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Student Activity Sheet Based on Inquiry for Supporting Practical Work in Solution Course

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Abstrak

Pandemi Covid-19 menyebabkan pemerintah membuat kebijakan dengan menerapkan metode pembelajaran online. Kegiatan praktikum di laboratorium tidak dimungkinkan selama pembelajaran online, sehingga dosen mengembangkan lembar aktivitas mahasiswa sebagai panduan praktikum di rumah dengan alat dan bahan yang mudah ditemukan. Penelitian ini bertujuan untuk mengembangkan keabsahan dan kepraktisan lembar aktivitas siswa berbasis inkuiri pada solution course, khususnya untuk pembuatan larutan dari bahan padat dan cair. Validitas dilihat dari kriteria isi, bahasa, dan penyajian. Sedangkan kepraktisan ditinjau dari aktivitas siswa selama proses pembelajaran dan respon siswa setelah penerapan lembar aktivitas siswa yang dikembangkan. Metode penelitian yang digunakan adalah desain Research and Development (R&D) dan dibatasi hanya pada tahap uji coba produk terbatas. Penelitian dilakukan pada 91 mahasiswa jurusan IPA. Instrumen penelitian terdiri dari lembar validasi, lembar observasi aktivitas siswa, dan angket respon siswa. Analisis data yang digunakan dalam penelitian ini adalah deskriptif kuantitatif dengan teknik persentase. Hasil penelitian menunjukkan bahwa lembar aktivitas siswa yang dikembangkan termasuk kategori valid dan sangat valid karena mencapai nilai 2,9. Aktivitas siswa yang paling dominan adalah berdiskusi dengan teman sekelompoknya. Lembar aktivitas siswa juga mendapat tanggapan baik dan sangat baik (positif) dari siswa karena mencapai persentase 61% dengan kategori baik dan sangat baik. Sehingga dapat disimpulkan bahwa lembar aktivitas siswa yang dikembangkan dinyatakan layak untuk digunakan dalam proses pembelajaran.

Kata kunci: *Lembar aktivitas siswa; pertanyaan; kerja praktek; kursus solusi.*

Abstract

The Covid-19 pandemic has caused the government make policies by implementing online learning methods. Practical activities in the laboratory are not possible during online learning, so the lecturer develops student activity sheets as a practical guide at home with tools and materials that are easily found. This study aims to develop the validity and practicality of student activity sheets based on inquiry in the solution course, especially for making solutions from solid and liquid materials. Validity is viewed from the criteria of content, language, and presentation. Meanwhile, the practicality in terms of student activities during the learning process and student responses after the implementation of developed student activity sheets. The research method used is Research and Development (R&D) design and is limited only to a limited product trial stage. The research was conducted on 91 students majoring in science class. The research instrument consisted of validation sheets, student activity observation sheets, and student response questionnaires. Data analysis that used in this study is descriptive quantitatively with percentage techniques. The results indicate that the developed student activity sheets are valid and very valid category because it reaches a value of 2.9. The most dominant student activity is discussing with a group of friends. The student activity sheet also received good and very good (positive) responses from students because it reached a percentage of 61% with good and very good categories. So it can be concluded that the developed student activity sheets are declared feasible to be used in the learning process.

Keywords: Student activity sheet; inquiry; practical work; solution course.

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1. INTRODUCTION

The COVID-19 pandemic has occurred since 2019 and spread to Indonesia in early March 2020 (Hossain & Rahman, 2021). Due to the rapid spread, the government has begun to impose large-scale social restrictions, including in education. The learning process in each

education unit is based online. This was done with the Circular Letter of the Ministry of Education and Culture Number 4 of 2020 concerning the Implementation of Educational Policies in Emergencies during the Spread of COVID-19 which stated that the learning process was carried out online (Raysha et al., 2020; Sutiani et al., 2021). Online learning is distance learning that can be done anywhere by utilizing technology and the internet. Online learning is one of the best choices as an alternative to classrooms during the COVID-19 pandemic (Hossain et al., 2021). This requires lecturers to be more innovative in designing teaching materials in order to arouse students' interest and activity during learning. The survey results stated that the number of students who liked lectures with teaching materials in the form of softcopy files and photos or visual forms was 71% while 29% liked lectures using audio, video, and video conferencing (Akuma & Callaghan, 2019; Tsakeni, 2021; Zhafira et al., 2020). One of the teaching materials that are often used in lectures is student activity sheets. Student activity sheets are teaching material that can help students to explore and solve problems. Student activity sheets contain instructions for investigating a problem and problem-solving instructions given in the form of assignments or questions (Fitria et al., 2020; Ramadhona & Izzati, 2018; Wityanita et al., 2019). Through student activity sheets, lecturers can increase student motivation (E. V. Aulia et al., 2018; Yerizon et al., 2018). High motivation to learn will cause excitement and assume that learning is no longer a burden but a necessity. Student activity sheets can provide benefits for teachers as well as for students so that their availability is very necessary to support learning activities (Aulia, E & Ismono, 2015; Dipuja et al., 2018). In addition, the use of student activity sheets can also increase students' independence in understanding the material so that learning takes place effectively and efficiently.

