



NEED ANALYSIS OF STUDENT WORKSHEET (LKS) OF IONIC EQUILIBRIUM AND pH OF THE SALT SOLUTION BASED ON PROBLEM SOLVING

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Abstract

Problem solving skills are one of the skills needed by students in the era of the industrial revolution 4.0, so it becomes a challenge for a teacher to design creative learning. One of the media that supports students' problem solving skills is to use worksheets. Meanwhile, the worksheets used so far are general in nature. Suitable worksheets are developed that support students in solving problems, namely problem solving-based worksheets. This study aims to analyze the need for problem solving-based student worksheets. This type of research is a qualitative descriptive study. This needs analysis is part of the research and development of the 4D model, specifically the Define stage. The subjects in this study were students of class XII in SMA Negeri 3 Cirebon City and chemistry teachers as informants. The results showed that students needed worksheets that were more attractive and easy to understand. The worksheets available are in accordance with KD, KI and the 2013 curriculum, but not yet according to student needs. Based on data obtained from several analyzes including analysis of student perceptions, teacher perceptions, student characteristics, curriculum, assignments, concepts and analysis of learning objectives. So it is necessary to develop problem solving worksheets, especially in the matter of ionic equilibrium and pH of salt solutions which can train students to solve problems and relate theory to facts in everyday life.

Keywords: *worksheets, Keseimbangan Ion dan pH Larutan Garam, Problem Solving*

INTRODUCTION

One of the biggest challenges for teachers in the era of industrial revolution 4.0 is making learning designs that can improve problem-solving skills in students

(Purwaningsih et al., 2020); Learning is not just transferring knowledge, but prioritizing the involvement of students actively in the learning process. Student activities in the learning process can be supported



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through a variety of learning methods or media so that later students have thinking and solving problems independency in everyday life. Based on this, teachers are expected to use teaching materials that can make students more active in solving problems as a tool in the learning process and can be used as a learning resource. One of the teaching materials that teachers can use to create active and independent learning is using Student Worksheets (LKS).

Worksheets are a printed teaching material in the form of sheets of paper containing material, summaries, and instructions for implementing learning tasks that must be done by students which refer to the basic competencies that must be achieved (Prastowo, 2015). Worksheets includes printed teaching materials (in addition to handouts, modules, books) that can help teaching and learning process (Zulyadaini, 2017). Worksheets can improve conceptual understanding of students (Zulianti, Kadaritna & Efkar, 2017). In addition, student worksheets can help students improve scientific literacy of students (Ekantini & Wilujeng, 2018). Therefore, student worksheets are needed to support learning activities (Susanti, Poedjiastuti & Taufikurohmah, 2018). However, the worksheets used must also have certain characteristics according to student needs, because not all existing worksheets are suitable for the conditions and needs of students.

Chemistry is a distinctive scientific discipline, one of its peculiarities is that it contains abstract concepts, but in fact chemistry is very closely related to everyday life (Faizah et al., 2013). The ionic equilibrium

material and the pH of salt solution are contextual material and closely related to everyday life, for example baking soda, chlorine, bleach solution and so on. Worksheets that are suitable to developed to facilitate students' ability to solve problems, namely problem solving-based worksheets (Hadinurdiana & Kurniati, 2018). This is because in the problem solving model learning activities, individuals are faced with problems that must be solved, there are stages in solving problems, namely gathering information, formulating hypotheses, testing hypotheses and drawing answer conclusions on problems. Problem solving has the advantage of strategies to understand real-life problems and can help students develop new knowledge. This is in line with the statement of Ruci & Purnomo (2020) that the use of problem solving stages in learning activities is expected to develop students' abilities to find a new concept from the problem solving activities carried out. In addition, problem solving skills are very important for students and their future (Wena, 2012).

