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Teachers' Understanding of Blended Learning in Science Classroom

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ABSTRACT
The adoption of blended learning in this digital era is pervasive. The learning approach is considered as a solution to overcome the disadvantages of fully face-to-face and only learning. However, do science teachers have a sufficient level of understanding of blended learning in science classrooms? To provide an answer to the question, this current study involved 53 science teachers from 40 secondary schools in a particular region in Indonesia. All of the teachers have been implementing blended learning in their classrooms. Using a case study design, two data collection methods including a test and artifact analysis are implemented to explore the teachers' understanding of blended learning in science classrooms. The author-designed test consisted of 10 multiple choice questions which were distributed to participants using the online application. The teachers' teaching artifacts in the form of lesson plans were analyzed using a scoring rubric. All collected data were analyzed separately, then the results were compared and compiled to triangulate the findings. The research findings revealed the fact that most of the participating teachers had insufficient understanding of blended learning in science contexts. The level of understanding influenced teachers' teaching approach which was apparent in their lesson plans. The implications of the results of the current study are also discussed.

Keywords: *Teacher's understanding, Blended learning, Science classroom.*

1. INTRODUCTION

The COVID-19 outbreak has great impact on every aspect of life, including education. Online learning is deemed to be the best solution for teaching and learning during the pandemic situation, especially in Indonesia [1]. However, the implementation of online learning has caused various problems for students, teachers, and parents. The problems faced by students during online learning included difficulties in managing study time (38%), comprehending learning materials (30%), understanding teachers' instruction on assignments (21%), and lack assistance from teachers and parents (11%) [2].

In fact, the similar obstacles were also recorded in studies that focused on online learning [3] [4] [5]. Both teachers and students encountered at least four major challenges during teaching and learning using online mode [5]. The first is the inability to use technology. Technology is the main component of online learning, therefore, digital literacy becomes mandatory to be able to be involved in this kind of learning environment. Digital illiteracy influences students' learning by causing anxiety, minimum engagements [6], and cognitive load [7]. The second problem is the lack of students' ability to self-regulate. As students are commonly working individually during online learning, their self-regulated learning capability is found to be the most predictor of their continuous intention and motivation to learn in online mode [8]. The third is access to technology. Online learning is ineffective when the facilities and infrastructure provided by the government, schools, and parents for online learning are less supportive. Lastly, lack of assistance from both teachers and parents is another factor causing a problem in online learning, such as lowering students' engagement and motivation [4]. The minimal interaction between students and teachers and among students during the online mode of learning, furthermore, causes a negative impact on students' learning motivation [9].

Despite the aforementioned problems in online learning, the integration of technology in education cannot be avoided. Undeniably, technology provides tremendous opportunities to improve teaching and learning. For example, the use of a well-designed virtual laboratory serves to make research activities more accurate, explicit, and accessible compared to a physical

laboratory [10] [11]. Technology-mediated learning, such as e-learning, also allows flexibility for students to learn anytime and anywhere [12] [13]. Furthermore, the implementation of technology in teaching and learning will encourage both teachers and students to develop technological skills and digital literacy which are necessary for this digital era [12].

To respond to the challenges of online learning, current education research proposed blended learning as a solution [4] [5] [14]. As blended learning combines online and face-to-face learning experiences [12] [15] [16], teaching and learning can be improved using the power of technology without overlooking the role of humans [4]. The effectiveness of blended learning compared to conventional face-to-face and online modes of learning which are carried out separately are proven empirically [5] [14] [17]. It is possible because blended learning combines the strengths of both modes of learning. In general, the advantages of blended learning include enhancing student-teacher and student-student collaboration, interaction, learning flexibility, self-regulated learning, digital literacy, learning achievements [4] [12].