In the 21st-century, learning can use authentic learning to direct and guide students to learn (Hadkaew & Liewkongsthaporn, 2016; Maison et al., 2020; Norahmi, 2017). This is in accordance with the demands listed in the 2013 curriculum so that learning is real/authentic, so students are required to relate what they learn to everyday life. By using such a learning process, students are expected to be productive, creative, innovative, and affective through strengthening integrated attitudes, knowledge, and skills. Graduate competency standards in the skill domain are obtained from observing, asking questions, collecting data, associating, communicating, and creating. Therefore, lecturers are required to create student activity sheets that can make students play an active, independent, and responsible role so that the alternative that can be chosen in making these student activity sheets based on inquiry (Ni'mah, 2016; Ningrum et al., 2019). The inquiry model is a learning method that places students as learning subjects so that they are required to think scientifically, develop their creativity, and solve problems independently (Yenni & Kurniasi, 2018). Student activity sheets based on inquiry contain several problems that can trigger students to think critically and make students independently design and solve problems with certain instructions such as reading literature or doing a practicum. This is in accordance with previous research, which states that 47.92% of students strongly agree and 50% of students agree with the use of student activity sheets based on inquiry because it can help students in criticizing a problem that occurs in everyday life (Nazar et al., 2018). Student activity sheets based on inquiry can increase student motivation and involve students to play an active role during learning. Lecturers provide direction through student activity sheets and guide students to conduct investigations or discoveries of a predetermined problem so that students are more enthusiastic and motivated during learning (E. V. Aulia et al., 2018). The results of previous study show that in general students learn better with guided inquiry-based laboratory experiments (Ural, 2016). Through the guided inquiry learning model, a significant increase occurred in all aspects of students' attitudes and academic achievement, as well as a significant decrease in student anxiety in the chemistry laboratory. Previous researchers

stated that in inquiry-based laboratory activities, students had fewer misconceptions and understood concepts more meaningfully (Acar Sesen & Tarhan, 2013). The average value of student performance also experienced a significant increase. Students believe that knowledge of chemistry helps interpret events in everyday life and has an important role in modern life. In addition, research by previous researcher that applies inquiry-based science literacy learning to laboratory activities proves that students' scientific literacy skills in aspects of content, context, process, and student attitudes increase (Ernita Aulia & Aulia, 2020). The characteristics of solution courses are practicum-based. One of the materials in it is to make solutions with various concentrations. The material can be understood by students well if students are directly involved in doing a practical work (Constantinou & Abrahams, 2019; di Fuccia et al., 2012; Kidman, 2012). Various studies have shown that students' lack of ability to formulate hypotheses and lack of inductive and deductive critical thinking can be overcome by guided inquiry-based learning in which various types of practical work can be integrated coherently in learning concepts, models, and "paper and pencil" problems (Estriegana et al., 2019; Martínez Torregrosa et al., 2012; Pereira et al., 2020). Practical work can be more effective in developing students' conceptual understanding if the teacher applies a "hands-on" and "minds-on" approach and explicitly plans how to link the two important components of practical work through student activity sheet (Abrahams et al., 2014; Abrahams & Reiss, 2012; Ferreira & Morais, 2020). Based on this description, the authors are interested in developing student activity sheets based on inquiry as alternative teaching materials that can be used to support practicum activities during the COVID-19 pandemic. In addition, it is also expected to help students study and do practical work independently at home with affordable tools and materials that available at home.

2. METHODS

This research is developmental research which refers to the Research and Development (R&D) research method (Sukmadinata, 2015). This research is a step to develop new products or improve previous products that can be accounted for. The product developed in this research is student activity sheets based on inquiry. The stages in the research and development method are (1) preliminary study, (2) development model, and (3) testing (Sukmadinata, 2015). The research design of student activity sheets development is show in Figure 1.

