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The Role of Problem Formulation in Problem-Based Learning to Improve the Students' Curiosity

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Abstract
Not many researchers report how to anticipate learning during the new normal, even though students are used to learning online, and it becomes a new challenge if they have to learn face-to-face after the pandemic ends. This article discusses PBL strategies integrated into blended learning (BL) as a solution in the new normal era to develop 21st-century skills, namely with the foundation of curiosity. This study aims to reveal the role of problem formulation in the PBL model in a blended learning framework to grow curiosity. The subjects of this study consisted of students of SMA Negeri 1 Metro and students of Physics education FKIP UM Metro. The research includes two stages, stage 1, the role of problem formulation in Physics subjects at SMA Negeri 1 Metro, to gain good experience in applying PBL, which is then applied to lectures in Higher Education, as stage 2. Data collection is carried out with documentation instruments, observations, and interviews. Data processing is carried out qualitatively based on observation through the involvement of researchers as participant observants—data analysis, including tabulation, classification, description, and interpretation to make conclusions. The results show that current learning needs to take advantage of online learning channels. The formulation of the PBL problem largely determines the occurrence of the learning process. The formulation of problems related to the application of technology is more exciting and can grow curiosity more optimally. So, it is recommended that design learning must facilitate the use of learning channels available online. The formulation of problems in PBL must be designed appropriately. It should be related to the application of technology so that the learning process runs well and can grow student curiosity.

Keywords: Blended Learning, Curiosity, PBL, Problem Formulation

1. Introduction

1.1. Identified problem

Many researchers report results related to PBL in learning in various fields of study and at various levels of schools (K-12) and universities (PT). In general, however, few discuss the formulation of the problem in PBL syntax and its effect on learners' curiosity. Search results in *Google Trends* generated a description as follows:

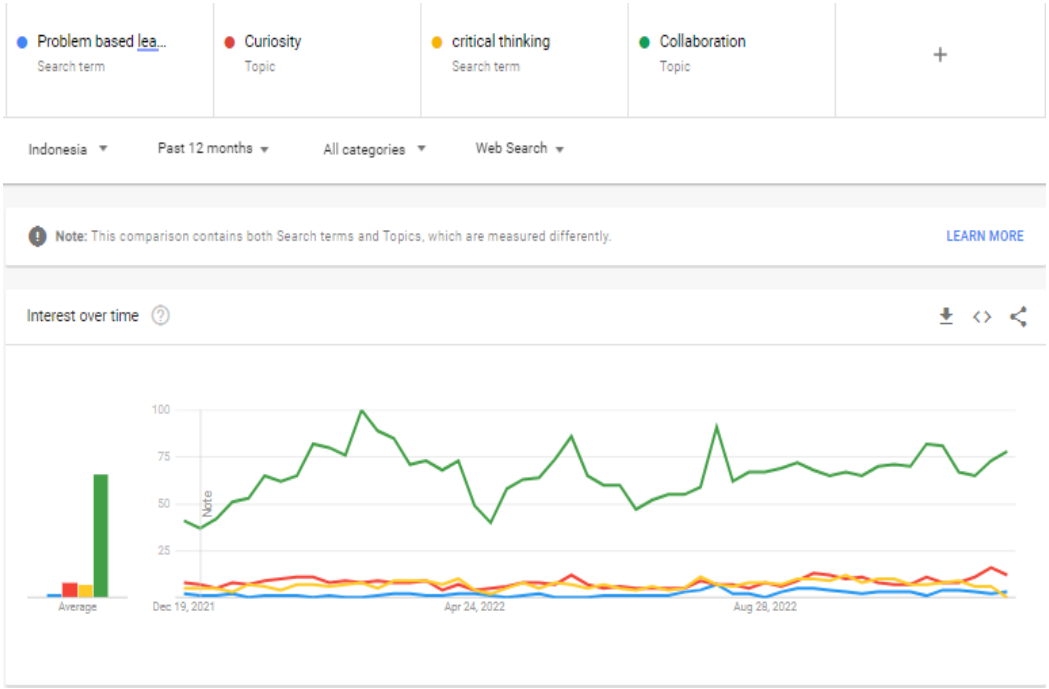


Figure 1: Google Trends Report
(https://trends.google.com/trends/explore?)

