning shift from fulfilling the quantity of information to the development of thinking skills, training related to intellectual skills (such as providing direct experience through real or simulated situations), problem-solving, and independent learning training [31, p. 397]. Thus, the results of this learning pattern are expected so that students are able to organize themselves independently. This is in line with constructivism which also underlies the BL model. This can be seen from the instructional impact of this model. This learning model is designed to train the problem-solving process through a scientific approach and influence the way students obtain and process information so that students after learning to use this model are expected to be able to solve a problem scientifically and have a strong knowledge structure of the information obtained [32]. In addition, students are also expected to have soul and cooperative skills with peers and be able to communicate their opinions or ideas. So, it is natural that face-to-face learning is able to affect students' cognitive level attainment and learning mastery.

5.2.3. Why are there differences in students' cognitive level attainment between blended and face-to-face learning. Based on the results of the hypothesis test, namely the hypothesis test achievement of students' cognitive levels, the results obtained that there are differences between blended learning with face-to-face learning. As the researchers examined before, blended learning has the potential to train students to be able to reach higher cognitive levels. This is due to the vastness of students in exploring and elaborating various information or concepts contained on the internet, both information that has been prepared by the teacher or circulated in the search engine. The extent of this information search is one of the advantages of blended learning. Through exploration and elaboration activities of students towards a piece of information or concept that is able to fill the gap in students' initial knowledge. Thus, the information or concepts they receive when they receive face-to-face learning can become whole information or concept.

This view is appropriate when we refer to the constructivism learning theory. Constructivism learning theory analogizes knowledge as a building in which the building is composed of information or concepts. If there is an incomplete piece of information or concept, knowledge cannot be formed. Meanwhile, if the knowledge is still formed, then the building of knowledge is not considered a strong knowledge building. Therefore, the integrity of information or concepts received by students is one of the main things and affects the achievement of students' cognitive levels.

The influence of the integrity of information or concepts on the achievement of students' cognitive levels cannot be separated from the number of knowledge students have. The higher the knowledge possessed by students, the student has more initial capital to process all kinds of information he receives to be presented into an artifact (can be in the form of activities, papers, and creations). Of course, the initial capital of students in processing all types of information can further develop if the student's knowledge is also more complete and complete.

However, so that students' knowledge becomes more complete and complete, random exploration and elaboration can certainly make it difficult for students to build or complete their knowledge. If the
process of building knowledge is analogous to building a building that has been illustrated before, then a systematic step in building knowledge is also needed. This systematic step is presented in the form of a problem-based learning model. Thus, the existence of problem-based learning models is able to direct students in constructing their knowledge and ability to guide them in exploring and elaborating on the information or concepts they need.

As explained before, in solving problems there are two patterns that can be used, namely factor tree patterns and research patterns. One of these two patterns is used as a guide for students in exploring and elaborating information or concepts contained on the internet. In addition, these patterns can also stimulate students 'thinking patterns so that students' metacognitive abilities also develop.

Whereas face-to-face learning which is limited in the learning process in the room and can only be carried out if the teacher and students meet in one room has an impact on the limitations of students in exploring and elaborating information or concepts they receive. The only primary source of information they receive is from their teacher and student books as supporting learning resources and other learning resources prepared by the teacher. Students cannot access other learning resources so that the ability of students to explore and elaborate is only about the available learning resources. In addition, if students have time to explore and elaborate information or concepts that they have acquired outside of school, students need one basic skill so that they are able and willing to explore and elaborate information or concepts they have previously received independently. The basic skills, namely self-regulated learning skills. Therefore, it is only natural that there are differences in cognitive level attainment between blended learning and face-to-face learning.

5.2.4. Why is there no difference in student learning mastery between blended and face-to-face learning. Basically, blended learning and face-to-face learning are models of delivery of learning but with different methods. If face-to-face learning has synchronous delivery methods, then blended learning combines synchronous and asynchronous delivery methods. In addition, the characteristics of synchronous learning in face-to-face learning, that is, its implementation is carried out in a room where the teacher and students meet each other/face to face.

Mastery learning is a criterion or predicate given to students who are deemed to have met the minimum criteria. Each student is required to obtain minimum criteria achieved which means students have reached the minimum criteria. The criteria obtained are generally used as school evaluation material for students, for example, evaluation materials for grade promotion or graduation.

In this study, mastery learning actually aims to determine the feasibility of blended learning to be applied in schools. In order to be implemented in schools, at least learning completeness in blended learning has no difference with face-to-face learning. That is because of the standard implementation of learning to date, namely face-to-face learning. Thus, mastery learning obtained from face-to-face learning can be used as a benchmark for the feasibility of implementing blended learning in schools.

By making face-to-face learning a benchmark in assessing the implementation of blended learning in schools, the researcher can provide his assessment of blended learning. If viewed from the results of the hypothesis test about students' learning mastery, then blended learning can replace face-to-face learning in schools.

6. Conclusion
This research proves that blended learning which is predicted to be the next conventional learning can replace face-to-face learning as conventional learning and blended learning is also able to accommodate the fulfillment of 21st-century basic skills, in this case, the fulfillment of critical thinking aspects through cognitive levels attainment. So, schools that have the same facilities can implement blended learning as a substitute for face-to-face learning.

Based on the results of research and hypothesis testing obtained and the discussion that has been done, the researcher has the following conclusions; (1) blended learning is able to provide breadth to students to explore and elaborate any information or concepts, which have been previously owned or that they have received from the teacher when attending face-to-face learning so that blended learning
is able to influence the achievement of cognitive levels that can be achieved by students, (2) face-to-face learning with problem-based learning can help students to gain stronger knowledge because the problems taken are contextual so that face-to-face learning is able to influence the achievement of students' cognitive levels, (3) blended learning has several advantages including, namely being able to make students more active and learning more efficient so that making blended learning can affect student learning completeness, (4) face-to-face learning has the main advantage, that is, familiar among teachers and students, which makes the implementation of learning run without obstacles so that face-to-face learning is able to influence student learning completeness for certain aspects, (5) blended learning has advantages in terms of exploration and elaboration activities that can be done by students, but still under the supervision of the teacher when compared to face-to-face learning that exploration and elaboration activities can only be done while at school so it can be seen that there are differences in the achievement of cognitive levels between groups of students who are taught with blended learning and face to face, (6) blended learning as a pedagogical approach also has the same effectiveness as face-to-face learning in terms of completing student learning completeness, so it can be seen that there is no difference in learning completeness between groups of students taught with blended learning and face-to-face.

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