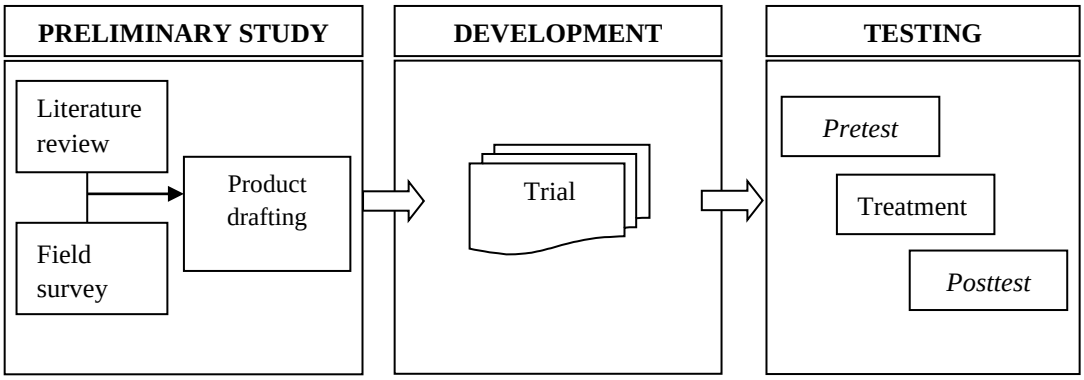

Figure 1. Design Research Development

The R&D research method is carried out until the limited trial stage to 91 students majoring in science class. Data collection in this research was carried out using a questionnaire method and an observation method. The questionnaire method consisted of a validation questionnaire and a student response questionnaire. Validation questionnaires were

given to two lecturers in charge of solution courses at the Science Department, State University of Surabaya to collect information on suggestions, input, and assessment of the feasibility of the student activity sheets. Student response questionnaires were given to students to determine student responses to the student activity sheets. Validity analysis was carried out on developed student activity sheets. Each aspect is assessed based on the validity rating scale in Table 1.

Table 1. Validity Rating Scale

Rating	Score
Very good	4
Good	3
Deficient	2
Not good	1

Furthermore, the data from the validity results were analyzed using quantitative descriptive analysis, which was carried out by calculating the average value given by the validator. This value is then described qualitatively according to the device assessment criteria presented in Table 2.

Table 2. Student Activity Sheets Assessment Category Criteria

Score Interval	Score Category	Information
$3.5 \leq S \leq 4.0$	Very Valid	Can be used without revision
$2.9 \leq S \leq 3.4$	Valid	Can be used with little revision
$2.3 \leq S \leq 2.8$	Enough	Can be used with multiple revision
$1.7 \leq S \leq 2.2$	Less Valid	Can be used with so many revision
$1.0 \leq S \leq 1.6$	No Valid	Can't be used

The percentage of student responses is converted to criteria that refer to the Likert scale as shown in Table 3.

Table 3. Interpretation Criteria for Student Response Score

Percentage	Criteria
0% - 20%	Very less
21% - 40%	Less
41% - 60%	Enough
61% - 80%	Good
81% - 100%	Very good

Based on the criteria in Table 3, the developed student activity sheets are declared practical if they get a positive response from students with a percentage of 61% or within the minimum criteria of good.

3. RESULTS AND DISCUSSION

Result

This section presents the results on the feasibility of student activity sheets in terms of validity and practicality criteria. Validity is determined based on the data from the validation results by two validators consisting of two lecturers in charge of solution courses at the Science Department, State University of Surabaya. Practicality is determined based on data

from observations of student activities and student responses to practicum activities using student activity sheets based on inquiry to make solutions from solid and liquid materials. The learning activities were carried out for 3 meetings.

Student Activity Sheets Validation

The developed student activity sheets are a guide for students to find concepts and conduct practicum. Student activity sheet 1 discussed the manufacture of solutions from solid materials and student activity sheet 2 discussed dilution of solutions. The results of the student activity sheets validation are presented in Table 4.