The picture shows a clear description that the PBL model is more dominant in collaboration, while critical thinking and curiosity intersect. It means that the gap in research in this field is still very high, so researchers are interested in researching this variable. Therefore, *this study aims to reveal the role of problem formulation in the PBL model in the blended learning framework to grow curiosity.* Previous research (Chen et al.,2017) produced findings, namely (1) sentence type classification can improve the performance of sentence-level sentiment analysis; (2) the proposed approach achieves state-of-the-art results on several benchmarking datasets (p.221). Similarly, the subjects and models of analysis and research contacts are different. Chen et al. (2017) studied more about analyzing sentence formulations in a context outside the subject of Physics.

The *COVID-19* pandemic has resulted in all activities being unable to run as they should, including the field of education. The learning process in the classroom cannot be carried out freely. As a consequence, (Ciotti et al., 2020; Daniel, 2020; Pfefferbaum & North, 2020; Watkins, 2020; Kogan et al., 2020; Toquero, 2020) the *COVID-19* pandemic has forced schools to conduct online learning. However, online learning is a new challenge for educators and is the best choice to prevent the transmission (Chick et al., 2020; Ferdig et al., 2020;Astini, 2020; Liguori & Winkler, 2020) of *covid-19* (Handarini & Wulandari, 2020). While still providing meaningful learning for students even though it is becoming the new normal, especially with the availability of technology based on Industrial revolution 4.0 and even 5.0 (Goddess, 2020; Jayul & Irwanto, 2020; Suseno et al., 2021).

As the *COVID-19* pandemic began to recede, learning was again held face-to-face in the classroom. However, it is certainly not easy because students have begun to get used to learning online, which has changed their learning patterns and habits. It can be concluded that (Sugiarto, 2020; Habibi, 2020; Turmudi & Ratini, 2022) *post-covid-19* pandemic habits are certainly not the same as before. Therefore, new learning strategies are needed (Widiantari, 2020; Indrawati, 2020), for example, by changing methods, models, and media (3M) or even changing the learning system to produce excellent and meaningful learning (Gusti, 2020).

Apart from *Covid-19, the Industrial Revolution* 4.0 (IR-4.0) has also caused problems of millennial disruption in the 21st century. One of the disruptions is that students' mindsets and learning patterns have significantly changed. The memory capacity of his brain is helped by (Saad et al., 2018) *cyber memory*, whose capacity is much larger and more accessible. So, human knowledge is not only what has been learned but also what has not been learned. Even humans can search for it through (Suseno et al., 2019), *the big-data* facility stored in cyberspace (Sagiroglu & Sinanc, 2013). Primary if it is associated with the 21st century, where the characters multitask, *multimedia*,

online social networking, online information searching, and game online (Kurniawan, 2019). All this also impacts the implementation of learning, objectives, strategies, methods, and approaches to learning. Therefore, educators must make changes to prepare a resilient generation with global competitiveness (Sedana, 2019).

The development of technology has also disrupted the field of education. The learning process is no longer a monopoly of educational institutions and teachers/lecturers. Many scholars (Siahaan, 2019; Suseno & Riswanto, 2020), suggest that *learning channels* replace sources of knowledge in the classroom, both in the form of information, animation, tutorials, even *Artificial Intelligence (AI), Augmented Reality (AR)* and so forth (Kibria et al., 2018).

