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# THE DEVELOPMENT OF GEOMETRIC ROWS AND SEQUENCES PROBLEM-BASED LEARNING WITH LIVEWORKSHEET MEDIA

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**ABSTRACT**

The lack of development of Student Worksheets that match what is needed by students can be one of the reasons why many students have difficulty understanding learning materials. This study aims to describe the process and results of the development of the mathematics worksheets based on Problem Based Learning by utilizing liveworksheets on geometric sequences and series material. The type of this research is research and development. This worksheet is designed using Canva and Microsoft Word by utilizing liveworksheets. The subjects of the field trial were 28 students of class XI. This research uses the Four D model from Thiagarajan which consists of the stages of definition, design, development, and dissemination. Data collection methods consist of observation, test, and questionnaire methods. Based on the results obtained from trials in the field, it can be concluded that the mathematics worksheets based on Problem Based Learning by utilizing liveworksheets on geometric sequences and series material met the valid, practical, and effective categories. Other researchers can make maximum use of the features provided on the liveworksheets site because in this study they only utilized a few features and must be alert in anticipating when an error occurs on the site while it is being used.



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## INTRODUCTION

Learning in the 2013 curriculum requires students to learn something through examples, implementation, and real experiences in everyday life both outside and inside the school. (Yusuf et al., 2015). The implementation of the 2013 curriculum is expected to support students in improving 21st century skills that are important for each individual to have. Based on observations obtained by researchers during teaching practice at a public high school in

Jember, the learning process at the school is still lacking in the use of media and learning models that can guide students to find their own concepts or formulas and learning is still teacher-centered. Teaching materials that are utilized are only sourced from textbooks and worksheets that only present formulas without any activities that make students actively participate in the learning process. Low student participation in the learning process in the classroom results in a lack of ability for students to formulate their own ideas and a lack of courage to convey ideas to others. (Paripurnawan, 2021).

there are several learning models that can improve students' abilities, one of which is problem-based learning. Problem-based learning is a constructivism learning model by leading to student-centered learning that can increase creative spirit, collaborative, metacognitive thinking, improve concept understanding, improve higher order thinking skills, provide problem solving, increase independence, and create teamwork. (sofyan & komariah, 2016). the problem-based learning learning model is very suitable for all subjects, one of which is mathematics. there is a common thread between the characteristics of mathematics and problem-based learning when associated. the link is that mathematics is a science that plays a role as problem solving and developing students' thinking skills, this is in line with the definition of the problem-based learning model, which is a learning model designed to improve students' ability to master material and solve problems so that the application of problem-based learning greatly supports improving the quality of learning and the quality of students in learning. (gunantara et al., 2014).

the application of problem-based learning can be done by utilizing learning media, one of which is the student worksheet. student worksheet is a guide for students to carry out problem-solving activities (tarigan et al, 2019). student worksheet can function as a stimulus and teaching material to support students in mastering subject matter, as a tool to practice solving problems properly, and to increase student activity in learning. Students will feel obliged to do tasks and solve problems, especially if the teacher appreciates all their work so that students are encouraged to play an active role in the learning process through the use of student worksheet (Haryonik & Bhakti, 2018). The lack of development of worksheets that are harmonious with what is needed by students can be one of the causes of many students having difficulty in understanding the material. Many worksheets developed today are just practice questions to explore the material, not learning activities that students carry out to gain their knowledge and understanding independently. These worksheets have not been able to make students understand the concept of a material, reduce students' ability to find knowledge independently, and make students passive during learning (Nuryani & Saraswati, 2018).

The student worksheet that is made can be designed and developed by adjusting the situation and conditions of the learning activities that will occur. During a pandemic like now, the use of technology is a solution and in accordance with 21st century learning. The student worksheet is not only in conventional (printed) form but can also be electronic (*online*). The use of conventional (printed) worksheets has several disadvantages in the manual learning evaluation process, such as requiring paper costs, difficulty reading unclear student writing, and teacher errors in calculating the number of grades on the worksheet. (Sabiilillah & Novian, 2021). This *online* worksheet can also save teachers time in correcting student answers because it can correct and assess student work automatically based on formulas or key codes that have been made late by the creator or researcher. The use of electronic (*online*) worksheets can also make it easier for teachers to manage the class to keep it under control when teaching and learning activities take place at school or from home. One of the *online* sites that can be utilized in this case is *liveworksheets*. This site can be accessed for free at www.liveworksheets.com. *Liveworksheets* is a *website platform* that provides services for

teachers to be able to utilize the available student worksheet by copying the student worksheet *link* then sharing it with students and making their own student worksheet interactive *online*.

