
Validity of Student Worksheet Integrated Scientific Literacy for the Use of Physics Practicum Integrated Instrument Components in Temperature and Heat

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Abstract. One of the efforts to improve the quality of education made by the Indonesian government is the implementation of the 2013 curriculum revision. The revised K-13 learning aims to develop students' critical thinking patterns for problem solving. One required component is scientific literacy. In the learning process observed during the needs analysis at SMAN 1 Lubuk Alung, scientific literacy has not been fully integrated into learning process. Moreover, the practicum KIT contained in the school laboratory is complete, but it rarely used by teachers in learning. The purpose of this research was to determine the validity of the scientific literacy integrated student worksheet for the use of practicum KIT in temperature and heat. Research and development (R&D) were used the Sugiyono model. Sugiyono's R&D research model consisted of 10 stages, in this study, however, it was limited to the design revision stage. The data analysis technique used was validity analysis. Based on the result, scientific literacy integrated worksheets for the use of physics practicum KIT in temperature and heat had produced. The product had an average value of 0,93 with a very valid category. Therefore, it can be concluded that the scientific literacy integrated worksheets for the use of physics practicum KIT in temperature and heat developed were very valid. This scientific literacy integrated worksheet is expected to be useful for students and teachers in the learning process, especially learning in the laboratory.

Keywords: Practicum KIT, scientific literacy, student worksheet, temperature and heat

Introduction

The curriculum implemented in Indonesian education is the 2013 curriculum. The existing curriculum must be in line with the times, according to its function, namely as a guide in education (Arifin, 2011). Kurniadi & Rozelin (2023) also explained that in education, the curriculum is the most important aspect besides teachers, media, and teaching tools due to the curriculum serves as the foundation for the teaching and learning process. The objective of the 2013 curriculum is to shape students to be more creative, innovative, fast, and responsive, as well as to instill courage in them. Rahmawati et al. (2022) also explained in their research that the curriculum 2013 has purpose to prepare Indonesian students have ability as individuals and citizen who are faithful, productive, creative, innovative, affective, and able to give contributions to society, nation, state, and

world civilization. The 2013 curriculum contains four main components that must be integrated into learning: strengthening character education (PPK), higher order thinking skills (HOTS) abilities, 4C abilities (critical thinking, creativity, communication, and collaboration), and literacy skills (Mulyasa, 2013).

The curriculum used in Indonesia is the revised 2013 curriculum (K-13 revision). One of the components include in the 2013 curriculum is literacy skills. Literacy refers to an individual's ability to access, understand, and use something intelligently through various activities, including reading, viewing, listening, writing, and speaking (Subandiyah, 2015). Scientific literacy plays a crucial role in everyday life. Howell & Brossard (2021) explain that scientific literacy helps individuals effectively navigate complex and dynamic scientific issues and access and use trustworthy scientific information when needed for decision-making. Literacy consists of eight categories: basic, scientific, economic, technological, visual, information, multicultural, and global awareness literacy (NCREL, 2003). This study focused on scientific literacy. Scientific literacy has a close relationship with one's understanding of the environment and the problems faced by society. Depend on modern science and technology development and social problems (Kurnia, et al., 2014). This makes scientific literacy very important in the world of education, meanwhile the scientific literacy abilities of Indonesian students are still relatively low. This is supported by the results of the program for international student assessment (PISA) research (2015) which shows that scientific literacy of Indonesian students is ranked 62 out of 70 countries with a score of 403. This score is still far below the international average score that PISA has set to 500. The low scientific literacy skills of Indonesian students are influenced by the difficulty of students in linking the material learned with everyday life (Hadisaputra, et al., 2019). Someone with scientific literacy skills can explain problems, interpret data, communicate information, design investigations, conduct research, and evaluate investigations scientifically. Students with scientific literacy skills will be able to apply the knowledge to solve the problems in their daily lives (Jufrida, et al., 2019). Siswanto, et al., (2023) explained that the literature in the field of science education also shows that scientific literacy is increasingly being accepted and valued by educators as an expected learning outcome or as one of the learning objectives that must be achieved, in particular, to equip students to be able to live and compete in their era. Integrating of scientific literacy in learning can be done in various ways, one of which is by integrating scientific literacy into the teaching materials used.

