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LKPD Based on Phenomenon Based Learning (Phenobl) for Mastery of 21st Century Skills on the Material of Colligative Properties of Solutions for Class XII SMA/MA Equivalent

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Abstract
Learning is an effort to provide stimulation, guidance, direction, and encouragement to students so that the learning process occurs which is characterized by changes in student behavior as a result of student interaction with the environment. The observation results explained that the 21st century skills possessed by students were still low. One of the causes of low 21st century skills possessed by students is the lack of active involvement of students in the learning process and the lack of orienting phenomena related to chemical concepts. Therefore, to develop 21st century skills, a learner-centered learning model such as phenomenon-based learning model is needed. This is a development research using 4-D model that aims to produce LKPD based on phenomenon-based learning on colligative properties material. The results of LKPD validation by material and media validators are considered very valid in terms of content feasibility, presentation aspects, linguistic aspects, graphical aspects, aspects of phenomenon-based learning characteristics, display aspects, and software utilization aspects with a percentage of 100%, 97.5%, 91.67%, 100%, 82.5%, 94% and 100% respectively. This LKPD is in the very valid range with a score of 94.74%, so this LKPD has been confirmed valid and can be tested.

1. Introduction

The student learning process at school occurs because of the educational interaction between teachers and students based on goals in the form of knowledge, attitudes, and skills. One of the lessons given at the Senior High School (SMA) level is learning about chemistry. Chemistry is the study of matter and its changes. Chemistry

examines the nature of matter on a microscopic and macroscopic scale and its associated phenomena (Firdaus, et al., 2022). Chemistry is the study of chemical facts, concepts, and principles—chemistry studies about processes, products, and attitudes. Chemistry in terms of process includes the ability to observe, measure, classify, ask questions, formulate hypotheses, conduct experiments and draw conclusions. From the attitude aspect, chemistry includes caring for the environment, being curious, tenacious, honest, patient, critical, diligent, disciplined, careful, paying attention to work safety, and working together. Some of these skills are process skills, and the attitudinal aspects are often referred to as scientific attitudes (Sukmawati, 2019).

Understanding the concept is very necessary for understanding chemistry. One of the characteristics of chemistry concepts is that they tend to be abstract and complex. Because of those characteristics, it requires a way to study chemistry thoroughly. According to Ni'mah, A. and Kamaluddin, A (2023) and Coll in Sukmawati (2019), to learn a complex and abstract concept, three levels of representation are needed, including macroscopic, submicroscopic, and symbolic. The macroscopic level is an aspect that explains something that happens in everyday life, while the submicroscopic level explains daily life events from a microscopic perspective, and the symbolic level explains real phenomena expressed in the form of symbols or images. One of the chemistry learning approaches that can be applied and beneficial to the lives of students is Phenomenon-based learning.

Phenomenon based learning is a learning model based on phenomena that exist in everyday life, where learners will play an active role in creating an understanding of the phenomenon and solving the given problem. Phenomenon based learning was first implemented in Finland in 2016 as a curriculum by requiring teachers to teach based on a phenomenon-based learning approach that utilizes the out-of school environment and innovative technology to increase learner engagement, interest, and activeness in learning (Wakil, K. et al., 2019). This learning model emphasises that in every learning process, students are active and build their knowledge (student-centred) by analysing phenomena to improve concept understanding. Learning resources used by teachers in learning must be adjusted to the situation. Learning resources are significant to be able to achieve a learning goal and are expected to make learning activities more active. Therefore, teachers must be careful in determining the learning resources to be used. Integrating various learning components, including learning resources, is expected to improve students' critical thinking ability in terms

of mastery of 21st-century skills. Learning resources can be textbooks, modules, LKPD and other materials where students can learn from them.

The use of LKPD in the learning process allows students to learn independently. Little interaction with the teacher can be overcome by the use of appropriate student worksheets. The use of LKPD in learning also supports the student-centred learning process. Prastowo, A. (2015) states that the Learner Activity Sheet (LKPD) is one of the teaching materials in the form of sheets containing material and instructions for implementing learning tasks that must be done by students to achieve basic competencies, especially in Chemistry materials.