1.2.Literature Review

The spirit of IR-4 and IR-5 has provided a variety of online-based technology features (Keshavarz & Ghoneim, 2021). Therefore, *online* learning uses zoom meetings, Google meet, moodle, Schoology, google classroom, teacher's room, and other social media. *Google makes* it easier for teachers and students to learn during the pandemic because they do not need to download the application, thus reducing storage space on *smartphones* (Haryani, 2020). *Google meet* can be used as a live learning solution via video conferencing. *Google classroom facility* is an application that allows the creation of virtual classrooms, facilitating interaction between lecturers and students online (Wijayanto et al., 2021). *Google Classroom* makes it easier for teachers to manage learning and convey information precisely and accurately, as well as a medium for assignments without using paper (Sutrisna, 2018). With the availability of online-based technology, it is feasible for educators to design learning that benefits all stakeholders in the world of education (Judge, 2016; Gunawan & Sunarman, 2017).

Beyond millennial disruption, the need for competence has also experienced disruption, where many professions are lost and replaced with new professions (Hartati, 2020). *The* 21st Century Skills Set needed critical thinking and problem solving, collaboration, agility & adaptability, initiative & entrepreneurship, assessing & analyzing information, communication, curiosity, and imagination (Rotherham & Willingham, 2010). A high order of thinking (*HOTs)* to face the era of disruption is a solution so that students are trained to think critically (Primary & Pramesti, 2018). In fact, learning objectives essentially include cognitive, affective, and psychomotor aspects. Therefore, the learning (Mazarno & Kendall, 2017) content of the 21st century includes learning and thinking skills, ICT literacy, and *life skills* (Winaryati, 2018).

The curiosity aspect is fundamental to the various capabilities needed in the digital century. Curiosity is an attitude to know and continue to find out about a problem (Harianja, 2020). Curiosity is a significant profit in developing knowledge and skills, and even (Dyche & Zayas, 1995) *the Agility mindset* is greatly influenced by curiosity. Further, curiosity is an essential component in developing an agility mindset. It means that (Storme et al. 2020; Müceldili et al. 2020) *curiosity* is beneficial for developing an agility mindset (Ulrich & Yeung, 2019).

Competencies are needed to build various competencies in the 21st century, so growing *curiosity becomes very important*. Curiosity can be obtained, one of which is by using *Problem-Based Learning (PBL)* or problem-based learning. Basically, *PBL* emphasizes learning as a process of problem-solving and critical thinking in an actual context (Khoiriyah et al., 2018). *PBL* provides opportunities for students to learn a broader range of things focused on preparing students to become active and responsible citizens. The learning patterns of students familiar with online learning and the number of learning channels (Glazer, 2001) that can be accessed online also need to be considered in designing learning. Based on the description above, this paper reveals an important part: developing student *curiosity* in *blended* learning mode through sentence selection in *problem-based learning* (Harianja, 2020).

To empower all the potentials and facilities available both offline and online, it is necessary to apply learning with various modes that combine online and offline learning by utilizing various learning channels in the form of writing, images, animations, and others called *blended learning* (Hockly, 2018).

1.3. Research question

Considering the empirical and theoretical studies above, researchers emphasize that this research is expected to contribute science to science. Therefore, the formulation of the problem is structured as follows:

1. What is the role of the *PBL model problem formulation in the blended learning framework to grow curiosity in stage 1?*
2. What is the role of the *PBL model problem formulation in the blended learning framework to grow curiosity in stage 2?*

2. Research Methods

2.1. Research Design

The study is a descriptive qualitative to describe students' responses to sentence formulation forms in problem-based learning. This type of research uses data in the form of documents and the results of observations on the implementation of learning related to teacher/lecturer statements and student responses when presented with problems expressed by teachers or lecturers in learning (Creswell, 2012).

2.2. Participants

This study involved 186 students of SMAN1 state high school students. All samples were taken from a Physics class of 67 men and 109 women. Learner data can be seen in the following table.

Table 1 Data of selected participants

K-Classes	Males	Females	Total
X IPA 3	8	26	34
XI IPA 6	19	15	34
XII IPA 2	18	18	34
XII IPA 6	9	27	36
XII IPA 7	13	23	36
Total	67	109	176

2.3. Instruments

In this study, the researcher served as the main instrument. However, in taking research data, it uses three auxiliary instruments: documentation review, direct observation, and structured interviews. Researchers took secondary documents from all Physics Teachers at SMAN 1 Metro, and researchers took secondary data by observing directly in the class that carried out PBL in the Physics class. In addition to the secondary data of observation, the researchers also interviewed physics teachers at SMAN1 Metro City.

