

Guided Inquiry-Based Questions Integrated Practice Worksheets Design to Improve Laboratory Skills and Knowledge

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Abstract

The essence of learning Science is not just remembering and understanding the concept but also a habitual behavior in finding concepts. Science learning requires a laboratory to train students' skills. Complete laboratory will be useful if used as possible. The Worksheet Practice design with guided inquiry approach is needed to facilitate students in conducting laboratory experiments. This study aims to determine the feasibility of integrated Worksheet Practice design based on guided inquiry and effectiveness of student laboratory skills. The research design used is one group pretest and post test design. Research data obtained by observation method, documentation, questionnaire, and test. The results obtained mean score 80.56 on the presentation aspect, 81.25 on the content feasibility aspect, 81.95 on aspects of graphical aspect, and 82.50 on the language aspect with maximal score 100. The results showed that Worksheet Practice design with guided inquiry approach is categorized as very feasible and can improve students' laboratory skill and knowledge.

Abstrak

Hakikat belajar Sains tidak sekedar mengingat dan memahami konsep melainkan juga merupakan pembiasaan perilaku dalam menemukan konsep. Pembelajaran sains memerlukan laboratorium untuk melatih keterampilan siswa. Laboratorium lengkap akan bermanfaat apabila digunakan sebaik mungkin. Desain Lembar Kerja Praktikum dengan pendekatan inkuiri terbimbing diperlukan untuk mempermudah siswa dalam melakukan percobaan di laboratorium. Penelitian ini bertujuan untuk mengetahui kelayakan desain Lembar Kerja Praktikum terpadu berbasis inkuiri terbimbing serta keefektifannya terhadap keterampilan laboratorium siswa. Desain penelitian yang digunakan adalah *one group pretest and post test design*. Data penelitian diperoleh dengan metode observasi, dokumentasi, angket, dan tes. Hasil penelitian diperoleh rerata skor 80,56 pada aspek penyajian 81,25 pada aspek kelayakan isi, 81,94 pada aspek kegrafikan, dan 82,50 pada aspek kebahasaan dengan skor maksimal 100. Hasil penelitian menunjukkan bahwa desain Lembar Kerja Praktikum dengan pendekatan inkuiri terbimbing dikategorikan sangat layak dan dapat meningkatkan keterampilan laboratorium dan pengetahuan siswa.

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INTRODUCTION

Scientific approach related to inquiry activity. Inquiry is a thinking process to understand something by asking a question (Sani, 2015). Based on the result of the PISA test followed by several countries including

Indonesia since 2000 on Table 1, it shows that Indonesian students were not able to answer questions which needed high thinking skill. High thinking skill, according to Bloom Taxonomy on cognitive aspect was in C4 (analyzing), C5 (evaluating) and C6 (creating).

Table 1. The result of Indonesia's Rank Recapitulation from LitbangKemendikbud from 2000 Based on PISA Test

Year of Study	Indonesia's Rank	The Number of Participations
2000	38	41
2003	38	40
2006	53	60
2009	57	65
2012	65	67

(Rusilowati, 2013)

At 2013 curriculum has set inquiry activity in scientific learning including observing, asking, reasoning, experimenting/collecting information, reasoning/ associating and communicating. Competence of Graduate Standard has also been set in 2013 curriculum on competence of graduate standard that is criteria about qualification of graduate ability covered attitude, knowledge, and skills.

The nature of science learning is not only remembering and understanding the concepts, but also a behavior custom in finding the concepts. Yadirgaroglu & Demircoglu (2011) states that in field of science education, laboratory is more important because it gives students opportunity to do various hand on activity. Chemistry is part of science and it is obtained and developed based on experiment to find an answer. Chemistry is also stated as an experimental science which is done in laboratory (Kurniati & Daena, 2011). Laboratory activity is very effective to improve cognitive, metacognitive psychomotor skill and attraction to chemistry, attraction to study chemistry and work related to chemistry learning (Hofstein, 2004).

The implementation of laboratory activity needs guidance about the purposes of practice, procedures of practice, observation worksheets, tools and materials of practice worksheets or known for practice guidebook (Arifin, 1995). Chemistry is also an inquiry method which

includes ways of thinking, reasoning, formulating problems, experimenting and observing, analyzing data and concluding to obtain products of science.

Based on the background elaborated above, then problem statements in this research are (1) is guided inquiry-based integrated practice worksheets design feasible to be used in practice activity? (2) is guided inquiry-based integrated practice worksheets design effective to improve student's laboratory skills and knowledge?