Based on this description, The student worksheet can guide and facilitate students in mastering the concept of subject matter. Furthermore, in the learning process not only devices or media are taken into consideration but also learning models that are able to stimulate students to have thinking skills in the 21st-century, and the use of technology that can make learning activities easier and more efficient. The student worksheet contains several stages that can guide students in solving the problems in it and presenting the results they have discussed. Therefore, this problem-based learning based worksheet by utilizing *liveworksheets* can be used by students to solve problems, find ideas, and trigger discussion activities. so that in classroom learning activities students become more active and interactive.

this study aims to describe the process and results of the development of problem-based learning based student worksheet by utilizing *liveworksheets* on valid, practical, and effective geometric rows and series material. this is important to do because the student worksheet developed can be a facility for students to improve their understanding and mathematical solution skills, as well as improve the quality of learning in schools according to 21st-century learning.

## METHOD

This type of *research* is research and *development*. The test site used in this study was a public high school in Jember. This research uses the *Four D* model with four stages, namely the *defining* stage (*define*), the *design stage (design*), the development stage (*develop)*, and the *dissemination stage* (*disseminate*) (Prastyawati & Hanum, 2015). The subjects chosen for the field trial were class XI students as many as 28 students on June 10-14, 2022. The data collection methods used are the observation method which is carried out by observing teacher activities in the implementation of learning by using problem-based learning based mathematics student worksheet by utilizing *liveworksheets* and observing student activities, the test method, and the questionnaire method. Data on student learning outcomes were obtained by giving tests after learning using the student worksheet was completed. Data on student responses to learning using the student worksheet was obtained using the questionnaire method. All instruments were validated by mathematics education lecturers and high school mathematics teacher by following the categories in Table 1 (Hobri, 2010).

**Table 1.** Instrument Validity Categories

| Value | Category of Validity |
|---|---|
| $1 \leq V_a < 2$ | Invalid |
| $2 \leq V_a < 3$ | Valid Enough |
| $3 \leq V_a \leq 4$ | Valid |

The practicality of the student worksheet was analyzed by looking at the results of teacher activity observations by following the categories in Table 2 (Hobri, 2010).

**Table 2.** Category of Practicality of Student Worksheets

| Value | Practicality Category |
|---|---|
| $1 \leq P < 1{,}75$ | Very Low |
| $1{,}75 \leq P < 2{,}5$ | Low |
| $2{,}5 \leq P < 3{,}25$ | Medium |
| $3{,}25 \leq P < 4$ | High |
| $P = 4$ | Very High |

The effectiveness of the student worksheet was analyzed by referring to three indicators, namely individual test scores declared classically complete with a percentage of ≥75%, observation of student activity with active criteria of at least 75% active, and giving a positive response to the use of student worksheet. Student activity observation data were analyzed using the categories in Table 3 (Arikunto, 2007 (in Suseno et al., 2017)).

**Table 3.** Categories of Student Activity Observation Results

| Value | Liveliness Category |
|---|---|
| $0\% \leq P_s < 25\%$ | Inactive |
| $25\% \leq P_s < 51\%$ | Less Active |
| $51\% \leq P_s < 75\%$ | Active |
| $75\% \leq P_s \leq 100\%$ | Very Active |

## RESULTS AND DISCUSSION

### *Results*

The following presents the process and results of developing problem-based learning based mathematics students worksheets by utilizing *liveworksheets* according to the defining stage, design stage, development stage, and dissemination stage.

### *Define Stage*

The defining stage consists of five main steps, namely initial analysis, student analysis, material analysis, task analysis, and specification of learning objectives. The initial analysis step was carried out by interviewing the math teacher. The results of the interview are learning with problem-based learning based mathematics students worksheets media by utilizing the *liveworksheets* site on the material of geometric rows and series has never been applied at the school. The student analysis step was carried out by interviewing the math teacher. The results of the interview showed that students' ability to solve problems, find concepts, and integrate concepts in a problem of geometric rows and series material was still low. The material analysis step was carried out by selecting the material of geometric rows and series. The selection of the material is due to the lack of student understanding of the material caused by the constraint factor in reasoning or associating, namely determining the number of terms and determining the formula used to solve the problem. In addition, the material is widely associated with everyday life. The task analysis step in this study looked at the final semester exam scores obtained by students. The result is that most of the students still do not reach the minimum completeness criteria. Therefore, a problem-based learning based mathematics students worksheet was developed by utilizing *liveworksheets* on the material of geometric rows and series. Step specification of learning objectives by formulating learning objectives and learning indicators that are adjusted to the core competencies and basic competencies on the material of geometric rows and series.

