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Inquiry-Based Student Worksheet Design for Introduction to Mathematical Statistics Course

Rezky Ramadhona[1], Sukma Adi Perdana[2]

[1] Universitas Maritim Raja Ali Haji, Tanjungpinang, Riau Islands, 29111, Indonesia
[2] STAIN Sultan Abdurrahman Kepulauan Riau, Bintan, Riau Islands, 29111, Indonesia

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Abstract

In the new normal, learning is carried out online. For this reason, educators must be able to package the learning activity interactively so that students have the motivation to learn. The inquiry method facilitates students to be active in learning. Students are guided through the questions arranged in the Worksheet. Therefore, this study aims to develop an Inquiry-Based Student Worksheet in the Introduction to Mathematical Statistics in the New Normal Era. The development model used is 4D with the stages of define, design, develop, and disseminate. However, the stages of this article are defined and designed. The instrument used in the define stage is a questionnaire. The results at the define stage are that teaching materials are needed to help students find concepts, and the Student Worksheets are one of the teaching materials that have a good impact on learning.

Keywords: student worksheet, inquiry, combinatorial.

I. Introduction

Learning in the new normal requires the creativity of educators so that learning remains meaningful and students remain motivated to participate in learning. A learning flow involving students' activities is needed to increase students' motivation. Students not only accept what is conveyed by the teacher but are also involved in finding the concept being studied with the help or guidance of the educator.

This guidance can be through student worksheets prepared by educators to find the studied concepts. The impact of the presence of the developed Student Worksheets is that they can become new alternatives to support previously existing teaching materials and be used by educators in schools (Anita, Rina Agustina, 2022). A student Worksheet is one of the teaching materials that contains a set of activities, problems, or questions that students will do during learning. Prastowo (2013) suggests the function of the Student Worksheet is a teaching material that can minimize the role of educators, in this case, lecturers, but increase student participation. This is also in line with the results of Ramadhona & Izzati (2018) that the Student Worksheets designed are very practical to use in learning. Students and teachers can use the student worksheet to support learning in the classroom (Basuki and Wijaya, 2018). Student worksheets are necessary to facilitate the achievement of student mathematical literacy and the role of presenting mathematical concepts (Muchsin et al., 2018). Then Rahmadhani &

* Corresponding Author
Email Address : ramadhona@umrah.ac.id
Handphone : +62 81277899604

Wahyuni (2020) also said that the student worksheets contain some information and instructions to instruct students to behave as expected by the teacher. So it can be concluded that using student worksheets in learning is very helpful for students in understanding the concepts being studied. If the students themselves discover the concept, the concept will last a long time in their memory. Mainly if the concept being studied contains theorems that must be proven true. Therefore, it is necessary to design learning that can increase student activity.

The inquiry method is a method that can facilitate students in finding the concepts being studied; educators only guide and direct through questions so that students themselves will find concepts (Perdana & Ramadhona, 2022). Ramadhona & Izzati (2018) say that through the inquiry method, students have the opportunity to find out for themselves what they need. The inquiry method is one method that can activate students in the learning process both physically and mentally. Sanjaya (2011) said, "The inquiry method is a series of learning activities that emphasize the process of thinking critically and analytically to seek and find the answer to a problem in question ."Schmidt puts forward another understanding in Sutawidjaja (2011) that Inquiry is a process of obtaining information by conducting observations and experiments to find answers. According to Indriani, M., Niswah, C., & Arifin (2017), in guided Inquiry, educators make experimental instructions, and students conduct experiments to find concepts that the educator has set. Students' ability to use their scientific process skills was promoted with Inquiry (Mutlu, 2020). So it can be concluded that the inquiry method is a series of learning activities involving students' intellectual abilities in acquiring knowledge by finding their answers to the problems.