Learning materials are a collection of information, concepts, or content that is organized and presented for educational or learning purposes. Teaching materials can also be interpreted as any form of material that is arranged systematically, which allows students to learn independently, and is designed according to the applicable curriculum (Magdalena, et al., 2020). Mahardika (2018) elaborated that learning materials not only facilitate students in learning but also provide enjoyment in learning and can encourage and sustain students' independent learning. Teaching materials consist of four types: printed teaching materials (in the form of student worksheets, modules, books, and handouts), audio teaching materials (in the form of radio, cassettes, and recordings), visual teaching materials (in the form of CDs and learning videos), and audio-based teaching materials (Depdiknas, 2008). Teaching materials used by teachers must be in accordance with the demands of the applicable curriculum. One of the teaching materials that teachers often use for learning is student worksheets (LKS).

LKS is a learning resource that can make it easier for students to improve their understanding of the concepts learned through systematic and directed learning activities (Oktari, et al., 2015). Hidayati et al. (2010) also explained that one form of teaching material that can be used as a practicum guide is LKS. In addition, student worksheets in printed instructional formats materials, sheets of paper containing material, summaries, and implementation of the learning tasks that must be done by students, both theoretically

and practically, which refers to the competencies that must be achieved by students (Fajriah & Yuni, 2020). LKS serves to achieve competence in learning and can be a reference in carrying out activities related to learning materials (Restu & Arini, 2020). LKS is also useful to provide concrete experiences for students, help with learning variations, arouse student interest, increase teaching and learning retention, and utilize time effectively and efficiently (Sukamto, 2009). Students must be actively involved in learning; therefore, teachers must provide worksheets that can guide students in learning and train their ability to think scientifically (Fitriani, et al., 2017). To achieve this objective, LKS should have an attractive appearance and employ language that is easy to understand. Besides that, Nizarullaah, et al. (2017) explained that through active learning, students can discover the most suitable methods or way for themselves to build concepts or construct their own knowledge so that they have abilities students' critical thinking is awakened. Hartini, et al. (2020) also explain that the student worksheets must also be able to help students train their process skills and thinking skills, both creative, critical, and innovative thinking skills. A good LKS must be arranged with the correct structure. The general structure of an LKS consists of titles, study instructions, competencies to be achieved, supporting information, tasks and work steps, and assessments (Depdiknas, 2008). Experimental worksheets, or practicum worksheets, are sheets that contain instructions for carrying out practicums with related practicum tools and materials. LKS practicum also serves as a guide for students in carrying out practicum activities or problem solving (Andriyatin, et al., 2016). LKS practicum is needed for learning physics. This is because competence in learning physics cannot be achieved only with theory but also requires the application of the knowledge learned in the form of a structured practicum.

Physics is a science that studies natural events that occur in everyday life. Restu & Wahyu (2020) explained that in essence, learning physics is a way to acquire skill abilities, maintain attitudes, and develop understanding of concepts so that students' perspectives become more systematic and directed. In another research, Darmaji, et al. (2019) explain that physics which is one branch of natural science that requires an investigation or scientific work to get a concept, principle, theory, and law. This condition is a challenge for a teacher to increase students' understanding concepts and science process skills. Learning physics with practical methods invites students to think scientifically and investigate, and students can be directly involved in finding concepts from the material being studied. Learning on a practicum basis can improve students' scientific attitudes (Pratiwi, 2014). Another study found that, in addition to understanding the material from a knowledge standpoint, doing practicum can improve skill (Hidayati & Masril, 2019). In addition, Malahayati & Saminan (2016) explained that learning with using practicum can lead to construction learning strategies (formation) and active, where the process of building or arranging new knowledge in a structure students' cognitive abilities based on experience are very necessary. The physics laboratory at school has been equipped with practicum equipment stored in a box called the practicum integrated instrument component (KIT). KIT is a box that contains equipment used as a demonstration tool in learning and can be customized in shape and size (Rochman, et al., 2021). There are four types of physics practicum KIT's: mechanics practicum KIT's, wave and optics practicum KIT's, electricity and magnet practicum KIT's, and hydrostatics and heat practicum KIT's. KIT practicum also plays an important role in increasing students' understanding in aspects such as the domain of knowledge, skills, and scientific attitude. KIT can improve students' competence in the realms of cognitive, affective, and psychomotor thinking (Juwita, 2018). The factor that causes students to understand the material being taught more quickly is the KIT practicum (Utami & Lutfi, 2021). The practicum KIT is equipped with a manual for its use, but the manual only contains tools, materials, and work steps. Even though it is equipped with instructions, the use of the physics KIT still requires adequate basic concepts of physics so that assembly becomes easier or can be done with the help of worksheets that

