Improving Students' Reading Literacy During the Covid-19 Pandemic Using the PBL Model and According to the Pisa Context

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Abstract. Several research results show that the reading literacy of high school students is still low, especially during the Covid-19 pandemic. This is also shown by Indonesia's ranking in the Study Program for International Student Assessment (PISA) which is still at level 2 PISA. As an effort to improve it, a class action research has been conducted with the formulation of the problem, "Can the reading literacy of class VIII students be improved by using the 'problem based learning' (PBL) model and texts that are in accordance with the PISA context?" The research was carried out covering the stages of planning, implementation, assessment and observation, as well as reflection. The subjects of this study were students of class VIII.1 SMPN 4 Palembang. The data collection techniques used observations and tests. The analysis was carried out qualitatively and quantitatively. The study was conducted in 3 cycles in one semester with different text contexts according to the context PISA and using the PBL model. The results showed that during the learning process students were very active, responsible, creative, and disciplined. The results of each cycle showed an increase in the average score obtained by students. Initial average score: 56; after cycle 1:73; after cycle 2:80; and after cycle 3 the average score reached: 87. The increase in the average score is not only due to the application of an innovative model but also due to the more contextual context of the text. Practitioners are advised to use texts that are appropriate to the context of PISA in learning and practice, so that students are accustomed to working on PISA type questions.

Keywords: reading literacy · Covid-19 pandemic · PBL model · PISA connection

1 Introduction

Literacy is an important skill that every student must have. Literacy is not limited to cognitive abilities, but rather more complex abilities because it includes social, linguistic, and psychological aspects. In general, literacy means a person's competence to reason in a situation or context that contains reading or reasoning with language. Literacy skills are needed by students to be able to master other fields of science [1]. Literacy is not only the ability to read, but also the ability to analyze a reading and the ability

to understand the concepts behind writing. Etymologically, the term 'literacy' comes from the Latin 'literatus', which means 'one who learns'. In general, the meaning refers to a person's ability and skills in reading, writing, speaking, arithmetic, and solving problems in everyday life. So, literacy cannot be separated from one's language ability. The ability to think with language is needed in various contexts, both personal, social, and professional [2]. This shows that reading literacy skills are needed, along with the rapid development of existing technology.

Several research results show that the reading literacy of high school students is still low, especially during the Covid-19 pandemic. This is also shown by Indonesia's ranking in the Program for International Student Assessment (PISA) Study which is still at level 2 PISA. The latest PISA results in 2018 show the ability of Indonesian students in reading to score 371 out of an average of 500 countries in the world [3]. The Head of Balitbang and Books of the Ministry of Education and Culture Totok S stated that Indonesia's literacy rate based on PISA is still low [4]. Furthermore, he said, "Lastly, 2018 showed that 70 percent of our children were below the minimum competency level in reading, 71 percent in mathematics, and 60 percent in science, so the standard of student literacy level in Indonesia is still at level 2 PISA". Students at this level are only able to understand what is written, have not been able to interpret, read critically, conclude, and create. In [5] the Minister of Education and Culture said that the 2018 PISA results showed the perspective of education in Indonesia. From 7 times participating in the PISA survey (2000–2018), there are several things that need to be improved, one of which is literacy competence, literacy skills and the ability to understand reading in various levels of difficulty.

The low level of literacy is a fundamental problem that has a very broad impact on the progress of the nation because most of the skills and knowledge are obtained through reading activities. Skilled readers, able to read, understand, evaluate, and filter information, and can reap the benefits of reading resources. Low literacy contributes to the low productivity of the country, namely the amount of output produced by the country in a period. Low productivity will affect the level of welfare which is characterized by low income per capita, namely the level of income of all people in a country if it is evenly distributed. Low literacy also contributes significantly to poverty, unemployment and inequality. It is said [6], reading literacy is the ability to understand, use, and reflect on written reading to achieve goals as needed, develop knowledge and potential, and participate in society. Reading literacy skills need to be improved, because reading is one aspect of skills that can support written communication activities. Students must also master these skills, because they can help improve learning activities.

Many studies and activities have been carried out to improve students' reading literacy, such as Harsiati's research, in 2018, Alwi et al. in 2021; and several activities launched by the government, including: the National Literacy Movement and the School Literacy Movement, in [7] also announced that there are 11 literacy activities that students can do to improve their literacy. In this research, it tries to offer an effort to improve students' reading literacy during the Covid-19 period using an innovative model, namely PBL, and using text according to the context of PISA.

