JPPIPA 10(6) (2024)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Development of E-Worksheet with the TPACK Approach to Train Students' Digital Literacy and Higher Order Thinking Skills

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Received: August 1, 2023
Revised: February 15, 2024
Accepted: June 25, 2024
Published: June 30, 2024

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DOI: 10.29303/jppipa.v10i6.4850

Abstract: 21st century skills that must be mastered by students in an era of rapid technological development, one of which is digital literacy and HOTS. Therefore, there is a need for innovation in form of E-worksheet with the TPACK approach to train students' digital literacy and HOTS. TPACK can integrate technology with learning. This study aims to analyze the validity of E-worksheets with the TPACK approach to train students' digital literacy and HOTS, and also to analyzing students' digital literacy and HOTS profiles after using the product. This type of research is Development which uses the ADDIE model. The average value of Aiken's E-worksheet products with the TPACK approach which was validated by 5 experts was 0.94 indicating that E-worksheet products developed were valid to be used to train students' digital literacy and HOTS. The digital literacy profile of 27 students is 7% very good criteria, 48% good criteria, and 45% good enough criteria. The HOTS profile of 27 students is 67% good criteria and 33% good enough criteria. It can be concluded that the E-worksheets with the TPACK approach is valid and can be used to train students' HOTS digital literacy.

Keywords: Digital literacy; E-worksheet; HOTS; TPACK

Introduction

In the 21st century, science and technology are developing very rapidly, affecting various fields including education. The development of science and technology in 21st century education has changed the learning paradigm which can be seen in changes in curriculum, media, technology, information, computing, automation, and communication (Khair et al., 2022; Rahayu et al., 2022).

Innovation in learning is needed to face the challenges of the 21st century. This innovation can take the form of student-centered learning so that it can help students face the changes and challenges of the 21st century. The 21st century skills that students must master amidst the rapid development of technology are digital literacy and Higher Order Thinking Skills (HOTS). Students must be able to utilize existing technology to develop an understanding of the problems that occur (Widiyawati et al., 2021).

The inability of students to master HOTS is a problem that needs to be addressed because it will impact on the low ranking results of the Program for International Student Assessment (PISA). The results of the 2018 PISA ranking carried out by the Organization for Economics Cooperation and Development (OECD) state that the science ability of Indonesian students is still ranked 71st out of 79 countries (Mustafa, 2023). The low results of the 2018 PISA ranking can be caused by various factors, including the lack of trained Indonesian students in solving HOTS questions, where PISA questions are HOTS-laden questions (Sara et al., 2020).

The rapid development of information technology in the 21st century requires students to have digital literacy skills. Digital literacy will help students filter correct information according to the facts, not just

How to Cite:
Niswah, P. U., & Dewi, N. R. (2024). Development of E-Worksheet with the TPACK Approach to Train Students' Digital Literacy and Higher Order Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, *10*(6), 3473–3485. https://doi.org/10.29303/jppipa.v10i6.4850

someone's opinion, so students will avoid hoax news and various types of online fraud (Ulfah, 2020). Research conducted by Oktavia et al. (2019), obtained results that the digital literacy level of students was still categorized as low and medium with percentages of 35.5% and 51.7%. In this study, the researchers suggested further strengthening students' digital literacy by integrating it with HOTS.

The level of high thinking ability of students according to research conducted by Kurniati et al. (2016), shows that high-level thinking skills of junior high school students are still classified as moderate to low levels. In line with research conducted by (Widiyawati et al. (2021), states that most of the HOTS achievements of junior high school students are still in the low to moderate category and digital literacy in the scope of learning is still inadequate to provide digital-based learning. An innovation that is suitable for the 21st century is the use of technology in learning, one of the innovations that can be done is the Electronic Student Worksheet (E-worksheet).

E-worksheets are interactive learning media that are arranged systematically presented in electronic format in which there are navigation, images, animations, and videos that students can work on via the internet network (Lathifah et al., 2021). E-worksheets made in electronic form are easier to access anywhere, anytime, are more interactive, and can be studied again (Mispa et al., 2022).