The colligative nature of the solution is one of the chemical materials that contain many phenomena in it. One of the basic competencies (KD) of the colligative nature of the solution is to analyse the phenomenon of the colligative nature of the solution in life. Based on the KD, students are required to observe a phenomenon of the colligative nature of the solution. This observing activity can arouse students' curiosity about the material of the colligative properties of the solution (Pratnyamita A. et al., 2019). In addition, students are asked to present the results of information searches related to the application of the principle of colligative properties of solutions in everyday life. Therefore, a learning resource is needed that has a variety of elements in the form of Phenomenon Learning-based LKPD that can help students learn every learning process so that students are active in building their knowledge (student-centred) by analysing phenomena to improve concept understanding and student interest and motivation.

Based on this background, it is important to develop phenomenon-based learning based LKPD on the material of colligative properties of solutions for class XII SMA / MA as valid teaching materials. The validity is seen from the aspects of content feasibility, presentation aspects, linguistic aspects, graphical aspects, aspects of Phenomenon Based Learning characteristics, display aspects and software utilization aspects. It is expected that this research will produce a valid LKPD of colligative properties of solutions and be used as an alternative learning resource that is interesting and innovative for students.

2. Method

This type of research was designed using a research and development design based on Research and Development (R&D) using the 4-D model. The 4 D (Four D)

development model is a learning device development model. This model was developed by (Thiagarajan, Dorothy a'., and Melvyn I. Somme, 1974). The 4D development model consists of 4 main stages, namely: define, design, develop, and disseminate. However, the 4-D model method used in this research only reaches the third stage, namely the development stage, considering that the aim of this research is only to develop a valid product.

- Define, activities at this stage are carried out to determine and define development requirements also known as needs analysis in development.
- Design, at this stage, researchers create a product design in the form of an LKPD that matches the characteristics and meets the feasibility criteria. The LKPD developed is a LKPD based on phenomenon-based learning on the material of colligative properties of solutions.
- Develop, the product that has been developed is then validated to determine whether the product is valid or not using certain criteria so that a valid product is produced after being revised based on expert input.

The rationale for choosing the use of this 4D model is that each step of the development procedure stage is explained in detail, what researchers will do when developing products in the form of teaching materials, books, or other teaching materials. This method and model were chosen because it aims to produce products in the form of Phenomenon Learning-based LKPD to improve 21st-century skills on the material of colligative properties of solutions. This research was conducted at the Chemistry Education Study Program, Faculty of Teacher Training and Education (FKIP) Riau University Pekanbaru.

Material expert validation consists of 5 aspects, namely aspects of content feasibility, PhBL characteristics, presentation, grammar, and graphics. After going through the first validation stage then revising until it reaches the second validation. The material aspects of this LKPD have entered the very valid category and can be continued at the next stage. While media validation consists of 2 aspects, namely display and software utilization. In the validation results, especially in the display aspect, there was a significant improvement due to the revisions that had been made. Revisions related to videos and buttons in the LKPD supporting application have been made and have received a better score.

Validator Assessment Data Analysis

Analysis of the validity of LKPD development products of colligative properties of solutions is carried out in terms of material, construction, language, content substance, learning design, appearance (visual communication) and software utilisation. The analysis technique is done by calculating the percentage of people's assessments. The validation sheet instrument is used to obtain an assessment and response from the validator to the LKPD. There are three lector validators in this research; one of them is a media validator, and two others are materials validators. The data used in this study, namely the scores of the results of the review by experts, were calculated on average to determine validity. According to Sugiyono (2016), product validation can be done by presenting several experienced experts or experts to assess the new product designed. Meanwhile, design validation is a process of activities to assess a particular product made by a researcher. In this study, the product being assessed is the LKPD of the colligative properties of the solution.

The validation sheet uses an attitude measurement scale with a score of 1-4 in the form of a checklist (√). Alternative positive attitude statements were converted into scores using a four-choice Likert scale to obtain quantitative data, as in table 1. The selection of Likert's four-choice scale aims to anticipate the selection of neutral points. Each score has certain assessment criteria, such as the rubric that will be attached. Calculate the average score of alternative positive responses attitude statements using the average equation for data that has not been grouped, with the equation:

$$R = \frac{f}{n} \times 100\%$$

Information:

R = Percentage of alternative scores for teacher attitude statements (%)

f = Total score obtained

N = Maximum number of scores

Table 1. Likert scale for validation stage

Attitude Statement	Score
Very Agree	4
Agree	3

Moderately Disagree	2
Disagree	1

Percentage analysis eligibility criteria can be seen in Table 2

Table 2. Percentage analysis eligibility criteria

Percentage	Description
81,00 – 100	Very good/Very valid/Very feasible
61, 00 – 80,00	Good/Valid/Appropriate
41,00 – 60,00	Good enough/ Valid enough/ Feasible enough
21,00 – 40,00	Less good/ Less valid/Less Feasible
<20,00	Not good/Invalid/Inappropriate