PBL was chosen considering that this model is included in one of the innovative and collaborative learning models, the model suggested in the 2013 curriculum and

independent learning curriculum by developing four aspects that are integrated into each other in learning, namely aspects of spiritual attitudes, social aspects, knowledge aspects, and skills aspects; this model is student oriented. The use of this model is supported by several learning theories, such as Vigotsky's theory [8], intellectual development in individuals can be formed when faced directly with new and challenging experiences when solving existing problems. The learning approach applied to this model is to use real-world problems as a context for students to learn about critical thinking and problem-solving skills, as well as to acquire essential knowledge and concepts from the subject matter, especially the Indonesian language. The approach used is a scientific approach using a themed learning system that links several subjects in one lesson. There are various subjects that must be taken by students, one of which is Indonesian. Learning Indonesian is no less important than other learning. Indonesian is a tool to convey or communicate ideas, opinions and so on so that the intended meaning can be conveyed.

In addition to applying the steps according to the PBL model with a scientific approach, the text used was also selected according to the PISA context. Related to the context, the pandemic period, crises and changes occur which are examples of interesting and global contexts/real situations because they have an impact on all aspects of life including the learning process [9]. In addition, the various variants of the Covid-19 virus have become a problem and affect all aspects of life, including the student learning process. Various crises and changing effects of the pandemic are examples of global contexts and real phenomena that are close to students. This context can be used to invite students to think in solving problems. Correspondingly, this uncertainty situation can be used as learning material to be resolved. As mentioned in [10], teachers should take advantage of learning opportunities from this pandemic to improve students' competencies and life skills. One of the content tested concerns the language of reading literacy, namely informational texts and literature. Its competence includes three levels, namely understanding, application, and reasoning, according to 21st century skills that require higher-order thinking, critical thinking, and problem solving, collaboration in networks or communities, agility (fast learning) and adaptability (flexible), communication (effective communication).) using reasoning or reasoning in the form of argumentation and justification), initiative and entrepreneurial, accessing and analyzing information, curiosity and imagination, as well as ICT literacy skills [11]. By selecting the text according to the context of PISA, it is hoped that it can improve students' reading literacy.

In connection with the above problems, the formulation of the problem in this study is, "Is the application of the PBL model with texts in the PISA context able to increase the reading literacy of grade VIII students during the covid-19 period?" The aim is to obtain a PBL learning model with PISA context-based texts that can improve the reading literacy of class VIII students during the covid-19 period and to find out whether the reading literacy of class VIII students during the covid-19 period can be increased by the implementation of the PBL model and texts in the PISA context. By applying the PBL model in learning to understand the content of the text, it is hoped that the difficulties experienced by students can be minimized and the ability of students to conclude, reflect, reason, and recreate the contents of the text can increase accompanied by changes in attitudes for the better. The results are expected to be useful for practitioners in the field

to apply the designed model and be able to improve students' reading literacy. The results of this study are expected to help practitioners in overcoming these problems.

2 Method

The method used is classroom action research (CAR). In [12] stated, action research is a systematic study carried out in an effort to improve practices in education by carrying out practical actions and reflections from these actions. The process of implementing this action research as a series of continuous cycles. Determination of how many cycles are based on the results of the initial cycle and the next cycle according to the criteria/indicators of success. Each cycle consists of four stages, namely: (1) planning, (2) implementation, (3) observation and assessment, and (4) reflection. CAR is a type of research that allows practitioners to become researchers in their own place, researchers can intervene in an action or activity to overcome real problems experienced in the real world (Fig. 1).

The research subjects were students of class VIII.1 of SMP Negeri 4 Palembang, totaling 40 people. The implementation procedure is recycling, lasting 3 cycles in one semester, with different text contexts according to the PISA context and using the PBL model. Each cycle consists of 4 stages, namely: planning, implementation, monitoring, assessment and reflection (reflection), according to the theory of I Kemmis and Mc Taggart, in [13]. The research was conducted with initial/pre-cycle activities, preliminary tests and observations were carried out. After getting the pre-cycle results, the researcher designed a study to improve students' reading literacy skills using PBL models and texts that fit the PISA context. Data was collected by using test and non-test techniques in the form of observation. The test instrument used consists of 10 questions related to covid-19-based texts that are in the context of PISA. The test was carried out at the beginning before giving the action and at the end of each cycle. Observations were made during the learning process by using attitude observation sheets. The instrument has gone through the validation test phase using expert judgment and got the proper criteria. The data obtained were analyzed qualitatively and quantitatively. The hypothesis proposed in this study is that the PBL learning model with text according to the PISA context can improve students' reading literacy during the Covid-19 period. The following is the flow of the research c ycle carried out.