explain in detail (Sukarjita, 2020). It is hoped that the practicum KIT can be used as well as possible by teachers to support physics learning in schools. The reality found in the field is that there are still many teachers who have not used the practicum KIT as expected. A needs analysis is performed to determine the actual conditions that exist.

The first problem encountered was that the physics teacher had not fully utilized the existing practicum KIT. After carrying out a needs analysis through direct observation, it is known that SMA Negeri 1 Lubuk Alung has a complete practicum KIT. However, the practicum KIT has not been used properly by physics teachers in practicum. Based on the results of interviews with students, it shows that students are more interested in and better understand learning physics when accompanied by practicum in the laboratory. This shows the potential for students to better understand learning if the KIT practicum is used properly in learning.

The second problem encountered is that students' literacy skills still tend to be low. This is based on interviews conducted with students; the majority of students stated that literacy, which is integrated into learning, tends to be in the form of speaking, reading, writing, and understanding only, so that students experience difficulties in associating phenomena that exist in everyday life with the concepts being studied. The third problem encountered is that the practicum worksheets used are not yet integrated with scientific literacy. The results of the needs analysis show that in Lubuk Alung 1 Public High School there are practicum worksheets. However, the LKS used has not been integrated with scientific literacy because it does not yet have introductory material and because the questions in the LKS have not been linked to problems in everyday life. The results of the needs analysis show that students are more interested if the practicum's LKS is accompanied by literacy.

Based on the problems encountered, researchers are interested in solving these problems. The solution that the researchers got was to develop scientific literacy integrated worksheets for the use of the physics practicum KIT. The purpose of this research was to determine the validity of the scientific literacy integrated student worksheet for the use of practicum KIT in temperature and heat.

Methods

The type of research used is research and development (research and development). The object of this study is an integrated scientific literacy worksheet for the use of physics practicum KIT on temperature and heat material. The practicum KIT used for temperature and heat material is the wave and thermodynamics KIT. The topic of temperature and heat discussed is related to proving the heat equation and applying black's principle. The development model used in research is the Sugiyono development model (Sugiyono, 2017). Sugiyono's model consists of 10 stages, but in this study it is only limited to the fifth stage, namely product revision as shown in Figure 1.