Table 4. Student Activity Sheets Validation Results

No	Assessed Aspect	Average	Category	Reliability (%)
I. Format				
1	Clarity of material distribution	3.33	Valid	66.67
2	Have attractiveness	4	Very valid	100
3	Clearly numbering system	3.33	Valid	66.67
4	Layout	3.67	Very valid	66.67
5	Appropriate font type and size	3.67	Very valid	66.67
6	The suitability of the physical size of worksheets with students	4	Very valid	100
II. Language				
1	Grammatical correctness and easy to read	3.67	Very valid	66.67
2	The suitability of sentence with the level of thinking and reading ability as well as the age of students	3.67	Very valid	66.67
3	Encourage work interest	4	Very valid	100
4	Simplicity of sentence structure	3.33	Valid	66.67
5	Sentences don't have double meanings	4	Very valid	100
6	Clarity of instructions for using worksheets	3.67	Very valid	66.67
7	The communicative nature of the language used	3.67	Very valid	66.67
III. Content				
1	Content/material truth	3.67	Very valid	66.67
2	The material is essential	4	Very valid	100
3	Grouped into logical sections	3.33	Valid	66.67
4	The suitability of material with basic competencies to be achieved	3.67	Very valid	66.67
5	Conformity of Indicators with basic competencies	3.67	Very valid	66.67
6	Conformity of learning objectives with indicators	3.33	Valid	66.67
7	Cultivate students' curiosity based on observing phenomena	3.67	Very valid	66.67
8	Includes the learning process with a guided inquiry model (6 phases)	3.67	Very valid	66.67
9	Laboratory activities carried out in student activity sheets are in accordance with the material	4	Very valid	100

No	Assessed Aspect	Average	Category	Reliability (%)
10	The order of material in the student activity sheet is systematic	4	Very valid	100
11	The suitability of task with the order of material	3.67	Very valid	66.67
12	Able to encourage students to find concepts	3.67	Very valid	66.67
13	Conformity with the criteria for scientific literacy skills, including aspects: context, knowledge, competence, and attitudes	3.67	Very valid	66.67
14	Eligibility as a learning tool	4	Very valid	100
IV.	**Presentation**			
1	The cover presents the contents of student activity sheets	3.00	Valid	100
2	Presentation of appropriate material	4	Very valid	100
3	Terms, formulas, and symbols are clearly stated	3.67	Very valid	66.67
4	Pictures can help students understand concepts	3.67	Very valid	66.67
5	Presentation of images accompanied by sources	4	Very valid	100
6	Writing bibliography in accordance with applicable rules	3.67	Very valid	66.67
7	The components of scientific literacy skills presented are complete, including aspects: context, knowledge, competence, and attitudes	3.67	Very valid	66.67
8	Presentation of the material allows students to work together/interact with friends/teachers/other learning resources	3.33	Valid	66.67

The data in Table 4 shows that the results of student activity sheet validation in each aspect obtained an average value range of 3.00 - 4. These results indicate that overall the developed student activity sheets are included in the valid and very valid category because it reaches a value of 2.9. In the format aspect, the average value range is 3.33 - 4 with a valid to very valid category. In the language aspect, the average score is 3.67 with a very valid category. In the aspect of content the most obtained an average value of 3.67 with a very valid category. In the presentation aspect, the average value is 3.67 with a very valid category. The range of the percentage of reliability between validators reaches 66.67% - 100%, which means that the assessment between the three validators has good conformity.

Based on suggestions and input from the validator, improvements were made to the draft of the student activity sheet based on inquiry as shown in Table 5.

Table 5. Student Activity Sheet Suggestions and Improvements

Number	Validator Suggestions	Revised Results
1	Some sentences need clarification	Fixed some sentences
2	The writing of some questions needs to be improved to make it easier to answer	Improved the grammar of some questions
3	Writing assignments need to be clarified	Fix writing assignments

Student Activity

The observed student activities included group and individual activities such as formulating problems, making hypotheses, determining experimental variables, conducting experiments, analyzing data, and drawing conclusions. This data was obtained from student activity observation sheets for three meetings. Student activity data is visually presented in Figure 2.