The inquiry method has several stages, as expressed by Sanjaya (2011); the first is the orientation stage. At this stage, the teacher explains the principal activities students will do during the learning process using the inquiry model, and the teacher explains the importance of these activities. The next stage is formulating the problem; at this stage, the teacher allows students to formulate the problem being discussed and ask questions about the problem. The third stage is formulating hypotheses; students are trained to formulate their answers and write the temporary answers correctly; the teacher can help students find the temporary answers by asking various questions. The fourth stage is collecting data; students are free to seek information from various sources, including conducting various experiments to get an answer that can be accounted for. Then the stage of testing the hypothesis is that students are trained to determine the answer received following the data obtained when collecting data. The last stage is formulating conclusions; students are trained to be able to develop their thinking skills by formulating conclusions obtained from the findings. So in this study, the stages of Inquiry will be used as a guide in developing Student Worksheets.

Introduction to Mathematics Statistics is one of the compulsory subjects that Mathematics Education Students must take. This course is a subject that studies many theorems that need to be proven true. So it needs guidance from educators so that students can prove the truth of the theorem. Based on the results of Dwinata's research, there were several student errors in solving the problem of the sample point counting rules: reading comprehension, transformation, process skill, and encoding (Dwinata & Ramadhona, 2018).

During the pandemic, learning is carried out using textbooks and electronic books available on the internet. Most students still have difficulty understanding the lecture material using these teaching materials because the teaching materials are information-intensive, so students feel bored and unmotivated to learn, especially during the new normal like today. Where student activity and creativity of educators are required in presenting learning materials, this study aims to design teaching materials like student worksheets for Introduction to Mathematics Statistics related to everyday life.

II. Research Method

This research and development research uses a 4-D (four-D) model, which consists of four stages. According to Thiagarajan in Trianto (2010), the four stages are definition, design, development, and dissemination. This article is only up to the design stage. At the define stage, student and needs analysis activities are carried out. Student analysis was conducted to see student responses related to learning that had been carried out previously during the new normal period. Student responses were obtained from questionnaires distributed via Google Forms. Data analysis technique by calculating the percentage of each statement. Needs analysis is analyzing the material in the Lesson Plan. Material analysis is done through documentation. This analysis was carried out by identification of the subject matter to be selected in the study, collecting relevant sources, and arranged systematically.

III. Results and Discussion

This study aims to design teaching materials like Student Worksheets for Introduction to Mathematics Statistics. In this section, the results of the research design are described following the sequence described in the development method.

Define Stage Results

The purpose of the define stage is to define the requirements needed for development. At the define stage, student responses were analyzed regarding online learning that previous lecturers had carried out in the Geometry course. From the results of the analysis of student responses, Student Worksheets are needed to assist students during lectures during the new normal period. Because through Student Worksheets, the students can learn independently. Worksheets force students to do their work (Ransom & Manning, 2013). This can be seen in Figure 1.

From Figure 1, it can be seen that 61.5% of students agree that they can learn independently by using the Student Worksheets. This is in line with Ayu's research that the Student Worksheets developed can positively impact student learning independence (Kurniawati & Negara, 2019) and has shown that students' beliefs can be pretty ingrained (Cooper et al., 2017).

Figure 1. Aspect of independence

When viewed from the aspect of student attitudes towards learning using the Student Worksheets, it can be seen that 82.5% of students stated that they were more active during lectures using the Student Worksheets (see Figure 2). This is because students, before the lecture starts, fill out the Student Worksheets first. So that students can be involved in finding the concept of the material being studied. This is in line with what Muchsin et al. (2018) said: the role of the presentation of mathematical concepts in the Student Worksheet is required for students' mathematical literacy education. Deep engagement in rich mathematics is the first pillar, indicating that students actively solve mathematics problems (Ernst et al., 2017).

Figure 2. Aspects of attitude

For student knowledge, while using the Student Worksheets in lectures, as much as 90% of students understand the concepts learned using the inquiry-based Student Worksheets (see Figure 3). This follows the opinion that by applying the

inquiry learning model, students build the knowledge they will seek (Sari et al., 2019). Using inquiry skills, students can learn new content knowledge (Stender et al., 2018).

