Feasibility of guided inquiry-based student lab worksheet on the topic of polymer through making squishy

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Abstract. This research aims to determine the feasibility of the student lab worksheet based on guided inquiry on the topic of polymer through making squishy. The research design used on this research is educational design research. Participants in this research are three chemistry education lecturers at Department of Chemistry Education FPMIPA UPI Bandung and two chemistry teachers at a private school in Bandung. The instrument used in this research is the feasibility test sheet related to the suitability of the components in student lab worksheet with indicators of inquiry skills, suitability of concepts, suitability of grammar, and suitability of layout and appearance in the student in the lab worksheet. The results of the feasibility test related to the suitability of components in student lab worksheet with indicators of inquiry skills, suitability of concepts, suitability of grammar, and suitability of layout and appearance are all scored above 80% thus included in the “excellent” category. The obtained results indicate that the student lab worksheet is feasible to be used in a limited trial and can be further developed.

1. Introduction

The learning activities are very decisive in increasing student motivation and learning outcomes. It is necessary to look for appropriate learning activities such as laboratory work method. In line with research conducted by [1], laboratory work activities can enable students to learn concepts directly through observation and experiment, so as to improve understanding on the concepts given and develop aspects of skills and attitude. In addition, guided inquiry-based laboratory works can improve students’ knowledge, science process skills, and motivation in learning [2].

In order to develop aspects of the attitudes, knowledge, and skills of students through laboratory work, a teaching material able to assist students in developing these three aspects is needed, one of which is the use of student lab worksheet. With the student lab worksheet, an effective interaction can be formed between students and teachers so that it can increase learning activities and student achievement [3]. There are 2 types of student lab worksheet, which are cookbook type lab worksheet and inquiry-based lab worksheet [4]. Cookbook student lab worksheet only asks students to follow step-by-step instructions to get predetermined results so the students rarely get the chance to feel challenged and thrilled to be involved in making their own experimental designs [5]. To overcome the disadvantages of cookbook lab worksheet it is necessary to use an inquiry-based lab worksheet.

Instructions in an inquiry-based student lab worksheet are able to improve students’ academic abilities and skills [6]. Laboratory works that used guided inquiry methods can develop positive attitudes and reduce students’ anxiety about chemical materials [7]. Student lab worksheet on the topic of polymers is still rarely used as a teaching material [8]. From the 10 instructional materials studied there
was only one teaching material that provides student lab worksheet on the topic of polymers and the type of the worksheet is cookbook worksheet.

The guided inquiry-based laboratory works will be even better if it relates to the daily life. Inquiry-based laboratory works with an environmental context can provide opportunities for students to apply the results of the experiments on their environment and construct their knowledge through experiments [9]. One of the chemical materials that exists in the daily life and often can be found by students is polymer. Starting from the examples that are commonly reviewed in the topic of polymer in class such as plastic, rubber, glue, pipes, textiles, and cables, to the examples of polymer that are currently often being talked about such as slime and squishy, all these examples are often found and used by the students.

The topic of polymer includes macromolecule material contained in the 2013 curriculum for grade XII content standard, on KD 3.9 namely “Analyzing the structure, nomenclature, characteristics, and classification of macromolecules” and KD 4.9, “Analyzing the results of information retrieval regarding the manufacture and impact of a product from macromolecules”. From both of the KD, students are not required to conduct experiments related to making macromolecules but only trace information of it. However, on the basis of the advantages of laboratory works methods in an environmental context that can provide meaningful learning and the benefits of student lab worksheet based on guided inquiry that can provide opportunities for students to develop their skills in thinking, therefore this polymer topic was chosen as the topic to develop the guided inquiry-based student or lab worksheet.

Based on the description above, it is necessary to develop a guided-inquiry based student lab worksheet on the topic of polymer properties through making squishy. One of the steps needed to develop student lab worksheet as a prototype in this research is a formative evaluation such as prototype assessment by experts or judgment to determine the feasibility of the prototype. The result of the feasibility test can be used later as a reference for improving the prototype developed [10].

2. Method
The design of this research is an educational design research approached developed by Plomp [10]. Educational design research, in general, has three steps: (1) analysis of problems to be solved in research (preliminary research); (2) design and development of prototypes to overcome research problems (development or prototyping phase); and (3) assessment of prototypes made (assessment phase). This research was carried out only until the second phase because the activities on this phase were formative evaluation such as prototype assessment by experts or judgment to determine the feasibility of the prototype being developed, and the results of this implementation could be used as reference on improving the prototype. Whereas in the third phase, activities carried out are summative evaluation that is focusing on implementing the prototypes and evaluating their effectiveness.

Participant in this research are three chemistry education lecturers at Department of Chemistry Education of FPMIPA UPI and two chemistry teachers at a private school in Bandung. The instruments used in this research are the component feasibility test sheet of the student lab worksheet which is developed with indicators of inquiry skills [11] as well as the feasibility test sheet for concept suitability, grammar suitability, and layout and appearance suitability of the student lab worksheet prototype based on the terms of drafting the student lab worksheet according to [12]. Feasibility test sheet used by the lecturers and teachers is using a Likert scale (Table 1).

| No. | Answer option on feasibility test sheet | Score |
|-----|----------------------------------------|-------|
| 1   | Strongly agree                         | 4     |
| 2   | Agree                                 | 3     |
| 3   | Disagree                              | 2     |
| 4   | Strongly disagree                     | 1     |
Scale used in this research is a 4-score scale, a modification of the 5-score scale to avoid bias doubts. Percentage score obtained from the test sheet is then interpreted using the score interpretation criteria according to [13] (Table 2).