At the end of each cycle, reflection is carried out to determine whether the next cycle is necessary. This research ends after the completion of cycle 3 because it has reached the specified completeness indicator/criteria. Testing of the action hypothesis is done by comparing the results of observations and tests given, which are carried out from the first to the last. If the results show an improvement or improvement and 85% of students get a score of 80 (completeness criteria), it can be said that the hypothesis is accepted.
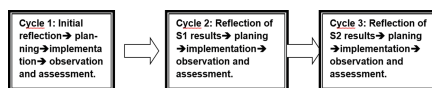

Fig. 1. Flow of research implementation

Conversely, if it does not show an increase/does not reach the criteria for completeness, then the hypothesis is rejected.

3   Results and Discussion

3.1   Results

Based on the results of the initial reflection, from the facts and evidence of research reports regarding students' reading literacy which is still low and from the data on the initial test scores of the sample students who have not been maximized, the average value of reading literacy for class VIII students in understanding texts is 56, the highest score is 65 and the lowest score was 45. No student got a score of 80, so learning was designed using the PBL model and using text according to the PISA context as an effort to improve students' reading literacy during the covid-19 period. The implementation is carried out in learning Indonesian, especially in understanding the material of exposition discourse.

Cycle 1 activity begins with preparing a lesson plan applying the PBL model and text according to the PISA context. The procedures carried out are: preparing learning tools complete with assessment instruments, carrying out learning according to the PBL model learning steps, namely: 1) learning begins with a problem, 2) ensuring that the problems given are related to the real world of students, 3) organizing learning around problems, not around disciplines, 4) giving full responsibility to students in experiencing directly their own learning process, 5) using small groups, and 6) requiring students to demonstrate what they have learned in the form of product or performance (performance). Thus, students are expected to have a complete understanding of the material formulated in the problem, mastery of positive attitudes, and skills gradually and continuously. The context of the selected text is scientific. When learning takes place, there are students who pay less attention, are less active, and are not enthusiastic about participating in learning. Based on the results of observations obtained data that most students have not been actively involved. After finishing the lesson, students took the final test of cycle 1 by answering 10 questions based on the text provided. Questions include accessing and drawing conclusions from the text, integrating and interpreting what is read, reflecting, evaluating, and creating. The text criteria used are:

Level 4, 5, 6
Information Text Content
Personal Context
Title Tips for finding a job in the time of covid-19
Reading source www.holisticare.co.id/benefits-vitamin-c
Competence Understanding, evaluating, reflecting, and recreation

Subcompetence Accessing and searching for information in the text, Reflecting on the content of the discourse for decision making, making choices, and relating the content of the text to personal experience.

Competency Details Finding explicit and implicit information in texts, reflecting new knowledge obtained from informational texts against their knowledge and relating them to life during the Covid-19 era.

Multiple choice questions with 4 options (5 questions: no. 1, 2, 3, 4, and 5) and essays (5 questions: no. 6, 7, 8, 9, and 10).

After the completion of cycle 1, reflection is carried out on the planning, implementation, and assessment that have been carried out. The results show that the PBL procedures designed and implemented in cycle 1 have not shown significant changes to students' reading literacy activities, only some students (30%) are actively involved in learning, others are still passive and busy with other activities, but the average score is still low. The average score achieved by students has increased, from the initial score of 56 to 73. Although the score has increased a lot (17 points), but has not yet reached the criteria for completeness, only 14 students (35%). The results of the final test of cycle 1 showed an increase, the average value was 73, the highest score was 80, and the lowest was 60. The low percentage of the average classical literacy reading cycle 1 was due to the lack of students' ability to understand the content of the text, students were also less able to take knowledge from the text to connect with information in the environment. There are also students who do not know the meaning of the words in the text, so some students ask the teacher. When discussing, there are groups that are still passive, as well as when communicating the results. Therefore, it is necessary to take action in cycle 2, by improving the PBL procedure, especially in steps 5 and 6. The context of the text used is different from cycle 1. The text criteria used are:

Level 4, 5, 6
Information Text Content
Social Context
Title: The Importance of Vitamins in the Time of Covid-19
Source Awalbros.com
Competence Understanding, evaluating, reflecting, and recreation

Subcompetence Understanding, evaluating, reflecting, and creating discourse content for decision making, making choices, making inferences, making connections, and predicting texts and relating text content to personal experiences.