The problem-solving process provides opportunities for students to play an active role in learning, looking for, and finding their own information so that it can be processed into concepts, principles, theories, and conclusions. The process is arranged in stages on a worksheet according to the stages of problem solving. Huda (2013) defined problem solving method as a way of presenting learning material by making the problem as starting point for discussion to be analyzed and synthesized in an effort to find solutions or answers by students. Problem solving will

increase intellectual power in solving difficult problems because students are given the opportunity to explore themselves by combining the knowledge they already have, namely declarative, procedural, conditional. (Căprioară, 2015). Several other advantages are that the application of problem solving learning models can also improve learning outcomes (Simatupang, 2019) and can improve students' science concepts because students are accustomed to being trained in the ability to give reasons and solve problems (Cheng, She & Huang, 2018). In addition, a problem solving approach can improve problem solving skills (Putra & Syarifuddin, 2019).

Generally teachers use student worksheets in their learning process, but the worksheets used are obtained from the publisher so that these student worksheets are still universal and not specific, even though each worksheet in the student worksheets can help students be active in the learning process such as improving students' ability to solve problems (Jannah et al., 2020). Therefore, before developing student worksheets, it is necessary to carry out a needs analysis to find out the various problems contained in chemistry learning, as well as to examine the strengths and weaknesses of student worksheets that have been used as handbook worksheets.

The development of teaching materials in the form of problem solving-based worksheets has been carried out by several other researchers in the field of chemistry (Pramesti, Rudibyani & Sofia, 2017); (Zulianti et al., 2017); (Ardiani et al., 2017). While research on the analysis of the needs of student worksheets in learning has also

been carried out by several researchers (Ayuwandari & Kusumawati, 2019); (Fadilah, 2019); (Putra & Syarifuddin, 2019). Problem solving worksheets have also been developed in physics learning and the results can be used to make students more confident, active and interested in the problems given (Kahar, Wekke & Layn, 2018), while the problem solving-based physics worksheets that have been developed by Alvino et al., (2020) can be used to achieve critical thinking skills. In addition, research-based learning worksheets have been developed to improve creative thinking skills (Krisdiana et al., 2019). This is convinced by the results of Putri (2020) which reveals that problem solving worksheets have a major influence in improving students' creative thinking skills. The ability to solve problems can also be improved through teaching materials oriented to problem-based learning models (Siagian, Saragih & Sinaga, 2019).

This study aims to analyze students' needs for problem solving-based worksheets as an effort to improve their problem-solving skills. Needs analysis aims to collect information about the problems contained in chemistry learning and their causes, the implementation of learning and the obstacles that occur, the use of student worksheets and their shortcomings. The results of the needs analysis are used as the basis for determining alternative solutions and recommendations for the specifications of the worksheets to be developed.

METHODS

This type of research is a qualitative descriptive study that aims

to analyze students' needs for problem solving worksheets on ionic balance and pH of salt solution. This needs analysis is a series of parts of the research and development (R&D) 4D model (Define, Design, Develop, and Disseminate) to be precise the Define stage. At this stage, initial information is collected on problems in chemistry learning as well as the availability of learning tools and support. This stage includes analysis of student perceptions, teacher perceptions, analysis of student characteristics, analysis of curriculum, analysis of tasks and concepts, as well as indicators and learning objectives. Subjects in this study were 50 students of class XII MIPA 1 and MIPA 2 in SMA Negeri 3 Cirebon, involving 3 Chemistry teachers as research informants based on purposive sampling. The research data were collected through a student perception questionnaire sheet containing 13 closed questions with yes and no answers. This questionnaire aims to determine students' perceptions of the need for problem solving-based student worksheets. In addition, the teacher perceptions questionnaire sheet was also collected as research data which aims to answer the shortcomings of handsheets, descriptions and learning constraints in class. Meanwhile, the analysis sheet for curriculum documents and the analysis sheet for assignments and concepts aims to analyze the conformity with the applicable curriculum.

RESULTS AND DISCUSSION

Problem solving-based worksheets are designed based on needs analysis. The planned problem solving must be clear about the

procedures that will be followed by students (Hidayat & Irawan, 2017). The needs analysis activity begins with the analysis of students' perceptions of chemistry learning, analysis of teacher perceptions, analysis of student characteristics, analysis of curriculum and analysis of assignments and concepts.