Blended learning has been implemented in Indonesia at various levels of education. For example, blended learning is found to be effective to improve undergraduates' learning achievements and engagement [18] [19]. The similar results are also identified at senior high school [20], junior high school [21], and elementary levels [22]. Students' communication, critical thinking, and creative thinking also improved when blended learning was implemented [23] [24] [25]. In contrast, 75 students from three higher institutions in Indonesia indicated their preference for face-to-face activities compared to the online mode of blended learning [26]. Those students found that online learning was problematic. Furthermore, Muis and Bahri [27] also revealed a fact that students are only given the tasks of finding information via the internet during the learning that they recognized as blended learning. It is understandable because many teachers may not have correct conceptions about blended learning [28] [29]. This is reasonable because the definition of blended learning presented in many studies also varies [16] [30] [31]. However, teachers' incorrect conception will affect the planning and implementation of blended learning in a classroom which in turn hinders the advantages of this promising learning.

Despite the importance of teachers' conception of blended learning, there has been little empirical research that focuses on this topic for Indonesian contexts. Most of the existing published articles on blended learning using Indonesian contexts emphasize the effectiveness of this kind of learning on students' achievements where the researchers are the learning designers. Therefore, this study investigated teachers' understanding of blended learning, especially in science classrooms where the scientific approach is a mandate of the 2013 Curriculum. By focusing on this topic, these research findings are expected to be able to contribute to improving the teaching and learning of science.

2. METHODS

This research was conducted by involving 53 science teachers from 40 secondary schools in a particular region in East Java, Indonesia. The ages of these teachers were ranging from 20 to 55 years when participating in this study. These teachers were selected for this study because all of them have implemented blended learning in their schools.

A case study design was applied in this study to investigate teachers' understanding of blended learning in science classrooms. Two data collection methods including a test and artifact analysis were implemented to collect relevant information. The author-designed test consisted of 10 multiple-choice questions which can be divided into three main categories including general conceptions of blended learning, general conceptions of scientific approach, and implementation of blended learning in science contexts. The test was created in the form of a Google Form and administered to the participating teachers through an online platform, Whatsapp Group. In addition to the test, teachers' lesson plans which implemented blended learning were collected and analyzed as artifacts of their understanding of blended learning in science classrooms. The analysis of teachers' lesson plans was conducted using a scoring rubric proposed by Perris and Mohee [32]. The rubric being used was focused on instructional design only because the assessment was conducted only on teachers' lesson plans..

Using the aforementioned data collection methods, both quantitative and qualitative information were collected in this study. The quantitative data were generated from teachers' scores on the test, whereas the artifact analysis provided qualitative information on the topic being investigated. The analysis of both types of data was conducted separately. Simple descriptive statistics including means and percentages were used to analyze the quantitative data, whereas the qualitative information was explored using a content analysis strategy. However, the analysis results were then compared and compiled to triangulate research findings [33] [34].

3. RESULTS AND DISCUSSION

In this section, the results of both the quantitative and qualitative data analysis are presented in sequence. The discussions of the research findings are presented in separate subsections for easy reading.

3.1. Results

This study used a test to explore teachers' general understanding of blended learning in science classrooms. The results of the test were tabulated and the percentages of the teachers' responses on the test items were calculated. Table 1 shows the distribution of the participants' response on each item of the test.

Table 1. Percentage of teachers' responses on the test (N=53)

Category	Test Item	Percentage of responses on each option (%)			
		Option A	Option B	Option C	Option D
Conception of blended learning	1	32.1	15.1	45.3*	7.5
	2	39.6	34.0*	17.0	9.4
	3	24.5	41.5	11.3	22.6*
	4	26.4	22.6	32.1	18.9*
	5	30.2	24.5	30.2*	15.1
	6	15.1	11.3	26.4	47.2*
Conception of scientific approach	7	22.6	7.5	56.6*	13.2
	8	20.8	45.3	30.2*	3.8
Implementation of blended learning in science contexts	9	41.5*	24.5	15.1	18.9
	10	13.2	49.1*	13.2	24.5

Note: star symbol (*) indicates the correct option.