Competency Details Understanding, evaluating, reflecting, and creating new knowledge obtained from informational texts on the knowledge they have and relating it to life during the Covid-19 period.

Multiple choice questions with 4 options (5 questions: no. 1, 2, 3, 4, and 5) and essays (5 questions: no. 6, 7, 8, 9, and 10).

Based on the observations of cycle 2, it was found that the students were active and enthusiastic in participating in the learning, especially in step 5, they shared and asked questions, the class became noisy with the discussions being carried out, and that was a good sign. However, in activity 6 there were still students who were not involved. After reflecting on the planning, implementation, and assessment that has been carried out in cycle 2, it is known that the PBL procedures designed and implemented have shown significant changes to students' reading literacy activities, 50% of students are already actively involved in learning, others are still busy with other activities. The results of

the final test of cycle 2 showed an increase, the average score was 80, the highest score was 85, and the lowest was 70. Overall, the test results in cycle 2 still did not reach the criteria for completeness, only 30 students scored 80 (80%). Therefore, it is necessary to do cycle 3 action, by improving the PBL procedure, especially in step 6, and with different text criteria. The text criteria used are:

Level 4, 5, 6
Information text content
Socio-cultural Context
Title: The social impact of the corona virus
Source puspensos.kemsos.go.id
Competence Understanding, evaluating, reflecting, and creating.

Subcompetences Reflecting on discourse content for decision making, making choices, making inferences, making connections, and predicting texts and relating text content to personal experiences Making inferences, making connections, and predicting singular and plural texts.

Competency Details Understanding, evaluating, reflecting, and creating new knowledge obtained from informational texts on the knowledge they have and relating it to life during the Covid-19 period.

Multiple choice questions with 4 options (5 questions: no. 1, 2, 3, 4, and 5) and essays (5 questions: no. 6, 7, 8, 9, and 10).

At the end of cycle 3, reflections were made on the planning, implementation, and assessment that had been carried out. The results showed a significant improvement, especially in the final test results. The results of the final test of cycle 3 showed a high improvement, the average score was 87, the highest score was 95, and the lowest was 80. Overall, the test scores for cycle 3 reached the criteria for completeness, 38 students who scored 80 (95%). 95% of students are already actively involved in learning, only 2 other people are still rather passive, less involved in discussions and busy with other activities. From the results of cycle 3 reflection, it can be concluded that the PBL procedure designed using text according to the PISA context that has been implemented has succeeded in increasing students' reading literacy during the covid-19 period. Figure 2 is a diagram of the grades achieved by students from pre-cycle to cycle 3.
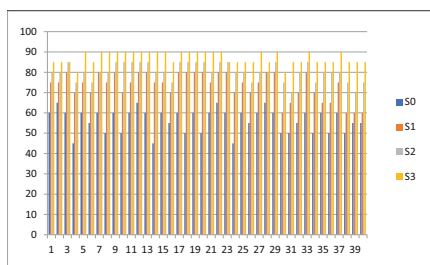

Fig. 2. The value of the initial test results, cycle 1, cycle 2, and cycle 3
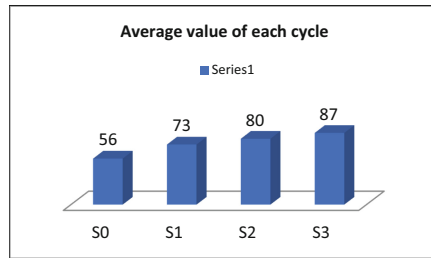
Fig. 3. Diagram of the average value of each cycle

Based on the Fig. 2, it can be seen that the value of each student from pre-cycle, cycle 1, cycle 2, and cycle 3, all increased. A very drastic increase from pre-cycle to cycle 1 was achieved by student no. 4 and 24 (from 45 to 70), participant no. 14 (from 45 to 75), student no. 18 and no. 20 (from 50 to 80). The drastic difference in grades from pre-cycle to the last cycle was achieved by student no. 8 and 20 (from 50 to 90), student no. 14 (from 45 to 90). The achievement of the lowest student scores was in pre-cycle 45, cycle 1: 60, cycle 2: 70, and cycle 3: 80. The highest score was in pre-cycle: 65, cycle 1: 80, cycle 2: 85, and cycle 3: 100. There is a significant increase. Likewise, the average score of students has increased, pre-cycle: 56, cycle 1: 73, cycle 2: 80, and cycle 3: 87. High score achievement in cycle 1, one of the main factors is due to the personal topic of the text. And an interesting title, namely "Tips for finding a job during the covid-19 period". The following chart shows the average score for each cycle achieved by students (Fig. 3).