2.4. Data collecting technique

The data were taken by observation and retrieval in two stages—the first stage of taking data from physics learning activities at SMA Negeri 1 Metro, which uses PBL. Researchers observe learning related to problems posed by teachers and student responses in the form of written and verbal expressions, as well as data on images, gestures, and other data related to student activities when responding to problems expressed by teachers in PBL. In addition, data were obtained from learning activity documents using google meet (Mirhosseini, 2020), *google classroom*, and *WhatsApp groups*, as well as the results of observations and reflections on *lesson study (LS)* activities (Seleznyov, 2018).

Phase 1 research was carried out in physics subjects at SMA Negeri 1 Metro. Five physics teachers at SMA Negeri 1 Metro with relevant education have been certified. Learning is carried out online. Online mode learning at SMA Negeri 1 Metro has been carried out since March 2020 until this partnership program activity was implemented. The second stage is the implementation of PBL in the UM Metro physics education study program in the quantum physics course, which is designed based on the findings of phase 1 research in partner schools related to sentences

used in PBL. In the implementation, observation and data collection are carried out in stage 1 and coupled with questionnaires given to students participating in quantum physics courses. Based on these data, an analysis is carried out through description and interpretation to obtain conclusions.

2.5. Data Analysis Techniques

Researchers analyzed problem sentences (in Indonesian) used in PBL learning to be grouped according to their type and shape. Then the researchers analyzed the effect of the problem sentence on student responses in the form of individual physical activity and student learning interactions. Analysis of student responses in this study focused on the (Turmudi, 2020) *curiosity* of learners. The *curiosity* in this study includes four aspects, namely (1) paying attention, (2) responding to questions, (3) asking follow-up questions, and (4) looking for further information/others from various ways. The curiosity level is set by the researcher as follows:

1. Level 4, if all four aspects are implemented;
2. Level 3, if aspects (1), (2), and (3) are implemented;
3. Level 2 if aspects (1) and (2) are implemented;
4. and level 1 if only aspect (1) is implemented.

Based on the analysis results, the researcher carried out an interpretation to establish good sentences in PBL that could grow students *' curiosity levels*.

3. Results

The research seeks answers to the problem formulation, namely: what is the role of the PBL model problem formulation in the blended learning framework to grow curiosity in stage 1? and play a role of the formulation of the *PBL model problem in the framework of blended learning to grow curiosity in stage 2?*

3.1. Description of PBL Phase 1 Implementation Data

The results of the study of the RPP document (lesson plan) and class observations obtained online learning data using PBL there are three classes as follows:

Table 1. Problem Formulation Data and Online Mode PBL at Partner Schools

No	Teachers, Classes & Materials	Learning Modes and strategies	Raised issues
1.	GM.1 XI IPA 7 Dopler Effect	The online mode uses google meet, assisted by google classroom for materials and assignments. The media uses video, and discussions are carried out through google meet.	1. If a sound source moves, for example, the siren of an ambulance car from afar is heard when it gets closer to us. How is the frequency heard? Is it getting stronger or weaker? 2. Furthermore, what if ambulances move further and further away from us? How is the frequency of the sound heard? ***(Type 1)***
2.	GM.2 XI IPA2 Elasticity	Online mode using WA assisted by Google Classroom. Media using video, and discussion through class WAGs, google classroom materials, and assignments	What is an Elastic object? What are some examples of elastic objects? If there are two identical springs, specify the following: 1. Comparison of total K if arranged in series and parallels? 2. Change the length if given the same style. ***(Type 2)***
3.	GM.3 X IPA 3 Vector Summatio	The online mode uses WA group and google classroom. Media using video, and discussion	About the story: Three people participated in the race, pulling one pole (available pole/other style ignored) with three ropes. Tini pulled the rope towards the east in a force of 2 N.