The data reveals that almost half of the participants had a good understanding of blended learning in the science classroom, whereas the rest constructed inappropriate conceptions of this learning environment. For item 1, as an example, 45.3% of respondents chose to watch online tutorials at home followed by classroom discussions to describe blended learning. However, 32. 1% of the teachers simply defined blended learning as the use of electronic learning resources in classrooms. The teachers' conception is supported by their responses to item 2 which asks about the benefit of blended learning compared to conventional face-to-face learning. While 34% of respondents selected the correct option that blended learning improves students' independence learning, 39.6% of the participants focused on the technological skills and literacy as the core advantage of blended learning. Another teachers' inappropriate conception is apparent when they answered Item 3 which compared the benefit of blended learning and fully online learning. Almost half of the teachers selected the option which mentioned that blended learning increases students' independence learning better than the full online environment. Furthermore, the teacher's response to Item 5 which asks about an example of a non-blended learning activity is evidence of their limited understanding of the models of blended learning. As shown in Table 1, 30.2% of the teachers selected option A which mentioned that synchronous and asynchronous activities cannot be considered as blended learning. However, their knowledge about the platforms of blended learning is sufficient as indicated by their response to Item 6.

In contrast, the teachers' understanding of the scientific approach and the blended learning in science contexts is sufficient. As shown in Table 1 for Item 7, more than half of the respondents understood the main characteristic of the scientific approach for science learning. However, their knowledge of learning models is insufficient as indicated by the results of Item 8. In terms of the implementation of blended learning in science contexts, the results of Items 9 and 10 show that most of the teachers had a sufficient understanding of designing blended learning for different learning materials.

In addition to the test, the teachers' understanding of blended learning in science classrooms was explored using their created lesson plans as artifacts. The assessment results of the artifacts using the scoring rubric proposed by Perris and Mohee [32] are presented in Figure 1.

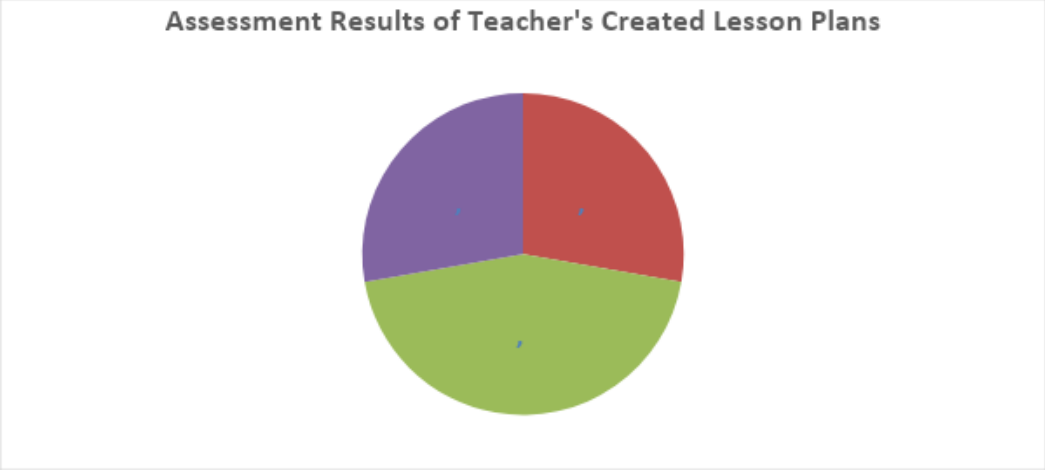

Figure 1 The analysis results of teachers' lesson plans in science classrooms with blended learning.

Figure 1 shows that most of the lesson plans created by the participating teachers are classified as need improvement categories. It means that the instructional designs which are presented in the lesson plans did not fully meet components of blended learning for science classrooms. For example, one teacher-designed learning activities for face-to-face and online modes of learning. The face-to-face activities were designed using a scientific approach and relevant to the learning materials. However, the online activities were not clear and consisted only of chatting and sharing links of resources among students using an online platform. In another case, the design of learning activities between face-to-face and online modes of learning were overlapping. However, the learning activities had implemented a scientific approach.

In addition to the need improvement category, the participating teachers also designed lesson plans which were categorized as satisfactory. The satisfactory lesson plans met almost all requirements of blended learning for science contexts. However, the selection of one or two learning objectives may be inappropriate. In another case, the satisfactory lesson plans may show a learning activity that was oriented to literacy instead of experiential learning.

In contrast, as presented in Figure 1, 28% of the lesson plans are categorized as not appropriate. These lesson plans were classified in the category for three reasons. Firstly, the lesson plans do not indicate any learning activities in face-to-face or online modes. Secondly, the learning activities mentioned in the lesson plans are more likely to be technology integration instead of blended learning. Lastly, the lesson plans do not show any use of technology.