Judging from the achievement of the value of each cycle as well as from student activities in learning from observations, based on observations made during learning, students are active, enthusiastic in participating in learning, directly involved in discussions, and trying to communicate the results obtained in group discussions, it can be said that the hypothesis received.

3.2 Discussion

Efforts to improve students' reading literacy have been carried out by individuals, communities, government, and educational institutions. In this study, classroom action research has also been carried out as an effort to improve students' reading literacy during the Covid-19 period, namely by using PBL learning models and texts in the PISA context which are carried out in Indonesian language learning. The results show that learning designed with an innovative model according to the characteristics of classroom action research which is carried out through the stages of planning, implementing, observing and assessing, as well as this reflection, by applying a scientific approach according to the 2013 Curriculum and independent Learning Curriculum, which uses text according to the context of PISA, gives results maximum, exceeding the specified success criteria. This is in line with what was said [14] that the result of learning activities is self-change, from a state of not knowing to knowing, from not doing something to doing something, from not being able to do something to being able to do something. The results of this study indicate that change. This is in line with [15] which says that reading literacy

learning is important to do well, because it serves not only to improve language skills, but also to increase students' overall knowledge.

Students' reading literacy experienced an increase in the test results of cycles 1, 2, and 3. A very high increase (17 points) occurred in cycle 1. The very high increase in cycle 1 was due to the interesting title, directly related to real life and personal, namely "Tips for finding a job in the time of covid-19". Cycle 2 and cycle 3 also experienced an increase, each by 7 points. This is because the learning process is optimally designed using PBL steps with selected texts according to the context of PISA and relating to Covid-19. Students like to have discussions to solve the problems raised. This is in line with the PBL concept which is a learning model by making confrontations with students with practical problems, in the form of ill-structured, or open-ended through stimuli in learning. As also stated [8] problem based learning has the following characteristics: 1) learning begins with a problem, 2) ensures that the problems given are related to the real world of students, 3) organizes lessons around problems, not around disciplines. Science, 4) giving full responsibility to students in experiencing directly their own learning process, 5) using small groups, and 6) requiring students to demonstrate what they have learned in the form of products or performance (performance). Thus, students are expected to have a complete understanding of the material formulated in the problem, mastery of positive attitudes, and skills gradually and continuously.

This shows that the use of PBL has a positive impact on students' reading literacy, as evidenced by an increase in grades in each cycle. In [16] it is stated that reading literacy can be trained using PBL because problem solving requires students to find the answers themselves. The PBL model invites students to combine understanding in solving the problems given, so that students can gain understanding through the process it does. This is in line with the opinion [17] that PBL model learning is learning that combines several rules to solve problems. It should also be noted that teaching and learning activities with the PBL model begin with giving a problem, the problems presented are related to the real lives of students, organizing discussions around scientific disciplines, students are given maximum responsibility in shaping and carrying out the learning process directly, students are formed into several groups. Small groups, and students are required to demonstrate the product or performance they have learned. This is also in line with the scientific approach, and the demands of 21st century skills, which must elaborate aspects of critical thinking and problem solving, creativity and innovation, communication, and collaboration [18], students can think critically and solve problems, collaborate in a network or community, fast learning and flexible, effective communication using argumentation and justification, initiative and entrepreneurship, accessing and analyzing information, curiosity and imagination, as well as ICT literacy skills. PBL is a learner-centered learning model by confronting these students with various problems in their lives, training and developing the ability to solve problems that are oriented towards authentic problems from students' actual lives to stimulate higher-order thinking skills. With this learning model, students from the beginning have been faced with various life problems that they might encounter, and it is hoped that they will be able to overcome them.

4   Conclusion

The results showed that during the learning process students were very active, responsible, creative, and disciplined. The results of each cycle showed an increase in the average score obtained by students. The increase in the average score is not only due to the application of an innovative model but also due to the more contextual context of the text. High score achievement in cycle 1, one of the main factors is due to the personal topic of the text and an interesting title, namely "Tips for finding a job during the covid-19 period". Practitioners are advised to use texts that are appropriate to the context of PISA in learning and practice, so that students are accustomed to working on PISA type questions.