The purposes of this research are to (1) find out the feasibility of is guided inquiry-based integrated practice worksheets design used in practice activity; and (2) find out the effectiveness of is guided inquiry-based integrated practice worksheets design towards student's laboratory skills. The result of this research will be beneficial to: (1) give practice worksheets design which is feasible to be used for students so they have clear practice guidance when they are doing the practice; and (2) find out student's laboratory skill after using the result of developing practice worksheets design.

METHOD

This research was pre-experimental research (pre experiment design). The design of the research was "One Group Pretest and Posttest Design", that was an experiment conducted to one group only without

comparison group (Rosalina et al., 2014), as presented on Figure 1.

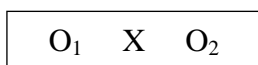


Figure 1. One Group Pretest and Posttest Design

Note:

- O₁: pretest used to find out pre-conception of students towards acid-base titration material before using guided inquiry-based cognitive question of integrated practice worksheets.
- O₂: posttest used to find out student's conception towards acid-base titration material before using guided inquiry-based cognitive question of integrated practice worksheets.
- X: treatment which is guided inquiry-based cognitive question of integrated practice worksheets on acid-base titration material.

Procedures of this research included: (1) observing background, (2) collecting data, (3) designing practice worksheets, (4) validating practice worksheets, (5) revising practice worksheets, (6) testing practice worksheets design, (7) revising practice worksheets, and (8) implementing practice worksheets. Sources of this research obtained from experts, education practitioners, and students. The data collected were quantitative and qualitative data which included: (1) Data from experts to determine validity of research instrument; (2) Data of laboratory skills toward practice worksheets obtained by filling observation worksheets of observers before and after learning, and student's response toward practice worksheets obtained by filling inquiry worksheets of students before and after practice activity; and (3) Data of student's knowledge skills result.

Subject of this research was 19 grade XII Science students as experimental class for feasibility of practice worksheets, 60 grade XII Science students as validity and reliability test of question and 2 experimental classes which were 23 grade XI Science-1 students, 23 grade XI Science-2 students, even semester academic year 2016/2017. Collecting data used in this research were: observation, interview, documentation,

inquiry distribution, and test. Instrument which would be used was initially validated (construct validity, content validity, and inquiry validity), inquiry reliability, distinguishing of question, and difficulty level of question. Based on the data analysis of pretest it was found 25 multiple choice questions which met the valid criteria with reliability 0.956.

RESULT AND DISCUSSION

The result of guided inquiry-based integrated practice worksheets design research on acid-base titration material shows that:

1. Potentials and Problems

Based on the result of interview with chemistry teacher of MAN Kebumen, it was obtained the information that: (1) the school had complete learning facilities; (2) most of teachers had teacher certification; (3) the school had dormitory for students; and (4) the school used 2013 curriculum in learning activity. The problems of MAN Kebumen were: (1) the low student's knowledge (cognitive) skill; (2) practice activity was rarely done; (3) practice related to acid-base titration material had never been done; and (4) students who got passing of learning were less than 10 from 80 students.

2. Collecting Data

Based on potential of problems above, then collecting data was obtained. The data collected included: (1) syllabus of grade XI Science class in even semester the main material was acid-base titration and acid0base titration curve; (2) the result of relevant research about practice worksheets arrangement and laboratory skills.

3. Practice Worksheets Design and Design Validity

Initial design of practice worksheets framework included: (1) Cover; (2) Preface; (3) Laboratory Rules; (4) Danger Symbols Introduction; (5) Tool Guidance List; (6) Table of Contents; (7) Practice Worksheets; (8) Cognitive Questions; (9) Bibliography. After printing practice worksheets design, validating practice worksheets design was done. Validation of practice worksheets design was done by three validators, they were were 2 lecturers, and a teacher.

The result of practice worksheets of validation of three validators can be seen on validation was based on content feasibility, presentation, language, and graphic. The result

Table 2. The result of practice worksheets validation

Validator	The number of Score on Aspect Maximal score 100			
	Content Feasibility	Presentation	Language	Graphic
Material Expert	78.13	79.17	80.00	79.17
Media Expert	78.13	79.17	80.00	79.17
Chemistry Teacher	87.50	80.33	87.50	87.50
Mean	81.25	80.56	82.50	81.94
Category	Very Feasible	Very Feasible	Very Feasible	Very Feasible

Table 3. Student's Response towards Practice Worksheets on Small Scale

Measured Aspect	Pretest Response (N = 19)	
	Score Max score 100	Category
Presentation	87.11	Excellent
Language	83.55	Excellent
Graphic	83.22	Excellent
Average	84.63	Excellent

Besides obtaining data about designed practice worksheets feasibility, the researcher also obtained suggestions from media expert validator. The suggestions were: (1) content material improvement (2) sources of picture on practice worksheets should not be written *http* but person's name and year of upload/publish of the pictures.