### *Design Stage*

This stage consists of four main steps, namely test preparation, media selection, format selection, and initial design. The test preparation step is used to measure students' abilities after conducting learning activities with students worksheet in problem-based learning based learning. The test questions consisted of three essay-shaped questions. The following are the test questions given to students.

Jawablah dengan jelas dan benar pada lembar jawaban yang telah disediakan!

1. Umur Risa, Jojo, dan Krisna membentuk barisan geometri. Jumlah usia mereka 65 tahun. Perbandingan usia Krisna dan Jojo adalah 3 : 1. Jika usia Risa paling muda, maka tentukan usia Risa!
2. Roy memotong seutas tali menjadi 5 bagian sehingga ukurannya membentuk barisan geometri. Jika panjang potongan tali terpendek 4 cm dan panjang potongan tali terpanjang 324 cm, tentukan panjang tali semula!
3. Suku pertama dan suku ketiga suatu deret geometri tak hingga berturut-turut adalah 30 dan $\frac{10}{3}$. Jika rasionya positif, maka tentukan jumlah semua suku dari deret geometri tersebut!

**Figure 1**. Test Questions

The next step is media selection which aims to identify suitable learning media. In this study, learning using problem-based learning based students worksheetby utilizing *liveworksheets* on the material of geometric rows and series. The utilization of the *liveworksheets* site is because the site is a free site that can be accessed *online* anywhere and anytime and has an attractive appearance. (Amalia & Lestyanto, 2021). The following is an example of the appearance of students worksheet 1 on *liveworksheets.*

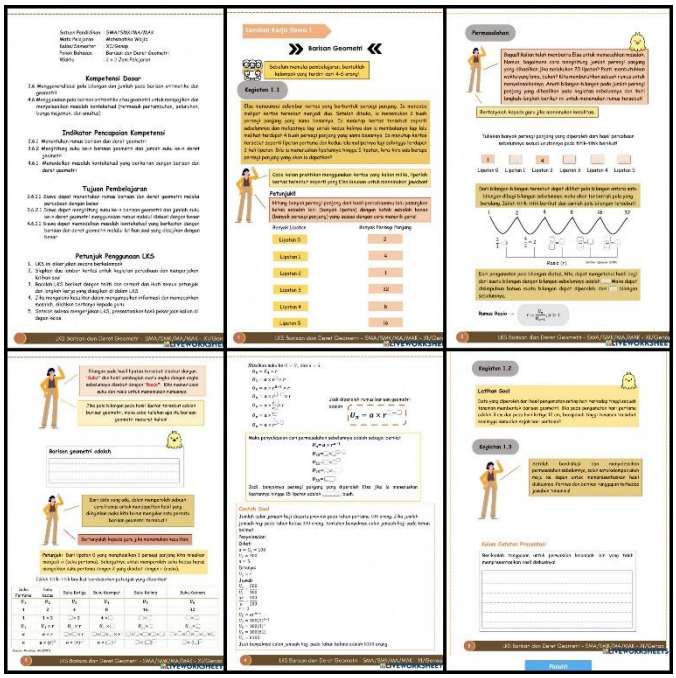

**Figure 2**. Example of students worksheet 1 Display on *Liveworksheets*

The next step is format selection which includes the selection of approaches, strategies, models, methods, and learning resources that are in accordance with the learning material following the students worksheet design of Hobri et al. Hobri et al. (2021). The learning model chosen is problem-based learning. This problem-based learning model is considered as a learning model that is compatible with the implementation of the 2013 curriculum and is able to encourage students to play an active role during learning. (Fristadi & Bharata, 2015).. The last step in this stage is the initial design. This design must be in accordance with the students worksheet format that will be developed by making a *prototype* that will later be assessed by experts. The following is an image for the initial design.