Results of Student Perception Analysis

This student perception analysis aims to obtain information about the student worksheets product specifications needed by students, so students are given a questionnaire about students' perceptions of chemistry learning as well as information about the student worksheets used so far. Based on the data obtained from questionnaires that have been distributed, the results show that as many as 68% of students stated that chemistry is a subject that is considered difficult and does not relate to facts in everyday life, in fact chemistry is very close to students' daily lives. This is because students are not accustomed to contextual learning, but if students are accustomed to linking chemical theory to everyday life, students will find it very easy to do problem solving-based learning activities.

The learning resource that students use so far is in the form of handbooks, but almost all students (94%) also use the internet as a learning resource, because in studying textbooks owned by students, as many as 70% of students also experience problems and difficulties in learning them, especially in the subject matter. ionic equilibrium and pH of the salt solution.

As many as 60% of students were given worksheets by their teachers, but students still found worksheets limitations including incomplete material, difficult explanations to understand the content and language so that assistance was needed in the form of explanations from the teacher. Worksheets designs are less attractive because they generally use opaque paper and black and white prints and are less varied so that students feel bored quickly and do not attract interest in learning. As many as 64% of students have difficulty understanding the material through the media and methods applied. As many as 78% of students have never used

problem solving-based worksheets so that almost 100% of students need problem solving-based worksheets. Based on the findings obtained from students' perceptual data, it is necessary to develop problem solving worksheets, especially on the material of ionic equilibrium and pH of salt solutions.

In addition to the questionnaire in closed questions, open questions were also provided in the form of student responses about the advantages and disadvantages of handbook worksheets. The results of students' responses to the current handbook worksheets can be summarized in Table 1.

Table 1. Recapitulation of Student Responses to the Weaknesses and Strengths of Handbook Worksheets

Lacks of worksheets	Advantages of worksheets
Lack of understanding of the material from the worksheet provided, because in the worksheets there are more practice questions than understanding of the material	In the worksheets the material is quite short
The language is difficult to understand, the material is incomplete, the lack of practice questions, sometimes there are chapters that are not included, do not learn concepts, concepts are incomplete, there are questions that are not understood, explanations are not in detail, many materials are not in the book, explanations are in the media image which is not clear.	Worksheets facilitate the search for the material being studied.
This handbook of worksheets can only be read/ studied in a fairly short time because of the small amount of material contained in the worksheets.	Worksheets facilitate the search for the material being studied.
Worksheets used by students who are less creative will be left behind compared to other students .	There is already a way to determine the ion balance and pH of the salt solution

Worksheets design is less attractive because it generally uses opaque paper and black and white prints	Can be used to work on question and problems
Worksheets are sometimes difficult to understand if the teacher is not explained thoroughly	Can study the material independently
	Can help us understand the material

Results of Teacher Perception

Analysis

This teacher perception analysis aims to obtain information about the use of worksheets as one of the teaching materials used so far. A total of 3 (three) chemistry teachers were respondents in filling out the teacher perception questionnaire. The results of the analysis of teacher perceptions included that almost all chemistry teachers used published worksheets for Chemistry. However, all teachers saw the limitations of the commonly used handsheets, for example incomplete material, explanatory techniques, inadequate practice questions and practicum sheets. In addition, the teacher assessed that the worksheets had a monotonous design (blurry print) and was not colored, so that it caused students to be less enthusiastic in using the worksheets. Almost all teachers have difficulty learning about ionic equilibrium and pH of salt solutions. This is due to the similarity of the ionic equilibrium and pH of the salt solution with the previous material, namely the buffer solution, so that students are still quite difficult to distinguish between the two materials. In addition, teachers have never developed problem solving-based chemical worksheets so that all chemistry teachers at SMA Negeri 3 Cirebon City need problem

solving-based chemistry worksheets that have been developed.