	n of one field	through group and class WAGs and assignments through google classroom	Tina pulled the rope towards the north in a force of 4 N. Toni pulled the rope in a force of 6 N towards the south. a. Draw vector summation in polygon b. What is the resultant force of the three directions so that the pole collapses c. Where did the pole collapse? ***(Type 2)***
4.	GM.4 XII Static Electricity	The online mode uses WA and *google classrooms*, and the media uses video and discussion through WAG.	What do protons and electrons mean? Under what circumstances is an object said to be negatively or positively electrically charged? ***(Type 1)***
5	GM.5 XI Fluid	The online mode uses google meet, assisted by WA, for materials and assignments. Media uses real objects, as well as discussions through google meet.	If the bottle contains water, it is given a hole with an equal distance towards the vertical. When the three holes are opened, what is the length of the horizontal flow to the three holes? What is the relationship between the height of the pit from the ground and the horizontal flow length? Why would a higher-mounted water tower be better? ***(Type 3)***

3.2. Description of PBL Implementation Data Phase 2

Phase 2 research is carried out in quantum physics lectures in the UM Metro physics education study program. The learning design is prepared based on an analysis of problem-based learning obtained in schools, and learning is carried out through blended learning mode using the PBL approach. The data from the RPP design and class observations can be stated as follows:

Table 2: Problem Formulation Data and Online Mode PBL in Higher Education

No	Classes of Knowledge/ Materials	Learning Modes and approaches	Raised issues
1.	UM, Metro physics education 7th semester TA. 2021/2022 Atomic models in quantum physics review	Blended learning mode uses classes and zoom meetings, assisted by MFIs.	X/Rontgen rays result from the excitation of electrons from one particular sub-skin to another (outer). Therefore, for the calculations to get x-rays or x-rays to be more precise, we must know the correct/appropriate atomic model. Which atom model is more appropriate?

3.3. Learning Data Analysis Phase 1

3.3.1. Analysis of the online mode used

The analysis of the online mode used can be grouped into Mode 1 and Google Meet, assisted by Google Classroom. Mode 2, Google Meet, assisted by WA, and Mode 3, WA, assisted by Google Classroom. While the media used is relatively the same, namely videos and problem sheets. Based on the results of interviews and observations, the following notes were found:

Table 3: Online mode data used in phase 1 learning and student responses

No	Learning Modes and strategies	Student Response Percentage	Note

1.	Mode 1, online using google meet, assisted by google classroom.	The average student who responded was 8.3% of the total number of students	Answers are their ideas that are remembered. 95.2% completed the task.
2.	Mode 2, online using WA assisted by Google Classroom.	The average student who responded was 21.3% of the total number of students	Answers are obtained from browsing results when learning and from one's ideas. 100% completed the task
3	Online mode 3 uses google meet, assisted by WA.	The average student who responded was 16.7% of the total number of students	Answers are their ideas that are remembered or browsed before because LKS has been given before. 100% complete the task.

Table 3 shows that students responses are high due to the opportunity for students to browse to access learning *channels* in online facilities. When learning using google meet (*mode 1*), students focus on participating in online learning, so the opportunity to browse is less effort than in offline learning. In online learning mode 3, the student response was somewhat higher even though they used Google meet because the student' work sheet (LKS) had been given before, so students had time to browse. Whereas in mode 2, because there is no face-to-face between students and teachers, and the online application still allows students to browse, the student's response to the questions asked by the teacher is high. Therefore, a good experience that will be adopted in the design of learning in higher education is the provision of opportunities for students to access learning channels available in cyberspace.