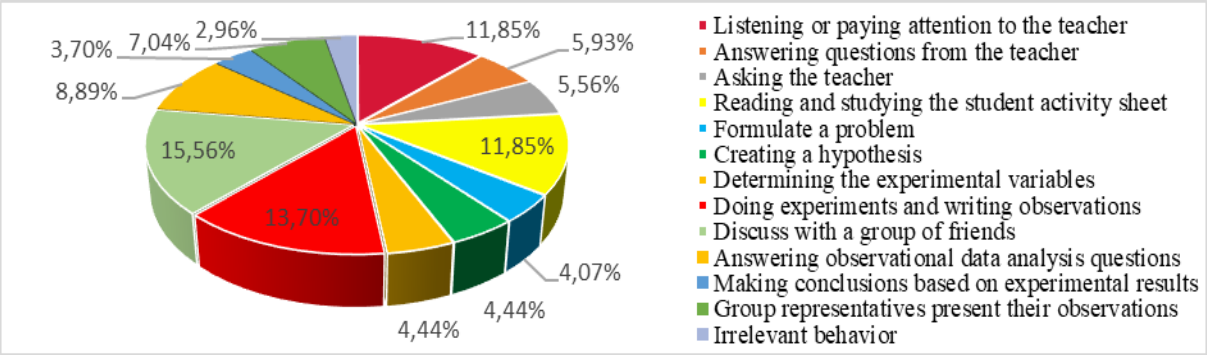

Figure 2. Student activity diagram

Based on Figure 2, it is known that the most dominant percentage of student activity is discussing with a group of friends (15.56%), conducting experiments and writing experimental data on the observation table in the student activity sheet (13.70%), reading and studying the student activity sheet (11.85%), and listening or paying attention to the teacher (11.85%). These data indicate that learning chemistry using the guided inquiry model tends to be student-centered, where students actively participate in group discussion activities, conduct experiments, and study worksheets independently or with teacher guidance if students have difficulties.

Student Response

Students' responses to the developed student activity sheet and the application of learning carried out by researchers are known from the answers to the response questionnaires filled out by students after three meetings. The developed student activity sheet and the application of learning by researchers received good and very good (positive) responses from students because it reached a percentage of 61% with good and very good categories. This is indicated by the percentage of students' positive responses to the attractiveness and novelty of teaching materials, student activity sheets, learning atmosphere, how teachers teach, and the stages directed by teachers in learning reach the range of 95% - 100%, meaning that most students feel very interested and very new learning tools and activities. The percentage of students' positive responses to the ease of teaching materials, worksheets, learning atmosphere, how the teacher teaches, and the stages directed by the teacher in learning reach the range of 90% - 100%, meaning that most students find it very easy to understand learning tools and activities.

Discussion

The developed student activity sheet consists of 2 subchapters, each of which contains pre-laboratory activities, material summaries, phenomena related to daily life, laboratory activities, and post-laboratory activities. In the format aspect, the lowest average value (3.33) was obtained, namely on the clarity of the distribution of material and numbering system, while the highest score (4.0) was obtained on the attractiveness of the student activity sheet and the suitability of the physical size of the student activity sheet with students. The value

obtained in the valid to the very valid category because in terms of appearance this student activity sheet has met the criteria for a good student activity sheet which includes presenting a summary of simple, clear, and easy to understand the material, pictures, and graphs according to the concept, layout of images, tables and questions arranged appropriately, and the features of "Did You Know" and "Phenomenons Related to Daily Life" have an appeal so that they can develop interest and invite students to think (Čanigová, 2022; Malicoban & Castro, 2022; Mouromadhoni et al., 2019). Viewed from the aspect of the format, the developed student activity sheet also contains eight important elements, namely the title, basic competencies to be achieved, completion time, tools and materials needed to complete the task, brief information, work steps, tasks to be carried out, and reports must be done (Hastuti et al., 2018; Prastowo, 2013; Servitri & Trisnawaty, 2018; Yulkifli et al., 2020).

In the language aspect, the lowest average score (3.33) is on the point of the simplicity of sentence structure, while the highest score (4.0) is obtained on the ability of student activity sheet to encourage interest in learning and the sentences used do not contain multiple meanings. In the content aspect, the lowest average score (3.33) was obtained, namely at the points of the student activity sheet preparation were grouped into logical parts and the suitability of the learning objectives with indicators, while the other points got an average value of 3.67 - 4.0. The value obtained in the valid to the very valid category is because in terms of content/materials this student activity sheet has met the good criteria, which includes the title of the student activity sheet according to the material, the material according to the level of student development, the material is presented systematically, logical, simple and clear, and supports the involvement and willingness of students to actively participate in learning and working both individually and in groups (Muskita et al., 2020; Septiani & Yulkifli, 2021). According to the validator's assessment, the preparation of this student activity sheet is in accordance with the stages of the guided inquiry model which consists of 6 phases as in the lesson plan. Presentation of material in student activity sheet also allows students to work together, interact with friends, teachers, and other learning resources (Arends, 2012; Bilgin, 2009; Husnaini & Chen, 2019).