4. Revising Design

Suggestions obtained from media expert validation were followed up by revising developed practice worksheets design. Practice worksheets revision on this stage included: (1) content material change; and (2) change of written sources of picture, which initially written as *http* into person's name and year of publish.

5. Small Scale Pretest

Revised practice worksheet was pretested on small scale. Small scale pretest was done to find out student's response and the effectiveness of practice worksheets. Student's response towards developed practice worksheets can be seen on Table 3.

On small scale pretest there were two students who gave response on developed practice worksheets, which were: (1) Cognitive questions were still difficult to be understood; and (2) The language was not communicative enough.

6. Revising Practice Worksheets Design

Student's response toward practice worksheets on small scale pretest then followed up by revising developed practice worksheets. Revision of practice worksheets on this stage was adding preface on cognitive questions.

7. Applying Practice Worksheets on Experimental Class

Revised practice worksheet was applied to experimental class. Practice worksheets application was done to find out student's response and the effectiveness of practice worksheets. Student's response on practice worksheets pretest of experimental class can be seen on Table 4.

Table 4. Student's Response toward Practice Worksheets on Experimental Class

Measured Aspect	Response of Experimental Class (N = 46)	
	Score Max Score 100	Category
Presentation	83.37	Excellent
Language	83.70	Excellent
Graphic	83.40	Excellent
Mean	83.49	Excellent

On experimental class pretest, the achievement of classic and per each indicator aspect of laboratory skill indicators, can be seen respectively on Picture 2, 3, 4, and 5.

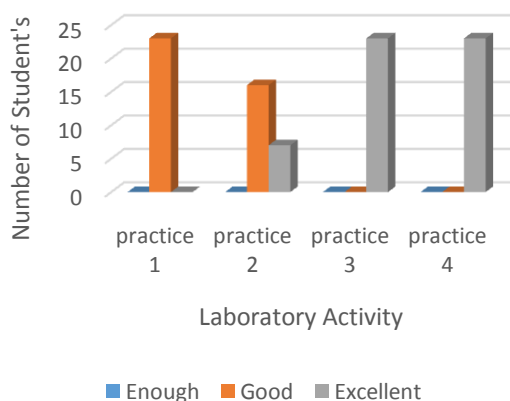


Figure 2. Graphic of the Achievement of Classic Indicator Aspect of Laboratory Skill Indicators on Experimental Class 1

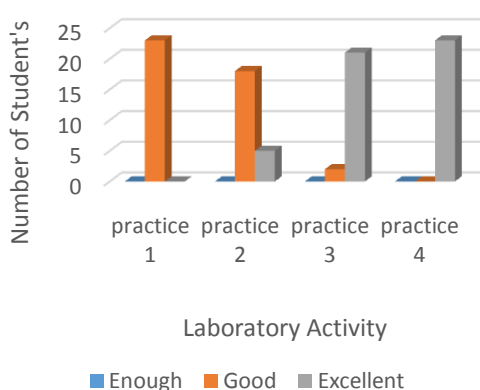


Figure 3. Graphic of the Achievement of Classic Indicator Aspect of

Laboratory Skill Indicators on Experimental Class 2

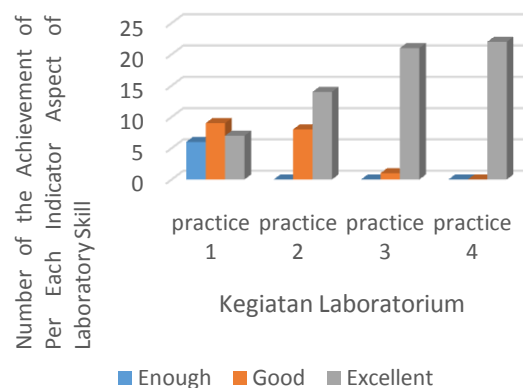


Figure 4. Graphic of the Achievement of Per Each Indicator Aspect of Laboratory Skill Indicators on Experimental Class 1