3. Results and Discussions

3.1 Results

The learning resources developed are student activity sheets on the colligative properties of solutions. The LKPD made has gone through the recommended instructional principles, starting from conducting an instructional analysis, syllabus, to becoming a learning resource. With the ease of use of learning resources made, it shows a positive impact on teachers, namely that they will have more time to guide students in the learning process, help students to gain new knowledge from various sources or references used in teaching materials, and the role of the teacher as the only source of knowledge is reduced. This learning resource is made in the form of LKPD for the concept of independent learning for students because in essence students have the ability to work alone and are more responsible for their actions. The following is a picture of the cover of the developed LKPD.

Figure 1. The cover of the developed LKPD

This LKPD of colligative properties material is divided into 3 sub-learning. In each sub-learning, students will be oriented to phenomena that will later be associated with learning. In its application, some phenomena that are integrated into this learning are as follows:

a. LKPD 1: Concentration of solution and decrease in vapour pressure of non-electrolyte solution (An example of a phenomenon is a floating pool in the phenomenon orientation section)

b. LKPD 2: Increase in boiling point and decrease in freezing point of non-electrolyte solutions (Examples of phenomena are the difference in boiling points and making cut ice in the phenomenon orientation section).

c. LKPD 3: Osmotic pressure of non-electrolyte solutions and colligative properties of electrolyte solutions (An example of the phenomenon is the use of infusion fluid in the orientation of the phenomenon).

d. LKPD 4: Practicum of boiling point increase and freezing point decrease of solution In each learning activity, the LKPD begins with a phenomenon related to the material discussed to train students' critical thinking skills. In this section, space is given to discuss in groups and express opinions to improve students' collaboration and communication skills.

Validity of LKPD

Table 3. Validation Results of LKPD Colligative Properties of Solutions

Assessment Aspect	**Percentage Score by Validator**
Content Feasibility	100%
Characteristics Phenomenon Learning	82,55
Retrieved	97,5%
Grammar	91,67%
Graphics	100%
Display (Visual Communication)	94%
Software Utilization	100%
Average Percentage Score	**94,74%**
Validity Criteria	**Very Valid**

The assessment of the content feasibility aspects of the phenomenon-based learning LKPD on the solution of colligative properties of solutions for class XII SMA / MA Equivalent includes four assessment indicators containing five statements, which aim to assess the suitability of LKPD with basic competencies and material indicators, suitability for the substance of the material, suitability for the needs of students and its usefulness. The average percentage obtained from the validation of the content feasibility aspect is 100%, with very valid criteria.

The assessment of the characteristics of phenomenon-based learning includes five indicators, namely orienting the phenomenon to students, organizing students to learn, individual or group investigations, presenting the results of the phenomenon investigation and analyzing and evaluating the phenomenon. The average percentage result of this aspect is 82.5% with very valid criteria. The assessment of the presentation aspect includes five indicators containing six statements to assess clarity, completeness, use of motivation, use of communicative aspects in the presentation of LKPD. The validation percentage result is 97.5% with very valid criteria. The grammar aspect assessment includes two indicators containing five statements to assess the accuracy and correctness of grammar in the LKPD. The average validation result is 91.67% with very valid criteria.

The assessment of the graphical aspect includes two indicators containing five statements to assess the suitability of typography and design on the LKPD. The average percentage result is 100% with very valid criteria. The display aspect assessment includes seven indicators that assess navigation buttons, typography, images, colors, videos, cover pages and layouts on LKPD. The average percentage result is 94%, with very valid criteria. The assessment of the software utilization aspect includes two indicators which include interactivity and supporting software on the LKPD. The average percentage result is 100%, with very valid criteria. The average percentage of all aspects validated by the P score> 84% with very valid criteria so that it can be tested.

3.2 Discussion

Based on the results of the study, it is known that the LKPD based on phenomenon-based learning using the articulate storyline application on the material of colligative properties of solutions for class XII SMA / MA Equivalent is feasible to use as teaching material. LKPD that has been developed and can be accessed by teachers and students through a link developed by the developer. The use of LKPD can be done outside of school hours using a smartphone or laptop.