Results of Student Characteristics

Analysis

Student characteristic analysis is carried out to examine student characteristics in accordance with the worksheets development plan that has been determined in the analysis of student needs, background abilities and student cognitive levels. In general, students at SMA Negeri 3 Cirebon City have almost the same characteristics cognitively for each class so that there are no superior classes, because students who have low, medium and high cognitive abilities are scattered in each class. The socio-economic condition of the students' families is also evenly distributed, starting from middle to lower and middle to top. Not all are superior in terms of the family economy. The livelihoods of student guardians are also very diverse, ranging from state and private civil servants, laborers, state-owned enterprises employees, TNI/ POLRI to retired officers. Most students have received knowledge of chemistry when they are still at the junior high school level which is integrated into science subjects. This causes students to have a high curiosity about chemistry in

particular so that students can get used to solving problems

Results of Curriculum Analysis

Curriculum analysis at this stage includes Competency Standards (SK), Core Competencies (KI) and Basic Competencies (KD) which are in accordance with the curriculum used in schools, namely the 2013 curriculum. This curriculum analysis aims to determine whether the material is sufficient to achieve the curriculum goals in developing the problem solving skills (Yanto, 2019),

So that the analysis at this stage is to know the competencies that must be achieved in accordance with the

learning objectives, namely the ion equilibrium material and the pH of the salt solution. Based on the curriculum files that apply in schools, the indicators described are in accordance with the provisions in the 2013 revision of the 2017 curriculum. Constraints that occur when the teaching and learning process takes place, the worksheets used are still not in accordance with the needs of students and the material on the worksheet is not easy to understand and explanation which is less detailed so that it is necessary to develop worksheets that function to facilitate students in learning the material with a problem solving model.

Table 2. Formulation of Indicators for Achieving Competency in Ion Equilibrium and pH of Salt Solution

No.	Basic Competencies (KD)	Indicators
3.11	Analyzing the ion equilibrium in saline solution and connect pH	<ol style="list-style-type: none"> 1. Identify the color changes of the red litmus and blue litmus indicators in some salt solutions 2. Classify salt compound on the materials or some of the products found in everyday life (additional indicators) 3. Understand the explanation of the ion equilibrium in a salt solution 4. Design experiments to predict the pH of a salt solution using litmus paper / universal indicator / pH meter and report the results. 5. Summing up the acid-base properties of a salt solution 6. Determine the pH of the salt solution
4.11	Reported experiments on the acid-base properties of various saline solutions	<ol style="list-style-type: none"> 1. Conduct experiments to predict the pH of a salt solution using litmus paper / universal indicator / pH meter and report the results. 2. Write down the ionic equilibrium reaction in a salt solution

3. Reported experiments on the acid-base properties of various saline solutions

Results of Task Analysis

This task analysis aims to identify tasks that must be done by students at each meeting in achieving learning objectives (Fadilah, 2019). This task analysis also ensures a thorough review of the tasks in the worksheets according to the concept and syntax (steps) of the problem solving approach, namely formulating problems, analyzing problems, formulating hypotheses, collecting and classifying data and proving hypotheses. There are practice questions in both essay and multiple choice form at the end of the worksheets. The final result of the task analysis is the availability of problem solving worksheets that will be used at the next development stage

Results of Concept Analysis

Concept analysis aims to determine the materials needed in developing worksheets to achieve competency achievement indicators (Putra & Syarifuddin, 2019). The concept is applied using problem solving steps whose learning activities are used to optimize the learning process in order to increase student learning outcomes (Fadilah, 2019) and the ability to solve problems, especially in material related to everyday life. The concepts needed in learning are then arranged in the form of a concept map so that they can explain the related material according to the sequence of competency attainment indicators. The concept map of the ionic equilibrium material and the pH of the salt solution can be seen in Figure 1.

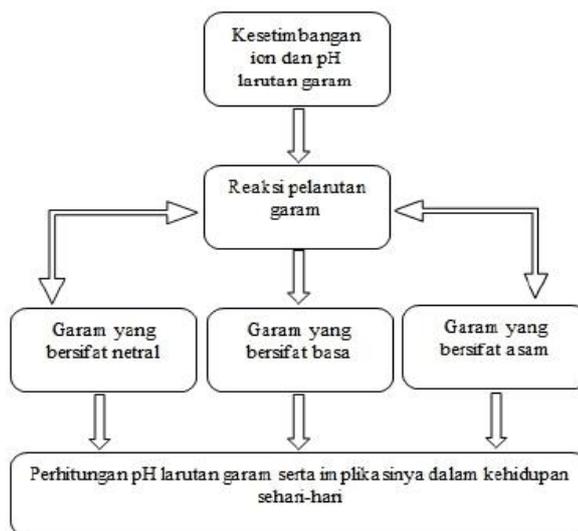


Figure 1. Concept Map of Ion Equilibrium Matter and Salt Solution pH

CONCLUSION

Based on the analysis data obtained, it shows that students need

worksheets that are more interesting to learn and easy to understand so that they can understand chemical concepts