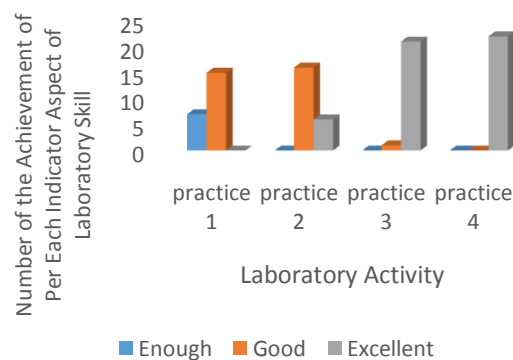


Figure 5. Graphic of the Achievement of Per Each Indicator Aspect of Laboratory Skill Indicators on Experimental Class 2

8. Revising Practice Worksheets

On wide scale pretest the researcher did not get suggestion/response from students about the weakness of developed practice worksheets. Some students wrote in the comment column that practice worksheet was very good, the delivery of practice in worksheets was attractive, language used was clear and easy to be

understood, and acknowledgement for given practice worksheets.

9. Final Practice Worksheets

Guided inquiry-based cognitive question of integrated practice worksheets which were stated as valid by validators and had been revised on some pretest stages and then they were able to be implemented on broader learning. Chemistry guided inquiry-based cognitive question of integrated practice worksheets was designed in order to make learning focused on students, so they were motivated in learning chemistry.

Learning approach was focused on students was a learning approach which engaged students to do various relevant activities and made teacher as a facilitator. Students were not only learn theories, but practiced directly the concept they had learned, so they felt that knowledge was not only learned, but also applied in daily life (Hude, 2010: 46). With learning approach that focused on students, they were easier to understand and be motivated to find out independently if there were unknown things (Sumarmi, 2014).

The result of validation of worksheets design was very feasible. Developed practice worksheet was categorized as "very feasible" in content feasibility aspect, presentation aspect, language aspect, and graphic aspect. It shows that designed practice worksheets were able to: (1) help students to prepare independent learning; (2) have an activity plan which could be responded maximally; (3) load learning content which was complete and able to give learning opportunity to students; and (4) be able to monitor student's learning activity (Indriyanti, 2010).

Effectiveness was measurement in achieving determined purposes (Zammi, 2014). Effectiveness of guided inquiry-based cognitive question of integrated practice worksheets was able to improve student's laboratory skills and knowledge. Before practice was conducted by using designed practice worksheets, students were given pretest. Pretest was done by 2 activities; observing of student's laboratory skills done by 3 observers and giving this pretest aimed to find out student's understanding about

acid-base titration material which had not been learned yet in the class. After giving pretest, experimental class had practice activity in laboratory that referred to designed practice worksheets. In the end of meeting, students were given posttest of knowledge and each practice activity was observed the classical and per aspect indicator of student's laboratory skills.

Laboratory activities in this research divided into 3 activities which were 5 indicators of initial activity, 11 indicators of implementing practice activity, and 7 indicators of final activity presented on Picture 7 and 8. Initial indicator was in indicator number 1 to 5 which planned practice procedures, made attributes, prepared tools list, and cleaned the tools, prepared materials and brought tools and materials of practice.

In practice 2 students had difficulty in determining work procedures to be longer as indicator 6 for experimental class 1. In experimental activity 3 and 4 students started to get used to plan work procedures independently in their groups. In practice 2 students got used to use attribute which were self-protection equipment. In indicator 4 to 6 students were able to prepare list of tools, clean tools, prepare list of materials, and bring tools and materials which were used.

Activity indicators of implementation of practice was in indicator number 7 to 15 which were arranged titration tools, used titration tools, took the materials, measured the materials and chose indicators, poured solution to Erlenmeyer, poured standard solution to burette, shook titrated solution, determined final titration, and communicated in practice activity. Indicator 1 achievement of practice activity 1 in experimental class 1 and 2 still had difficulties, because in the practice of acid-base titration had never been implemented yet in this school. Some students still did not know how to use the tools so indicator 15 which was communication the students were very well at it. Indicator achievement of laboratory skills in practice 3 had obtained good and excellent criteria, whereas in practice 4 had obtained excellent activity.