The integration of phenomena in the developed LKPD is able to improve the 21st century skills of students. 4C skills can be improved through each syntax in the phenobl learning model. The improved skills can be described as follows:

Table 4. 4C skills can be improved by the phenobl learning model's syntax

Phenobl syntax and activities	21st Century Skills developed
Orienting learners to real phenomenon related to the subject matter	Improve critical and creative thinking skills
Organizing student to learn	Improve critical thinking skills
Individual or group inquiry	Improve collaboration and communication skills
Presenting the results of investigation of phenomena	Improve collaboration and communication skills
Analyze and evaluate phenomena	Improve critical and creative thinking skills
Question evaluation	Improve critical thinking skills

The development product is said to be valid if the product has been validated and gets a very valid category. The Directorate of High School Development explains that the criteria assessed by experts in the development of teaching materials include

the eligibility components of content, presentation, and language must be valid before being used in the next test (Direktorat Sekolah Dasar, 2022). This is following the opinion of Widyaningsih (2014) which states that the validation test is an effort to produce teaching materials that are good and relevant to the theoretical basis of development and ensure whether or not the teaching materials are used in the learning process.

The aspect of the feasibility of LKPD content has a validity of 100% with a very valid category. This means that the LKPD material is in accordance with the applicable curriculum and by the demands of the Core Competencies (KI) and Basic Competencies (KD) which are translated into learning indicators. The suitability of teaching materials with the curriculum will make it easier for students to learn (Weng, F., et al., 2019). Valid criteria for the feasibility of content on LKPD also indicate the correctness of the substance on LKPD that is good (Aprilia, I and Suryadarma, I.G.P., 2020). The truth of the substance is needed so that there are no conceptual errors and understanding for students (Buchori and Rahmawati, 2017).

The aspect of PhBL characteristics of LKPD has a validity of 82.5% with a very valid category. This means that the LKPD material is by the syntax of Phenomenon-Based Learning. The valid criteria for this aspect also indicate that this LKPD can make students active in growing new concepts, understandings, and insights based on the facts obtained. However, the indicators for the usefulness of LKPD received a valid category. Therefore, the validator suggests adding chemical figures related to the material to broaden students' insight.

The presentation aspect has a validity of 97.5% with a very valid category. This means that the LKPD material is under the characteristics of the LKPD itself, namely self-instruction and also means that the LKPD presentation component already contains clear indicators and learning objectives. The material on the LKPD is also presented completely under the sequence of indicators developed. Clarity of indicators and learning objectives will help students so that student learning becomes directed (Imansari and Sunaryantiningsih, 2018).

The grammar aspect has a validity of 91.67% with a very valid category. The linguistic aspect is related to the use of clear sentences so as not to cause confusion and easily understood by students. Based on the validity value of the linguistic aspect, it shows that this LKPD has used good and correct Indonesian. Good and correct

language presented in the LKPD will make it easier for students to learn (Afriyanti, M., et al., 2021).

The graphic aspect has a validity of 100% with a very valid category. This shows that the design of the LKPD developed is good and attractive including the type and size of the font used, the layout and layout that attracts the attention of students to use it, providing illustrations of images that are by the material and the material is presented with clear writing and letters (Astra, I.M., et al., 2020).

The display aspect has a validity of 94% with a very valid category. This shows that the LKPD has ease of access and has good-quality images and videos. This ease of access will help students in using LKPD during learning. The software utilization aspect has a validity of 100% with a very valid category. This shows that LKPD has a good response to users and has ease in finding information in LKPD.

Based on the results of the study, it can be said that LKPD is a learning resource in the form of teaching materials and learning media that is effectively used in various learning processes because it has a positive impact on student learning outcomes in improving mastery of 21st-century skills.

4. Conclusions

Based on the results and discussion, it can be concluded that the LKPD based on phenomenon-based learning using the articulate storyline application on the material of colligative properties of class solutions XII SMA / MA Equivalent which has been developed as teaching material is declared very valid by material validators and media validators with a score of 94.74%, based on aspects of content feasibility, presentation aspects, linguistic aspects, graphical aspects, aspects of phenomenon-based learning characteristics, display aspects and software utilization aspects.