well. In general, the handbook worksheets used so far are good and in accordance with the KD, KI and indicators in the applicable 2013 curriculum, but they are general in nature and not yet in accordance with the needs of students both in terms of material context and their approach is less facilitating in solving problems. The learning that has been carried out so far has been in accordance with the applicable curriculum learning standards, but teachers have experienced difficulties in carrying out learning material on ionic equilibrium and the pH of salt solutions, especially in terms of directing students' ability to solve problems. Based on the results of the needs analysis that has been obtained from several analyzes which include student perception analysis, teacher perception analysis, student characteristic analysis, curriculum analysis, task analysis, and concept analysis, it is necessary to develop problem solving worksheets, especially on ion equilibrium and the pH of the salt solution. It is hoped that students can practice problem-solving skills and connect theory with facts in everyday life so that students no longer find it difficult to learn chemistry and can improve student learning outcomes. Researchers would like to thank the Directorate of Research and Community Service, Ministry of Research and Technology/ National Research and Innovation Agency for providing funding.

REFERENCES

- Alvino, M., Darvina, Y., Satria, W., & Amali, D. (2020). Validitas LKS Berbasis Problem Solving Untuk Mencapai Keterampilan Berfikir Kritis Pada Materi Dinamika Rotasi dan Elastisitas Fisika SMA / MA. *Pillar of Physics Education*, 13(1), 193–200.
- Ardiani, F., Rudibyani, R. B., & Efkar, T. (2017). Pengembangan LKS Berbasis Problem Solving untuk Meningkatkan Keterampilan Berpikir Kreatif Materi Asam Basa. *Jurnal Pendidikan Dan Pembelajaran Kimia*, 7(1), 91–103.
- Ayuwandari, G., & Kusumawati, E. (2019). Analisis Kebutuhan LKS Berbasis Problem Based Learning untuk Menstimulasi Kemampuan Berpikir Kreatif Siswa. *Proceeding of the 1st STEEM*, 1(1), 259–263.
- Căprioară, D. (2015). Problem Solving - Purpose and Means of Learning Mathematics in School. *Procedia - Social and Behavioral Sciences*, 191, 1859–1864.
- Cheng, S., She, H., & Huang, L. (2018). The Impact of Problem-Solving Instruction on Middle School Students' Physical Science Learning: Interplays of Knowledge, Reasoning, and Problem Solving. *EURASIA Journal of Mathematics, Science and Technology Education*, 14(3), 731–743.
- Fadilah, R. (2019). Need analysis of student worksheet based on tracker on static fluid learning material in high Need analysis of student worksheet based on