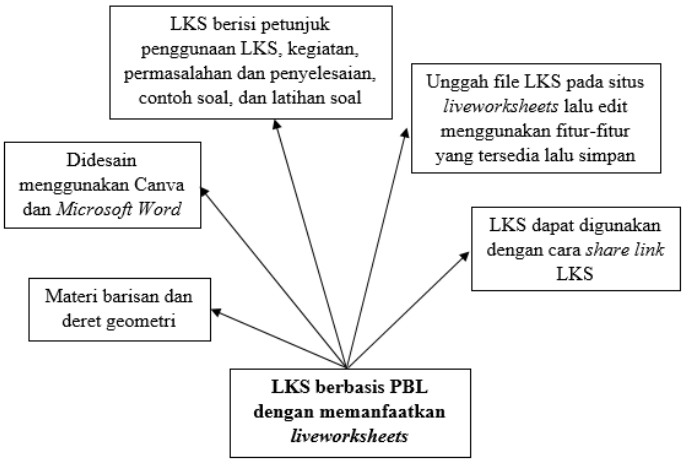


**Figure 3.** Initial Design

### *Development Stage*

Activities at this stage consist of expert assessment (validity test), limited trial, and field test.

### *Validity Test*

The expert assessment was carried out by three competent validators to provide an assessment of the students worksheet and several other research instruments. The average score of the three validators was 3.8 which was categorized as valid. As for the experts' assessment of research instruments such as test questions, teacher activity observation sheets, student activity observation sheets, and student response questionnaires obtained $V_a$ sequentially amounted to 3.7; 3.9; 3.9; 3.9. These results indicate that all instruments are valid and suitable for use to collect research data.

### *Limited Trial*

The next activity was a limited trial. Researchers tested the students worksheet and test questions to three students as subjects who came from different classes with the research subjects. From the trial, the scores of the three students were obtained, namely the lowest score of 93 and the highest score of 97. Based on input from the limited trial activities, revisions were made to the learning tools which were ready to be tested in the field. Here are the pictures before and after the revision.

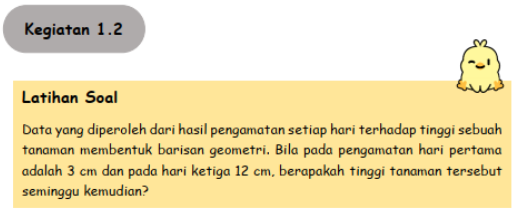


**Figure 4**. Students worksheet before revision 4

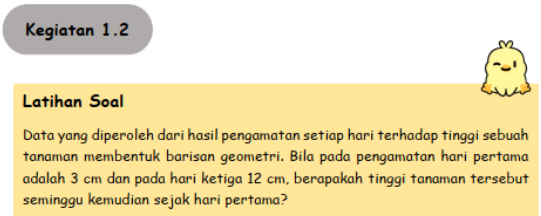


**Figure 5.** Students worksheet after revision

### *Field Trial*

The next activity is field trials. The field trial in this study aims to determine the practicality and effectiveness of the students worksheet. field trials in this study were conducted *offline*. the research subjects were 28 grade xi students who were carried out on 10, 13, and 14 june 2022 using the students worksheet by utilizing the *liveworksheets* site and working in groups via each student's *smartphone*. this worksheet has been designed using Canva and *Microsoft Word* by utilizing liveworksheets. The students worksheet link is sent by the teacher through the *Whatsapp group*. The link to the student worksheet are:

- https://unej.id/LKS1PBL
- https://unej.id/LKS2PBL
- https://unej.id/LKS2PBL

The problems contained in the students worksheet are problem solving problems with problem based learning and structured learning steps. the worksheet that utilizes the features on the *liveworksheets* site makes it easier for students to fill in the answers to the worksheet and makes it easier for teachers to get scores without having to correct them. examples of the results of students worksheet work by students can be seen in the following.

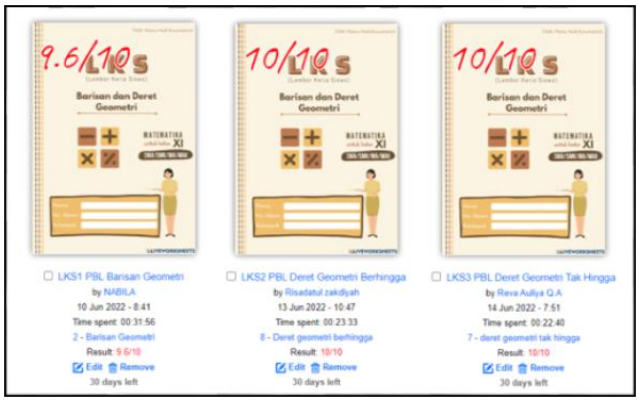


**Figure 6.** Students worksheet results on the *Liveworksheets* website

After conducting discussions and discussions on the material of geometric rows and series, students are asked to work on the test questions of geometric rows and series which are done once with three questions in the form of essays. After the learning activities are completed, students are asked to fill out a student response questionnaire. Based on the results of data collection through trials, the level of practicality and effectiveness of Problem-Based Learning based mathematics Student Worksheets by utilizing *liveworksheets* on the material of geometric rows and series was analyzed.