The preparation of student activity sheets also refers to several learning theories, namely Piaget's developmental theory of assimilation, accommodation, adaptation, and equilibration, as well as Bruner's discovery learning theory. Based on Piaget's theory of development, through learning with worksheets it is expected that students can assimilate new experiences in the worksheets, then accommodate (modify existing schemes to match new experiences), then adapt (adjust schemas) through assimilation and accommodation), and balancing current understanding and new experiences (equilibration) (Slavin, 2011). Based on Bruner's learning theory, through learning with worksheets it is expected that students can learn through active participation by discovering concepts and principles independently so that students gain experience and conduct experiments that involve students to find their own principles (Evans & Cleghorn, 2022; Mouromadhoni et al., 2019; Nunaki et al., 2019). Discussion activities with friends in one group obtained the highest percentage at meetings 1, 2, and 3, this shows that during the learning process most of the time students are used to find their knowledge independently so as to form meaningful knowledge (Dwikoranto et al., 2020; Jeppsson et al., 2022). Students not only learn from what is conveyed by the teacher but through an activity that allows students to build their own knowledge. In the learning process, students learn and work with groups that are chosen heterogeneously in terms of their abilities. When students face tasks that are above their level of ability, this study group is expected to help each other and work together to complete the task (Aulia, E & Ismono, 2015; E. V. Aulia et al., 2018).

The percentage of activity making conclusions based on experimental results at meetings 2 and 3 decreased compared to meeting 1. This shows that after guided inquiry

learning is carried out, students are better able to explain phenomena scientifically and interpret data and evidence scientifically to make appropriate explanations or conclusions in a short time. The activity of group representatives presenting the results of the experiment obtained the highest percentage at meeting 2 because it involved concentration calculations. At meeting 2 irrelevant behaviors is reduced because in every learning process the teacher always emphasizes students to be serious in learning through investigation activities so that students can find their knowledge independently. The percentage of students' positive responses to the teacher's explanations and guidance reaches the range of 95% - 100%, meaning that most students feel very clear with the teacher's guidance and explanation during learning. The percentage of students' positive responses to the way teachers implement guided inquiry-oriented learning reaches the range of 90% - 100%, meaning that most students feel very happy to follow the learning process. The percentage of students' positive responses to the ease of answering the test items is 65%, meaning that most students find it easy to answer the items tested. The percentage of students' positive responses to the novelty of the test items is 100%, meaning that all students feel very new to the test being tested. The percentage of students' positive responses to the interest in participating in guided inquiry-based learning is 100%, meaning that all students have high enthusiasm in the learning process. Based on the results of the questionnaire response analysis, students are interested in learning activities and learning tools used with scores in very good criteria. All students stated that they were very interested in the teaching materials and the learning atmosphere in the classroom. Students are also very interested in the teacher's way of teaching. This is because the teacher uses a guided inquiry learning model. It is in line with previous study that found inquiry learning encourages students to seek and use various sources of information and ideas to improve their understanding of problems, topics, and issues so that students do not just answer questions (Kuhlthau, 2015; Mutlu, 2020).

Students also feel new to the learning process and learning tools used by obtaining scores in very good criteria. The other previous research also found that the highest score was obtained in the aspect of the learning atmosphere and the way the teacher taught because it was the first time students had received learning accompanied by laboratory activities (practical work) so that students were directly involved in the problem-solving process (Servitri & Trisnawaty, 2018). It supported by previous study that state that very good student response to the guided inquiry learning given by the teacher with a score in the very good criteria. It is hoped that this research will be able to provide significant benefits to lecturers in charge of solution courses at the Science Department, State University of Surabaya and other universities in Indonesia in the application of student activity sheets based on inquiry for supporting students' practical work. The limitation of this research is that it is only at the stage of limited product trials, it is hoped that future research will be able to test and develop similar products in more depth.

4. CONCLUSION

Based on the results of the validity assessment, the developed student activity sheet obtained an average score in the valid to very valid categories. Thus, it can be concluded that the developed student activity sheet is suitable for use in the learning process, but some revisions still need to be made. Based on the analysis of student activity observations, it can be concluded that student activity sheet based on inquiry is able to encourage students to be actively involved in learning through personal discovery. One of the keys that determine the success of the learning process is a conducive academic environment, one of which is student-centered activities. This is supported by student activity data which shows that in general students can do work until they find answers, solve problems, and analyze

experimental results. Overall, the developed inquiry-based student activity sheets were considered practical because it received a positive response from students with good to very good criteria.

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