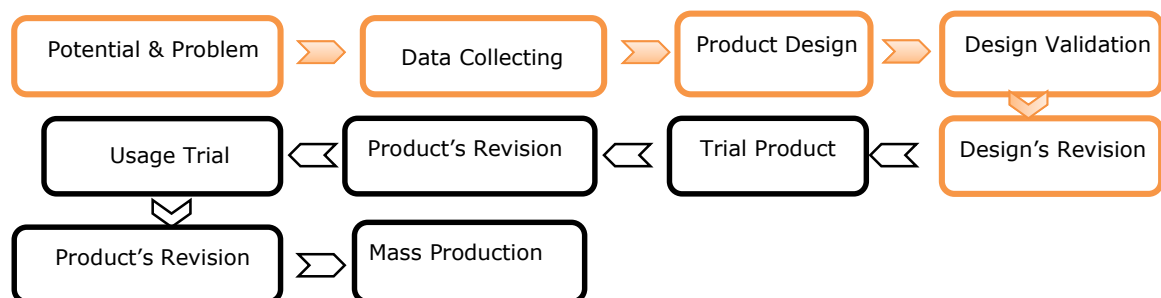


Figure 1. Research procedure

The sampling technique used to determine the research sample is probability sampling, a simple random sampling model. The research instrument used consisted of two instruments, namely a needs analysis sheet and a validation sheet by experts. The needs analysis sheet was used in the initial research observations, which consisted of an interview sheet and a needs questionnaire sheet. The data analysis technique used in this research is descriptive statistics in the form of validity analysis. The data obtained from the validity test results were analyzed using Aiken's (V) validity index formulated as follows:

$$V = \frac{\sum s}{n(c-1)} \quad (1)$$

Where the V is index of respondents' agreement on the validity of items, s is the score set by the respondent minus the lowest score ($s = r - I_0$), I_0 is lowest score in the scoring category (in this case = 1), c is the number of categories that respondents can choose, r is respondent choice category score and n is number of respondents. Retnawati (2016) explained that based on the calculation of the V index, an item or instrument can be categorized according to its index. If the index is less than or equal to 0.4, it is considered to have low validity; if it falls between 0.4 and 0.8, it is considered to have moderate validity, and if it is greater than 0.8, it is considered to have high validity.

Results and Discussion

In this study, researchers developed LKS by integrating scientific literacy into it. The researcher compiled a LKS for practicum, the part that was developed was the tools used in the worksheet, which are the tools that are in the physics practicum KIT. The results obtained in this study are an integrated scientific literacy worksheet for the use of physics practicum KIT on temperature and heat material. The developed LKS consists of a cover, an introductory section (learning instructions, competencies to be achieved by students and supporting information), a content section (context, process and scientific concepts) and a closing section (assessment and bibliography).

The validity analysis contains four assessment components, namely content feasibility, language, presentation and graphics. In the presentation component, there are aspects of scientific literacy assessment consisting of context, process and scientific concept.

The first assessment component is content feasibility. The content feasibility component consists of six indicators, namely: 1) The material presented in the LKS is in accordance with indicators of competency achievement and learning objectives, 2) The LKS material is prepared according to scientific developments, 3) The material presented in the LKS is in accordance with the mindset of student development, 4) The practicum KIT presented is in accordance with the LKS material, 5) The basic concepts presented in the LKS are correct, 6) LKS guides students in developing scientific skills. The results of the content feasibility indicator value plot are shown in Figure 2.

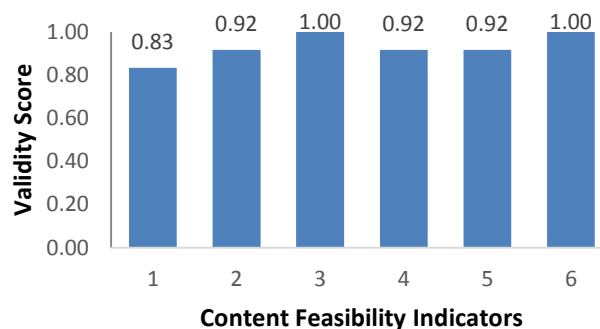


Figure 2. Content feasibility validity result

Based on Figure 2, it can be seen that the validation score for each indicator in the content feasibility component ranges from 0.83 to 1.00. The average validity value obtained for the content eligibility component is 0.93 with a very valid category. The indicator with the lowest value is the first indicator, namely the material presented in the LKS in accordance with the indicators of competency achievement and learning objectives with a validity score of 0.83. Salirawati (2004) explained that in compiling the learning material in the LKS it was explained based on the basic competencies to be achieved. In other sources it is stated that the preparation of the learning objectives contained in the LKS is in accordance with the principles of audience, behavior, condition, and degree because the learning objectives will determine the preparation of the material in the LKS (Depdiknas, 2008). Wulandari & Oktaviani (2021) also elaborated in their research that one of the functions of teaching materials (including student worksheet) for students is to serve as a guide in all learning processes because it contains the competence substance that should be learned or mastered by students. While the material presented in the developed LKS is relevant to the indicators of competency achievement and learning objectives, but the elaboration of the material is still lacking in.