Figure 3. Aspect of knowledge

Based on the needs analysis results above, the Student Worksheets have a good impact on learning. The drawback of the previous Worksheet is the lack of practice questions, and the material is not related to everyday life. Hence, developing Student Worksheets for other materials with more practice questions related to everyday life is necessary. Furthermore, the analysis of the Lesson Plan Introduction to Mathematical Statistics. The results of the Lesson Plan analysis are that Student Worksheets need to explain combinatorial concepts and the concepts of probability theory. In line with Roliza et al. (2018) that learning using Student Worksheets with the Inquiry model aims for students to gain knowledge and skills in determining the right solution or answer to the problem of learning mathematics, and one of the efforts to improve creative thinking skills (Umriani et al., 2020).

Design Stage Results

The design stage aims to design Student Worksheets. The design of Student Worksheets pays attention to didactic aspects, content, language, and readability. At stage design, it is decided which media will be used to design the Student Worksheets. The media used are Microsoft word office 2010. Then the draft Student Worksheets were designed for combinatorial material and probability theory. The first Student Worksheets component is covered (Figure 4). The cover is a reflection of the content. Therefore the cover must support the content (Yerizon, 2019).

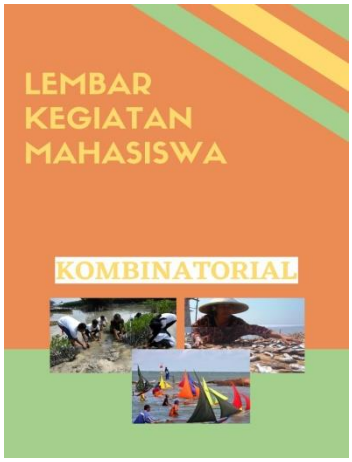


Figure 4. Example cover student worksheets for combinatorial matter

Based on Figure 4, it can be seen cover is made following the components cover, i.e., containing titles and images that support the content of the Student Worksheets. After the cover, the next Student Worksheets component is learning instructions (Figure 5). Students need learning instructions in using the Student Worksheets as one of the supporting learning resources.

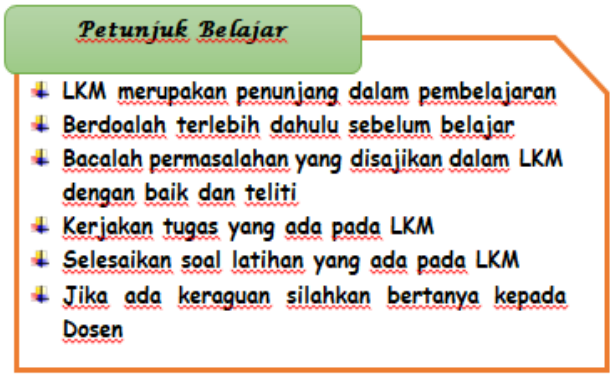


Figure 5. Learning instructions

After the learning instructions, the learning indicators (Figure 6) are presented; indicators are markers of achieving specific basic competencies that can be used to determine the achievement of learning objectives. Therefore, the indicator is helpful for students to know the learning outcomes they must achieve after studying.

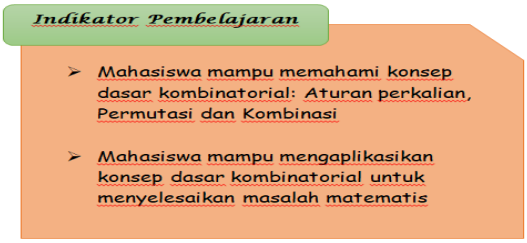
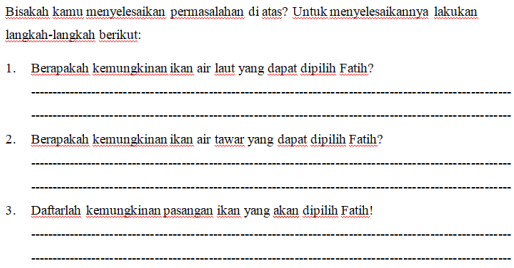


Figure 6. Learning indicators

Another component in the Student Worksheets is Content. An Inquiry-based Student Worksheet begins by presenting a problem. In finding the concept being studied, a problem related to the studied concept is presented at the beginning of the activity. Formulating the problem is an important starting point for educators' learning and improving students' attitudes and beliefs (Laursen et al., 2016). So that students gain a deeper understanding of what is being studied. One example of the problems found in the Student Worksheets can be seen in Figure 7. The problems are presented in text form and accompanied by pictures supporting the problem. The problems presented are related to everyday life, especially maritime affairs. Use language that is easy for students to understand and relevant to the problem presented (Yasin et al., 2019). This has given students the knowledge and tools to succeed (Miller, 2017).