Worksheet development needs to be supported by an approach that is able to integrate technology with pedagogical knowledge and learning content. This integration is in accordance with the *Technological, Pedagogical, And Content Knowledge* (TPACK) (Valtonen et al., 2017). Purnawati et al. (2020), show that the TPACK-based E-worksheet is very appropriate for use in learning. Maor (2017) stated that from the survey data, it was found that there was an increase in students' digital literacy when implementing TPACK. Zainuddin et al. (2021), stated that the use of HOTS-based TPACK in learning which has a problem solving can increase student interaction in the learning process.

Integration between digital literacy and HOTS in E-LKPD with the TPACK approach is very necessary in the 21st century because not only does digital literacy need to be mastered in utilizing various technologies in learning with the TPACK approach, but it needs to be combined with HOTS to create various breakthroughs in dealing with various problems faced in the digital era more efficiently.

The development of E-LKPD with the TPACK approach to train students' digital literacy as well as HOTS has never been done before. The e-LKPD that was developed was made more interactive, interesting, and more structured according to the level of indicators for digital literacy and HOTS from simple to more complex so that the integration of these two variables can help in training students' digital literacy and HOTS. This research aims to analyze the validity of E-LKPD with the TPACK approach to train students' digital literacy and HOTS, besides also analyzing the profile of students' digital literacy and HOTS after using E-LKPD with the TPACK approach.

Method

This type of research is Research Development. The development design used is the ADDIE model which has 5 stages of development namely analysis, design, development, implementation, and evaluation (Branch, 2009). The ADDIE development model scheme is presented in Figure 1.

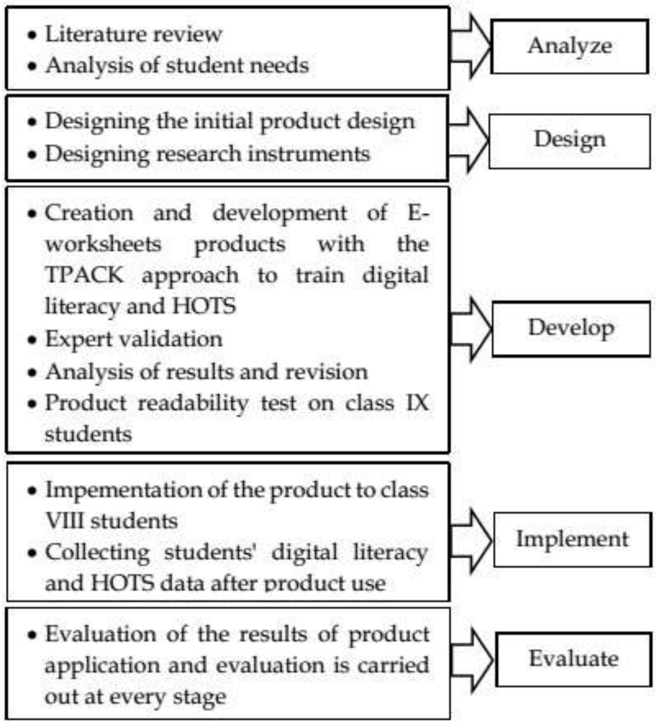

Figure 1. ADDIE development model scheme

Data analysis to determine product validity, test and non-test instruments was carried out using the Aiken's V method with equation (1):

$$V = \frac{\sum S}{[n(c-1)]} \tag{1}$$

where S = $(ri - lo)$
Information:
Lo = lowest validity rating score
C = the highest validity rating score
r = the number given by the expert
n = number of appraisers
(Azwar, 2016)

This study uses 5 raters and 4 rating categories according to a Likert scale of 1-4, so based on the standards set by Aiken, the research is said to be valid if the coefficient value is ≥ 0.87 (Azwar, 2016). E-worksheet validity criteria can be seen in Table 1.