The next assessment component is the linguistic assessment component. The linguistic component consists of 5 indicators, namely: 1) Consistency in the use of terms and symbols presented in the worksheet, 2) The information provided in the worksheet is clear and precise, 3) Writing sentences in the worksheet is in accordance with Indonesian language rules, 4) LKS uses the correct vocabulary and sentence structure, 5) The language used in LKS is easy for students to understand. The results of the plot of language indicator values are shown in Figure 3.

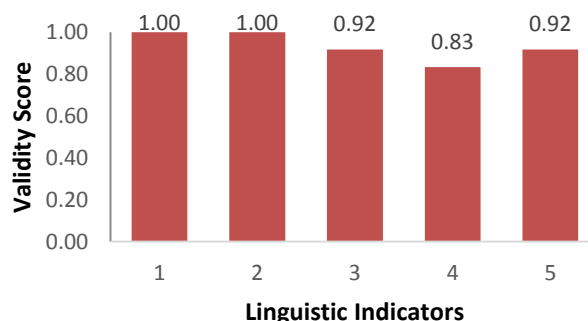


Figure 3. Linguistic validity result

Based on Figure 3, it can be seen that the score of each indicator has a range of 0.83 to 1.00, where each indicator has a very valid category. The average validation value obtained for the linguistic component is 0.93, meaning that the linguistic component is included in the very valid category. The lowest validity value is obtained on the LKS indicator using the correct vocabulary and sentence structure with a value of 0.83. This is in line with what was described by Widjajanti (2008) that in writing worksheets one must use language appropriate to the level of maturity of the child and use clear sentence structures. Whereas in the worksheets that are made there are still a number of sentences that are not well structured in accordance with the "ejaan yang disempurnakan (EYD)", the standard spelling and grammar rules for the Indonesian language. Sentences are structured so that they are not too long with the number of words used per sentence no more than 25 words and for one paragraph the number of sentences used is 3-7 sentences (Depdiknas, 2008). Fadhilah, et al. (2020) also explain that the language used in the student worksheets must have a sense of politeness, adhere to the rules of proper and correct Indonesian language, and follow the spelling according to the EYD. In the research results by Rahmatillah, et al. (2017) was stated that the language used in LKS must be easy for students to understand.

The next assessment component is the presentation assessment component. The presentation component consists of five indicators, namely: 1) LKS has clear learning objectives, 2) The LKS structure is appropriate according to the 2008 Ministry of National Education (cover, study instructions, competencies to be achieved, supporting information, tasks and work steps, assessment), 3) LKS encourages students to read and work in carrying out scientific literacy activities, 4) Practical KIT information for scientific literacy activities is complete, 5) Assessment aspects of scientific literacy. The results of the plot of the presentation component indicator values are shown in Figure 4.