3.3.2. Analysis of problem types used in problem-based learning

Analysis to classify the problems expressed in learning in stage 1, then the problems expressed by the teacher in learning can be grouped into three types, namely: ***Type 1***, problems related to daily activities around students; Type ***2,*** concepts related issues to be discussed; Type ***3***, problems related to the application of physics. The results of the analysis of the relationship between problem type and curiosity can be shown as shown in the following table:

Table 4: Data on problem types expressed in stage 1 learning and student responses

No	Raised issues	Student Response	Aspect/level of curiosity	Notes on the results of the reflection
1.	Type 1. problems related to daily activities around students	The average number of students who responded reached 9.7% of the number of students, with a response time lag after 2 minutes	(1) Watching (2) Responding to questions (3) someone asked	Online mode using WA assisted by google classroom has more interaction than using google meet assisted by google classroom.
2.	***Type 2,*** concepts related issues to be discussed;	The average student who responded reached 26.4% of the number of students, with a response time lag of 1 minute	(1) Watching (2) Responding to questions	The online mode uses WA group and google classrooms. Media using video and discussion through WAG, as well as materials and assignments through google classroom
3.	***Type 3***, problems related to the application of physics in technology	The average student who responded reached 16.7% of the number of students, with a response time lag after 1 minute	(1) Watching (2) Responding to questions (3) someone asked	The formulation of the presented problem is related to applying physics to technology, which is more interesting for students. In addition, students' answers and ideas are also more diverse

			(4) Looking for more information	

The analysis of the types of problems used in learning in partner schools) shows that in the formulation of the PBL problem type 3, namely the formulation of the problem presented related to the application of physics in technology, the percentage of student responses is more than type 1, although not as much as type 2. Likewise, with the time lag needed by students in responding to questions. However, the effect of the formulation of type 3 problems on curiosity levels is more significant than others. Therefore, this good experience will be used in designing learning in college in quantum physics courses.

3.4. Phase 2 Learning Data Analysis

Applying PBL Phase 2 in quantum physics lectures uses *blended* learning mode learning by choosing the formulation of problems according to type 3. The problems expressed are associated with applying physics to technology, according to Table 2. The expected target of learning outcomes is the growth of *a curiosity mindset* for students. Some of the data obtained are as follows:

Table 5: Data on the effect of the problem expressed on *curiosity*

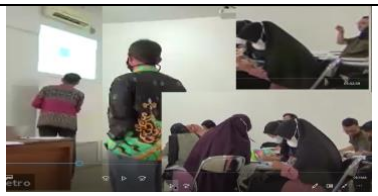
No	**Raised issues**	**Student Response as an aspect of curiosity**	**Student Activities**	**Document**
1.	X/Rontgen rays result from the excitation of electrons from one sub-skin to another. Therefore, for the calculation to get x-rays or Rontgen to be more precise, it must use a proper/appropriate atomic model. Which atom model is more appropriate?	Level 1 Pay attention 100%	(1) Watching (2) Reading MFIs	
		Level 2 Responding to Questions	(1) Browsing using Mobile (2) Discussion (3) Answering questions	
		Level 3 Ask	(1) Asking (2) Arguing (3) Comparing results	
		Level 4 Looking for More Information	Disclosing and questioning other matters related to further material.	• Asking about how x-rays impact our bodies • Linking the material to the Quran • After class hours are over, there are still students who ask about the relationship between the experimental spectrum and the spectrum of diffraction experiment results

Table 5 states that in the implementation of stage 2 learning in quantum physics lectures in the Physics education study program FKIP UM Metro, it was found that the curiosity of students reached level 4, namely paying attention, responding/answering questions, submitting questions and conveying ideas and trying to ask further questions and seek further information.

3.5. Discussion

This study seeks answers to whether the PBL model problem formulation in the blended learning framework is to grow curiosity in stage 1 and the role of the PBL model problem formulation in the *blended learning framework in growing curiosity in stage 2.*

The findings seen in terms of online mode applications can be grouped into three, namely 1). Google Meet assisted with Google classroom, 2). Google Meet is assisted with WA, and 3). WhatsApp is assisted with Google Classroom. Previous research reported how these three patterns were used.