Table 1. E-worksheet Validity Criteria

Criteria	Information
V < 0.87	Invalid
V ≥ 0.87	Valid

If $V_{count} \geq V_{table}$, then the instrument and product are valid. The price of the V table with n= 5 and c= 4 is 0.87 (Arikunto, 2013). Analysis of the results of readability and practicality using equation (2):

$$P = \frac{f}{N} x\ 100\% \quad (2)$$

Information:
P = Percentage of score obtained
f = Total score obtained
N = Total maximum score

The results of the percentage scores obtained are then converted into assessment criteria as shown in Table 2.

Table 2. Readability Assessment Criteria

Achievement percentage (%)	Criteria
81.25 < P ≤ 100	Very good
62.50 < P ≤ 81.25	Good
43.75 < P ≤ 62.50	Enough
25.00 < P ≤ 43.75	Not good

The results of the percentage of E-worksheet criteria with the TPACK approach are considered good to use if the assessment score is > 62.50%. Meanwhile, if the result of the percentage score of the assessment is ≤ 62.50%, then the E-worksheet is revised again until it meets the good criteria.

The results of the percentage of students' digital literacy are considered good if the assessment score is > 62.50%. Meanwhile, if the results of the percentage score of the assessment ≤ 62.50%, then it is categorized as not good, so a different treatment is needed so that students' abilities can increase.

HOTS analysis of students is carried out with equation (3):

$$Final\ score = \frac{Final\ scores}{Number\ of\ questions} \times 100 \quad (3)$$

The values obtained are categorized according to the HOTS assessment categories based on the International Center for the Assessment of Higher Order Thinking presented in Table 3.

The results of the HOTS assessment of students are considered good if the assessment score is ≥ 61. Meanwhile, if the results get an assessment score ≤ 40, then it is categorized as poor, so a different treatment is needed in the next study so that it can improve.

Table 3. HOTS Assessment Criteria (Megawati et al., 2019)

Final score	Rating category
81 ≤ Score ≤ 100	Very good
61 ≤ Score ≤ 80	Good
41 ≤ Score ≤ 60	Enough
21 ≤ Score ≤ 40	Not Enough
0 < Score ≤ 20	Very less

Results and Discussion

E-worksheet Validity with TPACK Approach

The validity of the E-worksheet with the TPACK approach to train digital literacy and HOTS for junior high school students was assessed based on the validation sheet of 5 experts. Validation aims to obtain assessment data and determine the validity of the E-worksheet with the TPACK approach before being tested on students. The results of the E-worksheet validation with the TPACK approach on each aspect of the assessment by 5 experts can be seen in Table 4.

Table 4. Results of the E-worksheet Product Validity Assessment with the TPACK Approach

Assessment aspects	*Aiken's V* average	Criteria
Component	0.93	Valid
Appearance	0.91	Valid
Material	0.90	Valid
Language	0.97	Valid
Learning activities	0.98	Valid
TPACK	0.98	Valid
digital literacy	0.93	Valid
HOTS	0.94	Valid

The average result of the assessment using the *Aiken's V formula* for E-worksheet products with the TPACK approach is 0.94 which indicates that the E-worksheet product developed can be categorized as a valid product to be used as teaching material for class VIII students of SMP on material vibrations and waves in everyday life. The standard set by Aiken states that a product can be said to be valid if the value obtained is ≤ 0.87 on a Likert scale of 1-4 with 5 raters. Content validity using the *Aiken's V formula* was assessed by 5 experts using 8 assessment aspects according to Pebriani et al. (2022), namely components, appearance, material, language, and learning activities, as well as special aspects contained in this E-worksheet which include TPACK, digital literacy, and HOTS.

The first assessment aspect is the component. The results of the assessment can be seen in Table 4, which can be declared valid. This is because the E-worksheet already includes components according to the Ministry of National Education (2008) consisting of criteria, which consists of material title, learning instructions, components to be achieved, material introduction, supporting information, tasks and work steps, HOTS-based assessment, and equipped with an identity column for student administration in each learning activity. The component aspects received several suggestions for improvement from experts, namely supporting the presentation of material on E-worksheets in the form of sample questions and practice questions at the end of each activity where there were only discussion questions and questions at the end of the chapter, thus affecting students' mastery of the material at each meeting. Improvements made include adding practice questions at the end of each activity so that students can better understand the concepts in the material being taught. Astiti et al. (2021) state that practice questions in each learning activity can strengthen students' understanding of the concept of the material being studied.