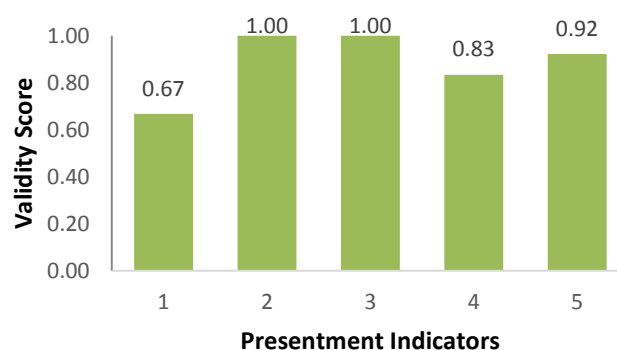


Figure 4. Presentment validity result

Based on Figure 4 it can be seen that the validity value of each indicator in the presentation component has a range of 0.67 to 1.00. The average value of each indicator in the presentation component is 0.88. The value of 0.88 is categorized as very valid. The indicator that gets the lowest validity value is the LKS having clear learning objectives with a value of 0.67. This is because initially the LKS did not describe the learning objectives, only described the experimental objectives. Sugiyono (2017) explained that the contents of a teaching material must have completeness and correctness based on KD. Herianto & Indana (2020) in another research also explained that the learning objectives in the LKS are an important component because they will help students be more focused in carrying out the series of activities in the LKS. After validation, the indicators and learning objectives based on basic competencies have been described on the product.

In the presentation component there is an assessment aspect of scientific literacy which consists of an assessment of scientific context, scientific processes and scientific concepts. The aspect of assessing the scientific context consists of 3 indicators, namely: 1) The worksheets presented have subject matter that is in accordance with the applicable curriculum, 2) worksheets contain basic concepts of material that are relevant to learning objectives, 3) worksheets contain contexts that have links with fields in the science application field. The results of the plot of the scientific context indicator values are shown in Figure 5.

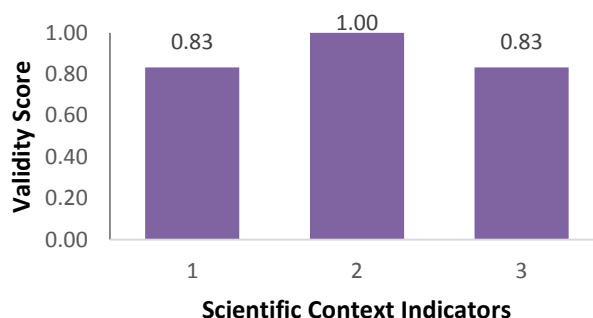


Figure 5. Scientific context validity result

Based on Figure 5 it can be seen that the validity value of each indicator in the scientific context has a range of 0.83 to 1.00. The average value of each indicator in the scientific context section was 0.89 with a very valid category. The indicator with the smallest validation value is the LKS that is presented has subject matter that is in accordance with the applicable curriculum and the LKS contains contexts that are related to fields of science application with a value of 0.83. In the aspect of the scientific context, it should contain material that is in accordance with the applicable curriculum and the material presented is related to the fields of life. Therefore, the discourse given in a scientific context must relate to the application of scientific knowledge in everyday life (Zalpita, et al., 2020). The aim of learning by integrating scientific literacy is so that students are able to solve scientific phenomena that they encounter in life well. This is in accordance with research by Jufrida, et al. (2019) that to improve students' scientific literacy skills can be done by applying approaches and learning models that train students to analyse scientific phenomena and environmental utilization as a learning resource. Other research also explain that selecting and teaching certain content is dependent on our culture, for example our norms, values and worldviews, and on the society we are living in (Sjöström & Eilks, 2018).

The next aspect of the assessment is the scientific process. The aspect of scientific process assessment consists of six indicators, namely: 1) LKS contains complete tools and materials to obtain accurate data, 2) LKS has a step mechanism to control the data obtained, 3) LKS makes data presentations through tables and graphs with proper use. appropriate, 4) LKS develops the ability to interpret phenomena that occur scientifically, 5) LKS makes evaluations based on scientific analysis of data and phenomena, 6) LKS develops the ability to interpret data with existing phenomena scientifically. The results of the scientific process indicator value plot are shown in Figure 6.