The use of Google Meet (G-Meet) has also been done by researchers before (Turmudi & Ratini, 2022), although in different study other than physics. Moreover, assisted by Google classroom (G-Classroom), the results are very positive (Gunawan & Sunarman, 2017;Banat , 2020). The results show that Google Meet is favored by students because of the ease of this type of application although it is below the choice of students to use Zoom(Turmudi & Ratini, 2022). The use of G-Meet Technology is supported by the theory of the use of Technology (Hamidy, 2021; Andriani & Bram, 2022). Finally, the use of G-Meet is interpreted as a solution due to demands and needs. As a result, G-Meet is a theoretical and practical choice to strengthen student learning outcomes in physics classes.

As with using G-Meet individually, G-Meet assisted by WhatsApp becomes interesting because it complements each other. In the previous research, it was reported that G-Meet has advantages, namely Google Meets (G-Meet) Provides longer times (LT), Practical (P), Comfortable or Sophisticated (C/S), Accessible in poor signal (N), and Easiness to access (E/A) as reported (Turmudi & Ratini, 2022, p. 23). Meanwhile, WhatsApp is reported to positively affect learning achievement even in accounting studies at SMK (Noviana & Solichin., 2021). The findings also reported a positive and significant influence between the use of WhatsApp social media and the motivation for student learning in the Bogor district with student subjects in general (Sahid, 2020). Other researchers stated that WA positively impacted physics education assessment lectures (Khusaini et al., 2017). It means that both G-Meet and WA interact with each other to support successful learning. Therefore, both G-Meet and WA can still support any student's Physics learners.

WhatsApp, assisted by Google Classroom, has a hand in supporting student learning outputs. Previous researchers combined WA with Zoom, and the results were positive. However, if combined with Zoom's influence is better than the influence of WhatsApp (Kusuma & Hamidah, 2020). However, this study occurred in *Madrasah Aliyah Negeri* (MAN) in Mathematics subject. Other researchers reported in the University's level in the field of English with the conclusion that Zoom and WA, combined, produced a positive influence during the Covid-19 pandemic (Suadi, 2021). This result means that Zoom and WA media will have a simultaneous influence compared to if the two were separated. As a result, these media combinations can still be used occasionally during the New Normal.

In the phase 1 study, three types of problem formulations were obtained: ***Type 1***, problems related to daily activities around students; ***Type 2,*** concepts related issues to be discussed; ***Type 3***, problems related to applying physics. Admittedly it is not easy to compare with previous studies because the use of PBL is spread across different fields of study. For example, in the field of mathematics with variables of effectiveness and student ability in problem-solving with the PBL model (Rahayu et al., 2022). However, the most apparent regarding the previous reference is the opinion to classify opinionated sentences into three types according to the number of targets appearing in a sentence (Rahayu et al., 2022). Another example of the application of PBL is in EFL contact with the variable effectiveness of PBL in improving writing ability (Chen et al., 2017; Ilham, 2022). In theory, the above findings are supported by scholars (Allen et al., 2011). The three problems related to technology applications are more attractive to students. It is the opinion of Veselá et al., (2004) that the *Topic-Focus Articulation (TFA) is feasible, the perception of contextual boundness.* As a result, with these findings, PBL and blended learning have a positive role in the development of HOTs of student participants.

In the phase 2 study, it was found that students' curiosity reached level 4: paying attention, responding/answering questions, conveying ideas, and trying to ask further questions and seek further information. Research related to this matter precisely in the field of Physics does not exist, but if the positive meaning is widely reported in the field of Physics in Higher Education (Khusaini et al., 2017), in the field of mathematics studies with a combination of Zoom and WA (Suadi, 2021), in the field of Accounting in Vocational Schools (Kusuma & Hamidah, 2020; Noviana & Solichin., 2021), and ELT contact in Higher Education (Suadi, 2021). Simultaneously the application of PBL in this research is in line with previous findings (Riska et al., 2022). In addition, this finding is supported by a theory stating that whatever form technology has an essential role in students (Alabdulkareem, 2015; Tess, 2013). The result of positive influence applies even if it is not in the same field of Physics.