References

1. R. I. I. Putri, Zulkardi, Higher-Order Thinking Skill Problem on Data Representation in Primary School: A Case Study, Journal of Physics Conference Series, 948(1), https://doi.org/10.1088/1742-6596/948/1/012056.
2. A. N. Wulanjani, C. W.Anggraeni,Meningkatkan Minat Membaca melalui Gerakan Literasi Membaca bagi Siswa Sekolah Dasar. Proceeding of Biology Education, 3(1), (2019). https://doi.org/10.21009/pbe.3-1.4.
3. OECD, PISA 2018: Insights and Interpretations. PISA, (2019), Paris: OECD Publishing.
4. F. Fahlevi, Kemendikbud: Tingkat Literasi Siswa Indonesia di Peringkat PISA Masih Rendah, Tribunnews.com.Senin, 22 Maret 2021, https://www.tribunnews.com/nasional/2021/03/22/kemendikbud-tingkat-literasi-siswa-indonesia-di-peringkat-pisa-masih-rendah.
5. Y. Yanuar, Skor PISA Murid Indonesia di Bawah Rata-Rata, Ini Kata Nadiem, (2020), https://akmpisa2021indonesia.wordpress.com/2020/10/27/skor-pisa-murid-Indonesia-di-bawah-rata-rata-ini-kata-nadiem/.
6. T. Harsiati, E. T. Priyatni, Karakteristik Tes Literasi Membaca pada Programme for International Student Asessment (PISA), Bibliotika: Jurnal Kajian Perpustakaan Dan Informasi, (2017)
7. Z. Alwi, Zulkardi, R.I.I. Putri, Syamsuryadi, R. Pabela, Pengaruh aktivitas literasi membaca pada era kelimpahan teknologi terhadap kemampuan literasi siswa, in: E. Sumarti, E. Setiawati, Kholik, Mulyono (Eds.), Menggagas pembelajaran bahasa Indonesia dan sastra Indonesia pada era kelimpahan: kajian bahasa Indonesia pada era kelimpahan, Unisma Press, Surabaya, 2021
8. Rusman, Model-Model Pembelajaran: Mengembangkan Profesionalisme Guru Inopendas Jurnal Ilmiah Kependidikan, 4(2), (2012)
9. Zulkardi, Meryansumayeka, R. I. I. Putri, Z. Alwi, D. S Nusantara, S.M. Ambarita, Y. Maharani, L. Puspitasari, How Students Work with PISA-like Mathematical Tasks using Covid-19 Context, Journal on Mathematics Education, 11(3), 405–416. (2020), https://doi.org/10.22342/jme.11.3.12915.405-416.

10. Kemdikbud, Surat Edaran Mendikbud No. 4 Tahun 2020 tentang Pelaksanaan Kebijakan Pendidikan dalam Masa Darurat Penyebaran Corona Virus Disease (COVID-19), (2020).
11. Kasbolah, E.S. Kasihani, Penelitian Tindakan Kelas, Universitas Negeri Malang, 2001.
12. Z. Alwi, Supriyadi, Suhardi, Ansori, Pelatihan Pembuatan Proposal dan Laporan Penelitian Tindakan Kelas bagi Guru-Guru SMP Pagaralam, Jurnal Logat, 6(2), 2019
13. D. Hopkins, A. Fawaid, S. Z. Qudsy, Panduan Guru: Penelitian Tindakan Kelas, Pustaka Pelajar, 2011.
14. Y. Abidin, T. Mulyati, H. Yunansah, Pembelajaran Literasi: Strategi Meningkatkan Kemampuan Literasi Matematika, Sains, Mambaca, dan Menulis. Bumi Aksara. 2017.
15. Z. Zulkardi, M. Meryansumayeka, R. I. I. Putri, Z. Alwi, D. S. Nusantara, S.M. Ambarita, Y. Maharani, & L. Puspitasari, How Students Work with PISA-like Mathematical Tasks using Covid-19 Context. Journal on Mathematics Education, 11(3), 405–416. 2020. https://doi.org/10.22342/jme.11.3.12915.405-416.
16. R. Pamungkas, R. M. Probosari, D. Puspitasari, Peningkatan Literasi Membaca Melalui Penerapan Problem Based Learning Pada Pembelajaran Biologi Siswa Kelas X MIA1 SMAN 1 Boyolali, Seminar Nasional Pendidikan Sains Magister Pendidikan Sains dan Doktor Pendidikan IPA FKIP UNS, November, 406–412, (2015).
17. J. Hamdayana, Metodologi Pengajaran, Bumi Aksara, 2018
18. P21 Partnership for 21st Century Learning, Framework for 21st Century Learning Definitions. Battele for Kids, 2019.