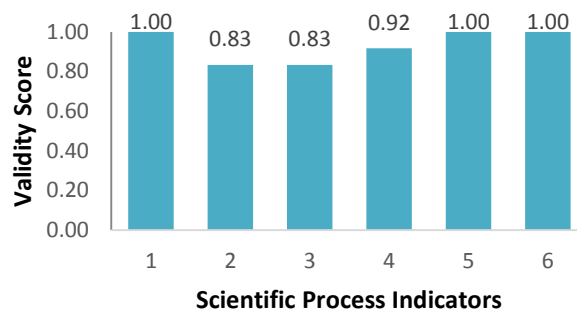


Figure 6. Scientific process validity result

Based on Figure 6 it can be seen that the validity value of each indicator in the scientific process section has a range of 0.83 to 1.00. The average value of each indicator in the presentation component is 0.93 with a very valid category. The lowest validity value in this process aspect is found in two indicators, namely the LKS has a step mechanism to control the data obtained and the LKS makes data presentation through tables and graphs with proper use. Both of these indicators obtain the same validity value of 0.83. These indicators relate to students' science processes in terms of collecting data and interpreting the data obtained. Pertiwi, et al. (2018) explained that one of the abilities assessed in scientific literacy is the ability to communicate. Dewi (2016) also explained in her research that scientific process indicators such as explaining scientific phenomena, designing and evaluating scientific research, and interpreting scientific data and evidence. In the LKS made there are two experiments that will be carried out by students, in one of the experiments there is no data presentation via graphics. Based on PISA (2003), one of the competencies that students must fulfill in this aspect of the scientific process is the ability to communicate conclusions and sharp understanding of scientific concepts. Communication of conclusions and demonstration of understanding of scientific concepts can be presented through graphics.

The next aspect of the assessment is the scientific concept. The scientific concept assessment aspect consists of 6 indicators, namely: 1) LKS contains phenomena that are in accordance with real life or everyday life, 2) Phenomena presented in LKS follow the development of science and technology, 3) Phenomena in LKS are developed according to the level of development students, 4) LKS contains scientific questions that are in accordance with the evidence data obtained, 5) LKS develops the nature of scientific observation in students, 6) LKS produces explanations about life based on the aims and objectives of science. The validation results of the scientific concept section are shown in Figure 7.

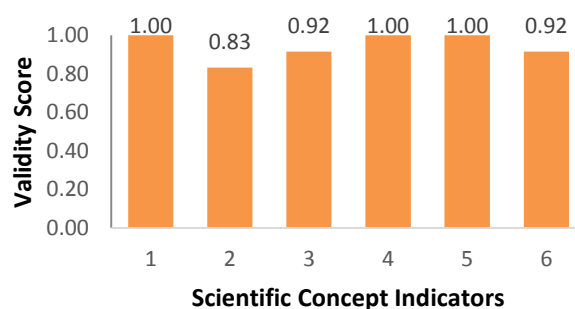


Figure 7. Scientific concept validity result

Based on Figure 7 it can be seen that the validation value of each indicator in the scientific concept section has a range of 0.83 to 1.00. The average value of each indicator in the presentation component was 0.94 with a very valid category. The lowest validity value in this concept aspect is found in the phenomenon indicators presented in the LKS following the development of science and technology with a validity value of 0.83. Scientific phenomena are the most important part of a worksheet that integrates scientific literacy because students' scientific literacy skills are improved through scientific analysis of phenomena around them, especially phenomena related to everyday life and the technology around them. Utami, et al. (2022) explain that science content/concepts refer to the key concepts of science necessary to understand natural phenomena and the changes they make on nature through human activities. Another research also explained that there are three competencies needed by someone who has scientific literacy skills, namely explain phenomena scientifically, evaluate and design scientific inquiry, interpret data and evidence scientifically (PISA, 2015). The phenomena described must align with the advancements in science and technology in order to achieve the goals of this scientific literacy integration. This is in line with Wulandari & Solihin in Subaidah, et al., (2019) elaborated that the knowledge aspect of scientific literacy in PISA aims to determine the extent to which students can apply their knowledge in relevant contexts. Explaining scientific phenomena requires more than just being able to memorize and apply theory, it also requires an understanding of how these things happened.

The final assessment component is the graphical assessment component. The graphical component consists of 4 indicators, namely: 1) The use of fonts (type and size) used in the LKS is proportional, 2) The layout on the LKS is proportional, 3) The illustrations, pictures, and photos presented on the LKS are in accordance with the material, 4) The color combination on the cover and each LKS sheet is proportional. The results of the graphical indicator value plot are shown in Figure 8.