Student response is high because of the opportunity for students to browse to access learning *channels* in online facilities. In this context, previous research reported that higher education students were concerned about virtual interaction because most have more than one account on social media to interact with others (Oktavia et al., 2016). When learning using G-Meet (*mode 1*), students focus on participating in online learning, so the opportunity to browse is little. This data is reported in the results of research findings in research courses (Turmudi & Ratini, 2022). Students' sense of reasoning is reduced because online lectures do not stimulate students to surf the internet. In online learning mode 3, the student response was somewhat higher even though they used G-Meet because students' work sheet (LKS) had been given before, so students had time to browse. Previous research on the function of LKS has a role as a trigger for learning in high school (Amelia, 2013; Sari et al., 2015). Whereas in mode 2, because there is no face-to-face between students and teachers, and the online application still allows students to browse, the student's response to the questions asked by the teacher is high. This substance is believed to be positive, as previously reported by researchers regarding information from the internet (Komalasari, 2020; Priyono et al., 2015; Sasmita, 2020). Therefore, the excellent experience that will be adopted in learning design in higher education is providing opportunities for students to access learning channels available in cyberspace (Komalasari, 2020). As a result, the more problem formulations that prevent students from surfing the internet, the higher the browsing power of students to get sources from the internet.

Based on the analysis of problem types, it was found that in the formulation of type 3 PBL problems related to the application of physics in technology, the percentage of student responses was more than type 1, although not as much as type 2. These results support previous research on Curiosity (Chen et al., 2017). The suitability of these results is minimal when referring to the results point by point as the Google Trend search results report that collaboration is the most significant positive impact of PBL (Google Tends :https://trends.google.com/trends/explore, 2022), even if it is not in a physics course. It means that the positive influence of curiosity is a new contribution of empirical data and is theoretically valid (Ulrich & Yeung, 2019). Likewise, with the time lag needed by students in responding to questions. However, the effect of the formulation of type 3 problems on curiosity levels is more significant than others. As a result, based on empirical data, researchers deserve to continue learning PBL in quantum physics courses in higher education as part of scientific contributions in English (López-Navarro et al., 2015). Overall (as shown in table 5), the results of the implementation of stage 2 learning in quantum physics lectures in the FKIP UM Metro Physics education study program was promising. It was found that students' curiosity reached level 4, namely *paying attention, responding/answering questions, submitting questions and conveying ideas and trying to ask further questions and seek further information*. Above all, we have concluded that the overall combination of media positively affects curiosity and critical thinking.

3.6. Limitation

This study only found three problem formulations from observing the learning process in 5 classes from 18 classes at SMA Negeri 1 Metro. There may still be other types of problem formulations, so this is one of the limitations of this study. However, of the three types of problem formulation, problem formulation types related to the application of physics in technology can be used to increase student curiosity in problem-based learning.

4. Conclusions and Implications

4.1. Conclusion

Referring to the formulation of the problem and the description of the findings and discussion, the researcher concluded that several essential points had been generated from this study. First, students have become accustomed to looking for sources online, so learning needs to be facilitated to take advantage of various learning *channels* in cyberspace. Second, the formulation of problems in problem-based learning is decisive in triggering students' learning process. Third, the formulation of problems related to the application of physics in technology is more attractive to students and can foster *curiosity* more optimally. Fourth, the formulation of problems in PBL associated with technology can encourage students to pay attention, respond/answer problems, ask questions, and look for other information. They can also ask more about other things related to the material and look for and express other ideas related to the learning material.

4.2. Implications

Students learning patterns have changed due to the Covid-19 pandemic and the industrial revolution 4.0. Therefore, in making learning designs, it is necessary to provide space and time for students to take advantage of various *learning channels* that can be accessed online. In making a problem-based learning design, the formulation of the problem must be designed properly and precisely because it determines the learning process that will take place. In problem-based learning, you can use problem formulations associated with technology to make them more exciting and foster students' curiosity.

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