Data analysis of the practicality of the students worksheet was obtained from teacher activity observation data. The observer in this study was a math teacher. Teacher activity observation data can be seen in the following figure.

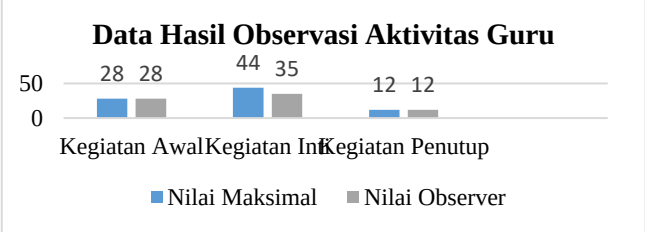


**Figure 7.** Teacher Activity Observation Data

Based on the calculation of data analysis of teacher activity observation results obtained $P$ by $3{,}9$ and based on the instrument's practicality category in the table, the students worksheet implementation is concluded to be high and can be declared practical students worksheet.

The effectiveness of the students worksheet is measured by three indicators, namely data on learning outcomes, student activities, and student responses. The students worksheet can be said to be effective if student learning outcomes are classically complete, student activity in the classroom has at least active criteria, and student responses are positive. Data on learning outcomes were obtained from test questions on geometric rows and series after learning. Based on the calculation of data analysis of learning outcomes in class XI IPA 5 with 28 students obtained $7\%$ students are not complete and $93\%$ students are complete because they have reached the Minimum Completeness Criteria with the lowest score of 63 and the highest score of 100 so that it can be categorized as classically complete because there are more than half of the total students who have been completed. $\geq 75\%$ of the total number of students have been completed. Data on student learning outcomes after participating in math learning using students worksheet can be seen in the following figure.

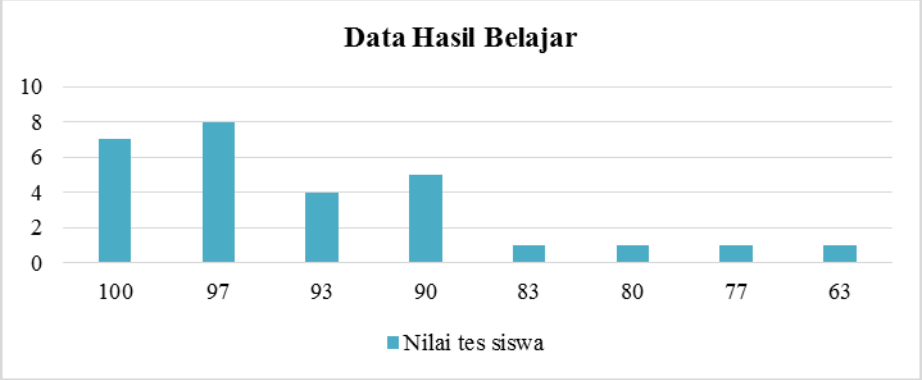


**Figure 8.** Learning Outcome Data

Data analysis of student activity observation results was carried out by summing up student activity observation scores. Data on student activity observation results can be seen in the following figure.


**Figure 9.** Data on Student Activity Observation Results

Based on the calculation of data analysis of student activity observation results obtained $P_s$ amounted to 96.4% and was at $75\% \leq P_s \leq 100\%$Therefore, it can be said that learning using problem-based learning based students worksheet by utilizing *liveworksheets* shows very active student activeness.

Analysis of student response data is obtained from student response questionnaires distributed after participating in learning. Based on the calculation of data analysis of student response questionnaire results, it was obtained that the student response chose the answer "yes" for

each indicator by 100%, so it can be said that the student response was positive towards the use of problem-based learning based mathematics *worksheets* by utilizing *liveworksheets*. Therefore, the students worksheet can be said to be effective because the learning outcomes are classically complete, student activities in the classroom are very active and student responses are positive to the use of the students worksheet.

### *Disseminate* Stage

This stage aims to disseminate the use of students worksheet that has been produced and developed. The dissemination of the students worksheet that has been designed using Canva, *Microsoft Word*, and utilizing the features of the *liveworksheets* site is carried out to mathematics teachers of SMA Negeri Arjasa, social media (*Whatsapp*, *Instagram*, and *Twitter*) and *websites* (*blogs)*. The *blog* link can be seen at https://bit.ly/3QOmmTP. The following picture shows the distribution through social media and *website*.