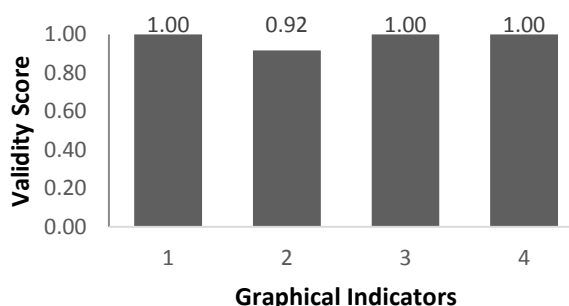


Figure 8. Graphical validity result

Based on Figure 8 it can be seen that the validity value of each indicator in the graphical component has a range of 0.92 to 1.00. The average value of each indicator in the graphical component was 0.98 with a very valid category. The graphic component assesses the appearance and suitability of the LKS design made with the material presented. This is in line with Salirawati's (2004) explanation which said that the appearance of the LKS is very important in attracting students' interest in learning, LKS is a combination of pictures and writing that is arranged as attractively as possible. The validity value of the graphic component belongs to the very valid category with an average value of 0.98. The lowest indicator is obtained on the layout indicator and the layout on the LKS is proportional to the value of 0.92. Afannudin & Winarsih, (2019) explain that effective layout, appropriate placement of tables, images and page numbering can make worksheets easier for students to understand do activities on the LKS. The appearance of student worksheets (LKS) is

very important in their creation because generally, students are initially attracted to their outer appearance rather than their content (Nofayukisari, et al., 2021).

The validity value is obtained by calculating the average value of each assessment component value. Component values are obtained from data processing from the scores given by each validator. Based on these values, the results of the average plot of the validity value of each component can be seen in Figure 9.

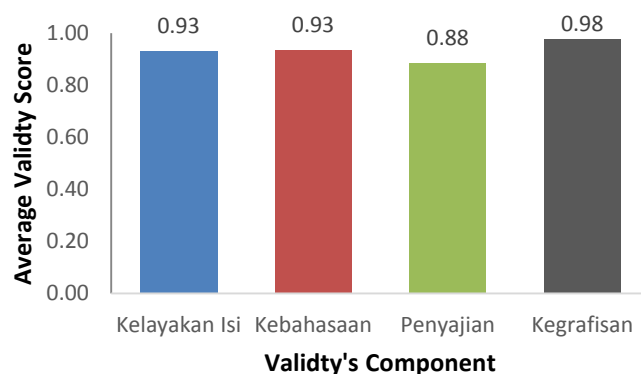


Figure 9. The result of the validation of student worksheet integrated scientific literacy for the use of physics practicum KIT in temperature and heat

Based on Figure 9 it can be seen that the validity value of each LKS component integrated with scientific literacy for the use of physics practicum KIT on temperature and heat materials has a range of 0.88 to 0.98. Of the four components, the component that has the highest validity value is the graphical component, which is 0.98, and the component that has the lowest value is the presentation component, which is 0.88. The average component validity value was 0.93. Based on the decision of the Aiken's V index, the integrated scientific literacy worksheet for the use of physics practicum KIT on temperature and heat material has a very high validity value. This is in line with what Retnawati (2016) explained, that if the V index value is higher than 0.8, it is considered to be highly valid. Based on these validity scores, the student worksheets are suitable for use in learning.

Conclusion

Based on the results, it can be concluded that the student worksheet integrated scientific literacy for the used of physics practicum kit in temperature and heat is very valid. Student worksheet were valid for the four components of the assessment consisting of a content feasibility with a value of 0.93, a language with a value of 0.93, a presentation with a value of 0.88, and a graphic component with a value of 0.98. Based on this validity assessment, it was obtained an average validity value of 0.93 (very valid) so it can be stated that the scientific literacy integrated worksheet for the use of physics practicum KIT can be used by students in physics learning, especially in temperature and heat.

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