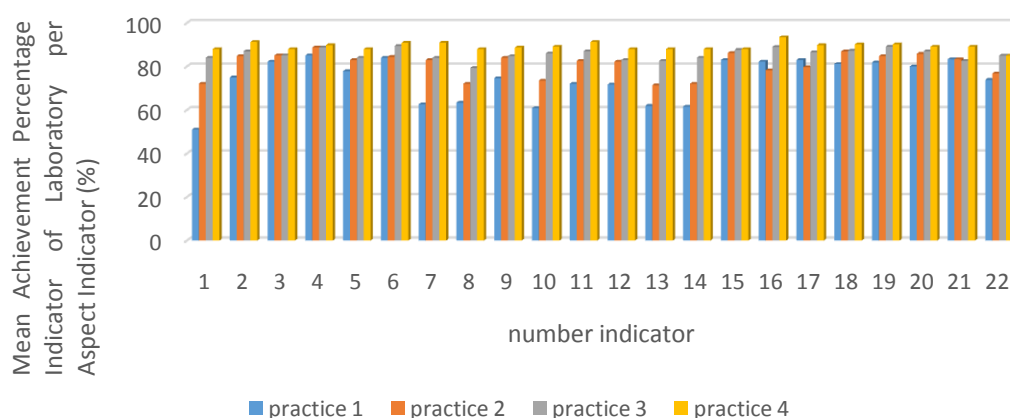


Figure 6. Graphic of Mean Achievement Percentage Indicator of Laboratory per Aspect Indicator (%) of Experimental Class 1

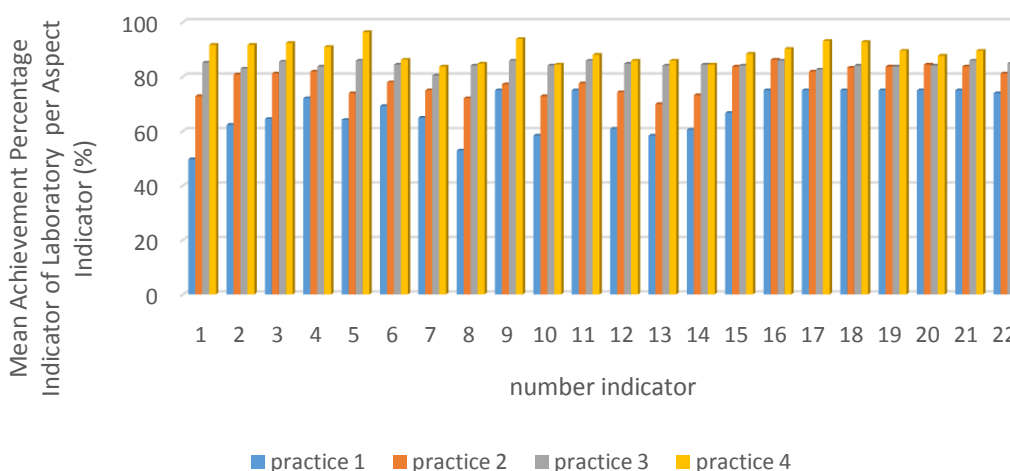


Figure 7. Graphic of Mean Achievement Percentage Indicator of Laboratory per Aspect Indicator (%) of Experimental Class 2

The last indicator of practice was in number 16 and 22 which were: cleaned the tools, checked the tools and organized them, be honest in measuring and calculating practice result, threw the materials away, cleaned work

place of practice. Indicator achievement in the end of practice generally for practice activity 1 to 4 and students had obtained good and excellent category.

Table 5. T Test Result of Design Usage

Aspect	Treatment Class	Mean	N-Gain	Tcalculate	p value	Conclusion
Knowledge	Experiment 1	Pre	41.86	0.48	20.15	0.000
		Post	69.83			
	Experiment 2	Pre	37.95	0.49	20.065	0,000
		Post	69.22			

It was appropriate with a research by Suansah (2016) and Nuritasari (2016) which also showed that learning with inquiry was appropriate to be used to improve student's observation skill (reading the result of scale, reading the result of volume measurement and observing each change occurred during practice). Practice worksheet in this research was effective to improve student's laboratory skills because it was able to describe profile of student's laboratory skills clearly based on observation result.

Knowledge skill in this research referred to student's cognitive aspect. The result of t test of knowledge was presented on Table 5 which shows that there was a difference of student's knowledge before and after using PW with guided inquiry approach. The result of obtained posttest score shows that student's knowledge skill had quite high improvement with classical completeness for 86% with the number of students who passed was 20 of 23 students.

The result is aligned with Ural (2016); Sesen & Tarhan (2013) which stated that the result had significant difference which was higher than using traditionally cook book method. The result of this research suggests that laboratory activity was needed to be developed by using guided inquiry to improve laboratory skills and knowledge and also to give positive response toward students.

CONCLUSION

Based on the result about guided inquiry-based integrated practice worksheets design, then it can be concluded that: (1) guided inquiry-based integrated practice worksheets design was feasible to be used in practice activity, (2) guided inquiry-based integrated practice worksheets design was effective to improve student's laboratory skills and knowledge. This practice worksheets design is able to be used by teacher in teaching practice material related to acid-base titration.

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