Table 2. Score interpretation criteria

| Range of score percentage (%) | Category |
|-------------------------------|----------|
| 0-20                          | Poor     |
| 21-40                         | Fair     |
| 41-60                         | Average  |
| 61-80                         | Good     |
| 81-100                        | Excellent|

3. Results and Discussion

The results of data processing from the feasibility test regarding the suitability of the student lab worksheet components developed with indicators of inquiry skills, the suitability of concepts, suitability of grammar, and suitability of layout and appearance are shown in Table 3.

Table 3. The results of feasibility test

| Aspect                                           | Score (%) | Criteria |
|--------------------------------------------------|-----------|----------|
| Suitability of the student lab worksheet components with indicators of inquiry skills | 96.8      |          |
| Suitability of concepts                          | 96        | Excellent|
| Suitability of grammar                           | 90.8      |          |
| Suitability of layout and appearance              | 93.5      |          |

Based on Table 3 above, all of the aspects assessed on the feasibility test sheet are included in the “excellent” category. This indicates that the student lab worksheet developed is feasible to be used in a limited trial and the student lab worksheet can be further developed to go through assessment of prototypes (assessment phase) [10]. The percentage of average score from the feasibility test regarding the suitability of the student lab worksheet components with indicators of inquiry skills shows 96.8% and is included in the “excellent” category. This shows that the components in the student lab worksheet developed are very compatible with the indicators of inquiry skills and can guide students to achieve the expected inquiry skills. The expected inquiry skills to be achieved are identifying problems, making hypothesis, choosing the required equipment and materials, determining experiment variables, designing procedures, conducting experiments, collecting data from experiments, analyzing data from experiments, testing hypothesis, and making conclusions [11].

The percentage of score for the aspect of the suitability of concepts in the student lab worksheet developed shows 96% and is included in the “excellent” category. This shows that the student lab worksheet developed is in accordance with the indicators of conformity assessment. The components of the student lab worksheet are in line with the concepts of polymer that relates to the daily life according to the didactic requirements stated by [12]. The percentage score for suitability of grammar shows 90.8% which also is included in the “excellent” category, meaning the grammar of the student lab worksheet developed is in accordance with the assessment indicators. This indicates that the student lab worksheet has fulfilled the linguistic aspects based on the constructive requirements [12]. The percentage score for suitability of layout and appearance shows 93.5% and is also included in the “excellent” category. This shows that the layout and appearance of the student lab worksheet developed is in accordance with the assessment evaluation indicators. This result also has fulfilled the composition and typology aspects based on the constructive requirements [12].
4. Conclusion
The result of the feasibility test related to the suitability of components in the student lab worksheet with indicators of inquiry skills, suitability of concepts, suitability of grammar, and suitability of layout of appearance of the student lab worksheet developed are all scored above 80% thus included in the “excellent” category. The obtained results indicate that the student lab worksheet is feasible to be used in a limited trial and can be further developed.

5. References
[1] Duda H J 2010 Pembelajaran berbasis praktikum dan asesmennya pada konsep sistem ekskresi untuk meningkatkan kemampuan berpikir kritis siswa Kelas XI J. VOX Edukasi 12 p. 29–39.
[2] Cheung D 2011 Teacher Beliefs about Implementing Guided-Inquiry Laboratory Experiments for Secondary School Chemistry J. Chem. Educ. 88 11 p. 1462–1468.
[3] Arafah S F Priyono B and Ridlo S 2012 Pengembangan LKS Berbasis Berpikir Kritis pada Materi Animalia Unnes J. Biol. Educ. 1 1 p. 75–81.
[4] Wenning C J 2005 Level of Inquiry: Hierarchies of Pedagogical Practices and Inquiry Processes J. Phys. Teach. Educ. Online p. 3–11.
[5] Gowally C Brickman P Hallar B and Armstrong N 2011 Lesson Learned About Implementing an Inquiry-Based Curriculum in College Biology Laboratory Classroom J. Coll. Sci. Teach. 40 3 p. 45–51.
[6] Wang C Kim D H Bong M and Ahn H S 2013 Examining measurement properties of an English Self-Efficacy scale for English language learners in Korea Int. J. Educ. Res. 59 p. 24–34.
[7] Ural E, 2016 The Effect of Guided-Inquiry Laboratory Experiments on Science Education Students’ Chemistry Laboratory Attitudes, Anxiety and Achievement J. Educ. Train. Stud. 4 4 p. 217–227.
[8] Firdausy G L 2015 Pengembangan Lembar Kerja Siswa (LKS) Praktikum Berdasarkan Model Inkuiri Terbimbing pada Topik Polimer Melalui Pembuatan Lem Kayu, Universitas Pendidikan Indonesia.
[9] Mandler D Blonder R Yayon M Mamlok-Naaman R and Hofstein A, 2014 Developing and Implementing Inquiry-Based, Water Quality Laboratory Experiments for High School Students To Explore Real Environmental Issues Using Analytical Chemistry J. Chem. Educ. 91 4 p. 492–496.
[10] Plomp T 2013 Educational Design Research: An Introduction, in Educational Design Research, N. Nieveen and T. Plomp, Eds. (Enschede: Netherlands Institute for Curriculum Development (SLO)) p. 10–51.
[11] Lou Y Blanchard P and Kennedy E, 2015 Development and Validation of a Science Inquiry Skills Assessment J. Geosci. Educ. 63 1 p. 73–85.
[12] Widjaya E 2008 Kualitas Lembar Kerja Siswa in Pelatihan Penyusunan LKS Mata Pelajaran Kimia Berdasarkan Kurikulum Tingkat Satuan Pendidikan Bagi Guru SMK/MAK.
[13] Riduwan 2014 Dasar-dasar Statistika Bandung: Alfabeta.