3.2. Discussion

The research findings which are elaborated in the preceding subsection indicate that most of the participating science teachers in this study had insufficient understanding of blended learning in science classrooms. This fact is supported by both quantitative and qualitative data. The phenomenon was also revealed by Syarifah and Handayani [29] when conducting a survey involving elementary school teachers in Indonesia. As reported by the authors, 56.6% of the teachers mentioned that they have no idea about blended learning, whereas the rest proposed various definitions of blended learning. Furthermore, the teachers' explanation about the implementation of blended learning is more directed to technology integration instead of a combination of face-to-face and online learning. Similarly, Muis and Bahri [27] found that in a particular school in Indonesia blended learning was implemented by combining conventional teaching and activities of finding information via the internet.

As recorded in this study, the participating teachers constructed various conceptions of blended learning. This finding is in line with the results of other relevant research investigations [29] [35]. This fact is understandable because explanations about blended learning which are found in many studies and literature vary [16] [30] [31] [36]. Based on a critical analysis, for example, Oliver and Trigwell [36] found that blended learning can be defined as a mix of different kinds of things, such as online and face-to-face learning, media, contexts, theories of learning, learning objectives, and pedagogics. However, the most influential definition of blended learning has two key ingredients, face-to-face and online learning [16] [31]. This simple definition may be interpreted differently by different people leading to abroad conceptions of blended learning. The implementation of technology-mediated learning may be simply a case of technology integration instead of blended learning when online learning, the opportunity of independent learning, and online interactions are minimal [12]. Therefore, a clear and careful definition of blended learning is necessary as a reference for teachers

to construct a correct conception before implementing this type of learning.

The findings of this study also indicate that the participating teachers had insufficient pedagogical knowledge of blended learning as reflected in their created lesson plans. Although almost half of the respondents showed a good understanding of the scientific approach as indicated in the test, the design of learning activities in their lesson plans revealed the opposite facts. A similar finding is apparent in a study which was conducted by Bliuc, et al. [35]. The authors identified that some teachers focused on the technicalities of blended learning rather than learner-centered activities. Although the technological component is critical for blended learning, the pedagogical aspect cannot be overlooked. Without pedagogical knowledge, blended learning design cannot support the expected learning objectives [12] [37]. For example, Setyaningsih [26] reported students' preference for face-to-face mode over online activities because the teaching practices were unchanged despite the change of the modes of learning. Furthermore, blended learning in science classrooms is effective when students are involved in inquiry-based learning [12] [25] [38] [39].

This study also identified the relationship between teachers' conception and the design of lesson plans of blended learning. The teachers who had a conception that blended learning focuses on technology tended to design learning activities that are more likely to simply technology integration. Similar findings are also reported by Bliuc, et al. [35] which involve teachers from vocational education in New South Wales. The association of teachers' conception and their teaching approach is also evident in the study which is conducted by Ladachart [40]. It is understandable because conception influences and provides an orientation to teachers in adopting a particular teaching approach [41]. Moreover, the teachers' conception may also influence personal belief which in turn guides their pedagogical orientation [40].

4. CONCLUSION

Blended learning is considered a promising strategy for improving teaching and learning in this digital era. However, the quantitative and qualitative data collected in this study using a test and artifact analysis revealed that most participating science teachers had insufficient understanding of blended learning in science contexts. The teachers' level of understanding influenced the teaching approach that they selected. In this study, the teachers' selected teaching approach was analyzed through their created lesson plan. Based on the research findings, we suggest that the participating teachers are involved in Teacher Professional Development Programs that focus on blended learning for science classrooms. The knowledge and training that the teachers received will help to reshape their conceptions and understanding of blended learning which will affect their teaching approach. In addition, researchers and practitioners are necessary to provide a clear and detailed description of blended learning being implemented to avoid teachers' misconceptions when using blended learning in their classrooms.

AUTHORS CONTRIBUTION

All authors conceived and designed this study. All authors contributed to the process of revising the manuscript, and at the end all authors have approved the final version of this manuscript.

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