References

Afriyanti, M., Suyatna, A., and Viyanti. (2021). Design of e-modules to stimulate HOTS on static fluid materials with the STEM approach. *J. Phys. Conf. Ser.*, vol. 1788, no. 1, doi: 10.1088/1742-6596/1788/1/012032

Aprilia, I and I. G. P. Suryadarma, I. G. P. (2020). E-module of mangrove ecosystem (emme): development, validation and effectiveness in improving students' self-regulated, *Biosfer*, vol. 13, no. 1, pp. 114–129, doi: 10.21009/biosferjpb.v13n1.114-129

Astra, I. M., Raihanati, R., and Mujayanah, N. (2020). Development of Electronic Module Using Creative Problem-Solving Model Equipped with HOTS Problems

on The Kinetic Theory of Gases Material. *J. Penelit. Pengemb. Pendidik. Fis.*, vol. 6, no. 2, pp. 181–194, doi: 10.21009/1.06205

Buchori, A. and Rahmawati, N. D. (2017). Achmad&Noviana. *J. Pendidik. Dasar*, vol. 1, no. 4, pp. 23–29

Direktorat Pembinaan SMA. (2017). *Panduan Praktis Penyusunan E-Modul*. Jakarta: KEMENDIKBUD.

Direktorat Sekolah Dasar. (2022). Buku Saku Serba-Serbi Kurikulum Merdeka Kekhasan Sekolah Dasar. pp. 1–51

Firdaus, M., Rusman, R., and Zulfadli, Z. (2022). Analysis of Students' Learning Difficulties on the Concept of Buffer Solution Using Four-Tier Multiple Choice Diagnostic Test. *Chim. Didact. Acta*, vol. 9, no. 2, pp. 57–61, doi: 10.24815/jcd.v9i2.25099

Imansari, N. and Sunaryantiningsih, I. (2017). Pengaruh Penggunaan E-Modul Interaktif Terhadap Hasil Belajar Mahasiswa pada Materi Kesehatan dan Keselamatan Kerja. *VOLT J. Ilm. Pendidik. Tek. Elektro*, vol. 2, no. 1, p. 11, doi: 10.30870/volt.v2i1.1478

Ni'mah, A., and Kamaludin, A. (2023). Development of a Chemo-Entrepreneurship Practicum Video to Improve Material Understanding of Colligative Properties for Senior High School. *Jurnal Penelit. Pendidik. IPA*, vol. 9, no. 2, pp. 666–675, doi: 10.29303/jppipa.v9i2.1512

Pradnyamita, M. I., Tika, L. N., and Sudiana, I. K. (2019) Pengembangan Lembar Kerja Siswa (Lks) Dengan Model Discovery Learning Pada Materi Sifat Koligatif Larutan. *J. Pendidik. Kim. Undiksha*, vol. 3, no. 2, p. 61, doi: 10.23887/jjpk.v3i2.21142

Prastowo, A. (2015). *Panduan Kreatif Membuat Bahan Ajar Inovatif*. Diva Press.

Riduwan. (2012). *Dasar - Dasar Statistika*. Bandung: Alfabeta.

Sugiyono. (2016). *Statistika untuk Penelitian*. Bandung: Alfabeta.

Sukmawati, W. (2019). Analisis Level Makroskopis, Mikroskopis dan Simbolik Mahasiswa dalam Memahami Elektrokimia Analysis of Macroscopic , Microscopic and Symbolic Levels of Students in Understanding Electrochemistry. *Jurnal Inovasi Pendidik. IPA*, vol. 5, no. 2, pp. 195–204

Wakil, K., Rahman, R., Hasan, D., Mahmood, P., and Jalal, T. (2019). Phenomenon-Based Learning for Teaching ICT Subject through other Subjects in Primary Schools. *Jurnal Comput. Educ. Res.*, vol. 7, no. 13, pp. 205–212, doi: 10.18009/jcer.553507

Weng, F., Ho, H. J., Yang, R. J., and Weng, C. H. (2019). The influence of learning style on learning attitude with multimedia teaching materials. *Eurasia J. Math. Sci. Technol. Educ.*, vol. 15, no. 1, pp. 1–9, doi: 10.29333/ejmste/100389

Widyaningsih, R. (2014). Pengembangan Bahan Ajar Geografi Berbasis Penanggulangan Bencana melalui Pembelajaran Contextual Teaching and

Learning (CTL) Di Kelas XI IPS SMA Negeri 1 Trawas. *Swara Bhumi*, vol. 3, no. 2, pp. 1–7