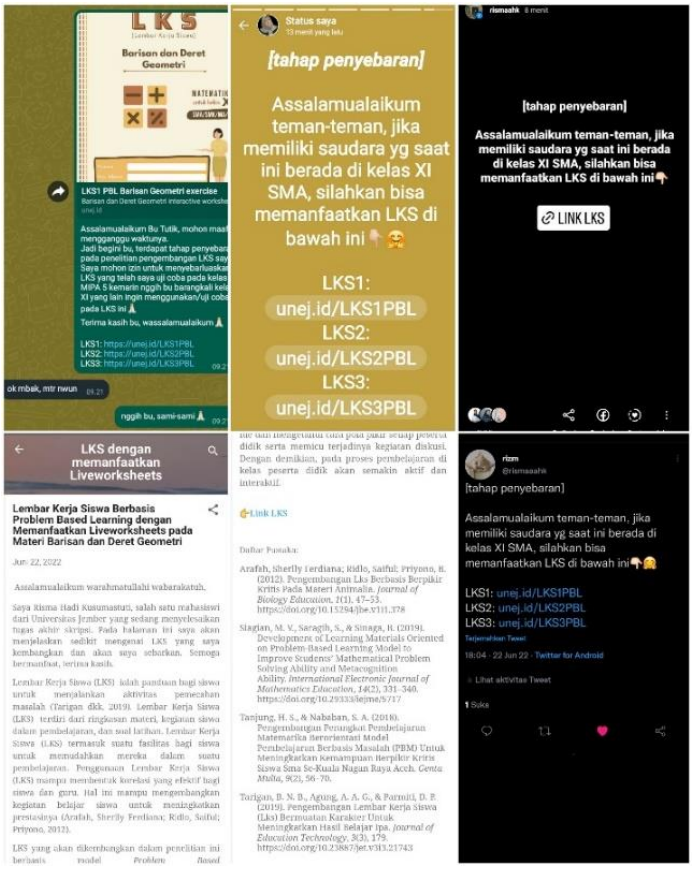


**Figure 10.** Dissemination of students worksheet through Social Media and Website

### *Discussions*

Based on the results of the study, the development of problem-based learning based mathematics *worksheets* by utilizing *liveworksheets* has been successfully carried out with four stages of the *Four-D* model, namely the *defining* stage (*define*), the *design stage (design*), the development stage (*develop)*, and the *dissemination* stage (*disseminate)*. The resulting students worksheet reached the valid, practical, and effective categories. This study developed a worksheet with several problems solved by problem-based learning steps on the material of geometric rows and series made with the aim of increasing students' understanding in finding concepts. Therefore, this worksheet is suitable for use to support learning on the material of geometric rows and series. The use of problem-based learning based mathematics *worksheets* by utilizing *liveworksheets* on the material of geometric rows and series provides

good results. The students worksheet has an impact on increasing teacher and student activities, improving student learning outcomes, and triggering students to respond positively to learning activities. This is in accordance with the results of research conducted by Amalia & Lestyanto (2021); Murtikusuma (2016); Pambudi et al. (2021); and Khikmiyah (2021). Based on these results, it can be said that problem-based learning based mathematics *worksheets* by utilizing *liveworksheets* need to be developed further on other mathematics materials at other school levels.

## CONCLUSION

The development of problem-based learning based mathematics *worksheets* by utilizing *liveworksheets* meets the valid category with an average score of 3.8 from a maximum score of 4. This worksheet meets the practical category with an average score of 3.9 from a maximum score of 4. This worksheet is also said to be effective because 93% of students reached individual and classical completeness. Students were very active with a percentage of 96.4% and the responses from students and teachers were very positive, namely they agreed and supported the use of these worksheets in learning mathematics. So it can be concluded that the mathematics *worksheets* developed based on problem-based learning by utilizing *liveworksheets* on the material of geometric rows and series can be said to be valid, practical, and effective.

Based on the conclusions obtained, the advice that can be given is that other researchers can make maximum use of the features provided on the liveworksheets site because in this study they only utilized a few features and must be alert in anticipating when an error occurs on the site while it is being used. Other researchers can also use materials, learning models, or use them to look at students' thinking skills as a learning resource. This research only describes the development process and results of LKS development. Further research is recommended to develop worksheets to improve students' creative thinking abilities.

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