Figure 7. Examples of problems

After students read the problem, then they put forward a hypothesis. In formulating hypotheses, educators guide in the form of questions, as shown in Figure 8. Students explore real-life problems using the process and research tools (Rooney, 2009).


Bisakah kamu menyelesaikan permasalahan di atas? Untuk menyelesaikannya lakukan langkah-langkah berikut:

1. Berapakah kemungkinan ikan air laut yang dapat dipilih Fatih?

   ---
2. Berapakah kemungkinan ikan air tawar yang dapat dipilih Fatih?

   ---
3. Daftarlah kemungkinan pasangan ikan yang akan dipilih Fatih!

Figure 8. Formulating the hypothesis

The next step is to collect data. Students may compare their answers with friends or other sources in collecting data. During Exploration and Experimentation, data will be collected (Pedaste et al., 2015). The next step is for students to test the hypothesis. The last step of the Inquiry Learning Model is to conclude (Figure 9). Students make conclusions about the concepts studied.

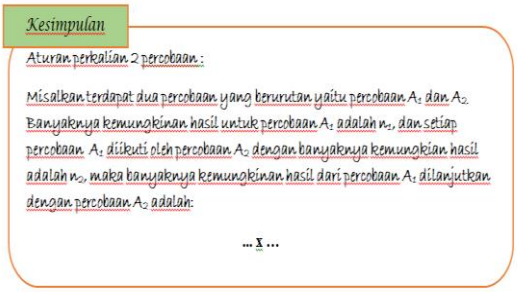
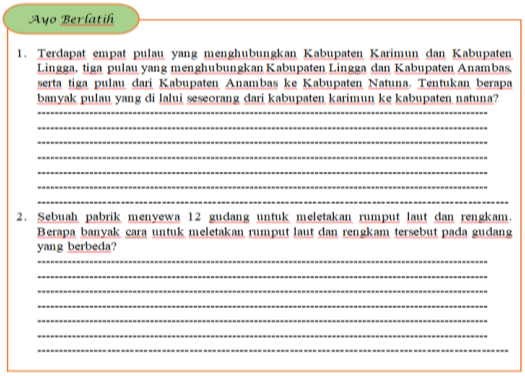


Figure 9. Conclusion

The last component of the Student Worksheets is practice questions (Figure 10). Practice questions are helpful for honing students' abilities to the concepts that have been found. This follows Suvriadi's (2018) opinion that students who practice often increase their confidence in completing them. Hence, Inquiry is essential to support learners in mathematics (Dudu & Vhurumuku, 2012), and students who engage in inquiry-based learning can increase their positive emotions and abilities (Chen et al., 2020). After the Student Worksheets draft is complete, it is continued with the development stage.


Ayo Berlatih

1. Terdapat empat pulau yang menghubungkan Kabupaten Karimun dan Kabupaten Lingga, tiga pulau yang menghubungkan Kabupaten Lingga dan Kabupaten Anambas, serta tiga pulau dari Kabupaten Anambas ke Kabupaten Natuna. Tentukan berapa banyak pulau yang di lalui seseorang dari kabupaten karimun ke kabupaten natuna?

2. Sebuah pabrik menyewa 12 gudang untuk meletakan rumput laut dan rengkam. Berapa banyak cara untuk meletakan rumput laut dan rengkam tersebut pada gudang yang berbeda?

Figure 10. Practice questions

IV. Conclusion

Based on the study results, it can be concluded that Student Worksheets are needed to help students learn. The draft of Student Worksheets is designed to contain components of the title, learning instructions, learning indicators, problems, formulating hypotheses, collecting data, testing hypotheses, and conclusions.

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