- tracker on static fluid learning material in high school. *The 2018 International Conference on Research and Learning of Physics*, 1185, 1–7.
- Hadinurdiana, & Kurniati, A. (2018). Pengembangan Lembar Kerja Siswa (LKS) Berbasis Problem Solving untuk Memfasilitasi Kemampuan Pemecahan Masalah. *Juring:Journal for Research in Mathematics Learning*, 1(3), 189–198.
- Hidayat, A., & Irawan, I. (2017). Pengembangan Lks Berbasis RME dengan Pendekatan Problem Solving Untuk Memfasilitasi Kemampuan Pemecahan Masalah Matematis Siswa. *Journal Cendekia: Jurnal Pendidikan Matematika*, 1(2), 51–63.
- Huda, M. 2013. Model-Model Pengajaran dan Pembelajaran, Yogyakarta: Pustaka Pelajar
- Jannah, M., Yerizon, Y., & Musdi, E. (2020). Needs Analysis to Develop Mathematics Teaching Material of Senior High School (SMA) Based on Problem Based Learning. *Journal of Physics: Conference Series*, 1554(1), 1–5.
- Kahar, M. S., Wekke, I. S., & Layn, M. R. (2018). Development of Problem Solving-Oriented Worksheet of Physics Learning in Senior High School. *Jurnal Ilmiah Pendidikan Fisika Al-BiRuNi*, 07(2), 79–90.
- Krisdiana, I. *et al.* (2019) ‘Worksheet-Based Learning Research to Improve Creative Thinking Skills’, *IOP Conf. Series: Journal of Physics: Conference Series*, 1254(1), pp. 1–7.
- Pramesti, E. T., Rudibyani, R. B., & Sofia, E. (2017). Pengembangan LKS Larutan Elektrolit dan Non Elektrolit Berbasis Problem Solving. *Jurnal Pendidikan Dan Pembelajaran Kimia*, 6(1), 86–100.
- Prastowo, A. 2015. *Panduan Kreatif Membuat Bahan Ajar Inovatif*. Yogyakarta: Diva Press.
- Purwaningsih, E., Sari, A. M., Yuliati, L., & Masjkur, K. (2020). Improving the problem-solving skills through the development of teaching materials with STEM-PjBL (science, technology, engineering, and mathematics-project based learning) model integrated with TPACK (technological pedagogical content knowledge) I. *Journal of Physics: Conference Series*, 1–7.
- Putra, A., & Syarifuddin, H. (2019). Analisis Kebutuhan Pengembangan Lembar Kerja Siswa Berbasis Penemuan Terbimbing Kelas VIII Sekolah Menengah Pertama. *JEMS (Jurnal Edukasi Matematika Dan Sains*, 6(1), 39–49.
- Putri, lisa rahma, Rudibyani, ratu beta, & Sofya, E. (2018). Pengaruh LKS Berbasis Problem Solving untuk Meningkatkan Keterampilan Berpikir Kritis Siswa. *Jurnal Pendidikan MIPA*,

19(2), 75–86.

- Ruci, gita wandira, & Purnomo, T. (2020). Pengembangan LKS Berbasis *Problem Solving* Pada Materi Perubahan Lingkungan untuk Melatihkan Keterampilan Berpikir Kritis dan Kemampuan Argumentasi Tertulis Siswa Kelas X SMA. *Bioedu Berkala Ilmiah Pendidikan Biologi*, 9(1), 65–72.
- Siagian, M. V., Saragih, S. and Sinaga, B. (2019) ‘Development of Learning Materials Oriented on Problem-Based Learning Model to Improve Students’ Mathematical Problem Solving Ability and Metacognition Ability’, *International Electronic Journal of Mathematics Education*, 14(2), pp. 331–340.
- Simatupang, M. (2019). Penerapan Model Pembelajaran Problem Solving Untuk Meningkatkan Hasil Belajar Fisika. *Jurnal Global Edukasi*, 3(1), 49–54.
- Susanti, L. B., Poedjiastuti, S. and Taufikurohmah, T. (2018) ‘Validity of worksheet-based guided inquiry and mind mapping for training students’ creative thinking skills Validity of worksheet-based guided inquiry and mind mapping for training students’ creative thinking skills’, *IOP Conf. Series: Journal of Physics: Conference Series*, 1006(1), pp. 1–6.
- Wena, M. (2012). *Strategi Pembelajaran Inovatif Kontemporer Suatu Tinjauan Konseptual Operasional*. Jakarta : Bumi Aksara.
- Yanto, F. (2019) ‘Development of problem-based student worksheet with authentic assessment to improve student’s physics problem solving ability’, *IOP Conf. Series: Journal of Physics: Conference Series*, 1185(1), pp. 1–8.
- Zulianti, Y., Kadaritna, N., & Efkar, T. (2017). Efektivitas LKS Problem Solving dalam Meningkatkan Keterampilan Mengkomunikasikan pada Materi Asam Basa. *Jurnal Pendidikan Dan Pembelajaran Kimia*, 6(2), 372–386.
- Zulyadaini (2017) ‘A Development of Students’ Worksheet Based on Contextual Teaching and Learning’, *IOSR Journal of Mathematics (IOSR-JM)*, 13(1), pp. 30–38.