The second assessment aspect is display, the results seen in Table 4 show valid criteria. The most prominent thing from the display aspect is the layout of the contents of the E-worksheet which looks consistent and harmonious. The display aspect received several suggestions for improvement from experts, namely the cover illustrations were adjusted to those that were more relevant to make them more harmonious, the writing of the words sub-chapters was removed and the illustrations or videos were sized accordingly, showing videos that were more real and contextual. Contextual videos can help students understand the material being taught. Jundu et al. (2020), state that contextual science learning videos help students understand the concepts of the material being taught. Dewi et al. (2019), state that illustrations that are in accordance with learning objectives can help students understand the material.

The third assessment aspect is material, the results seen in Table 5 show valid criteria because it $V_{count} \geq$ is 0.87. The advantages of the material aspects of this E-worksheet are the accuracy of facts, concepts, principles and procedures. This aspect received several suggestions and improvements from experts, namely adjusting the material to core competencies, basic competencies, and learning objectives besides adjusting examples and illustrations that were more accurate and contextual. Accurate and contextual examples and illustrations can help students understand the material being taught. Rahmadhania et al. (2017), state that clear and accurate examples or illustrations can help students understand learning material.

The fourth aspect of assessment is language. The results presented in Table 5 show valid criteria. The advantages of the language aspect are that the Indonesian language rules are appropriate, the information presented in the E-worksheet is complete and clear, and supports students to carry out activities in the E-worksheet. Suggestions and improvements from experts, namely the words used must be more consistent, so that students can easily understand them. A good E-worksheet must show grammar that is appropriate to the level of development and understanding of students, besides that the words used must be consistent, clear, easy to read and understand (Lawi et al., 2022).

The fifth assessment aspect is learning activities, the results seen in Table 5 show valid criteria. The advantages of this aspect can be seen in the presentation of material in E-worksheets which are interactive and can motivate students to study independently, and have clear learning objectives in each activity. The value obtained in the learning activity aspect is included in the very good criteria among other aspects. This shows that the aspects of learning activities contained in E-worksheet products are among the most superior. The strategy applied by the teacher to the learning activities in the E-worksheet is presented clearly and in accordance with the characteristics of the students where the syntax of the *scientific model learning* is shown in a clear and coherent manner, besides that digital literacy indicators and HOTS are also presented clearly, making it easier for students to understand vibration and wave material in everyday life, this is in accordance with the PCK component. Dewi et al. (2022a), states that PCK is used to determine appropriate learning methods based on the characteristics of students. Learning objectives are clearly presented in each activity, so as to facilitate students' able to actively and independently carry out digital literacy and higher order thinking. Clear learning steps on E-worksheets can facilitate students to think at a higher level (Pebriani et al., 2022).

The next assessment aspect is TPACK, the results seen in Table 5 show valid criteria because the value V_{hitung} obtained is ≥ 0.87. The thing that stands out in this aspect is the E-worksheet that is presented in accordance with the TPACK component, and the learning has been integrated with technology according to the material and learning models. The value obtained on the TPACK aspect is included in the very good criteria among other aspects. This shows that the TPACK aspect is a superior aspect in the developed E-worksheet product. A description of the TPACK aspects can be seen in the introduction to the E-worksheet product or in each activity where all TPACK aspects in the E-worksheet product are clearly visible. The TK component can be seen in the use of Liveworksheets, internet, YouTube, and virtual laboratories. The PK component can be seen in the scientific learning model. CK components can be seen in the material studied, namely vibrations and waves in everyday life. The TPK component can be seen in the use of Liveworksheets and virtual laboratories in teaching activities that follow scientific learning steps or learning models. TCK components can be seen in the use of Liveworksheets, YouTube, and the internet to study vibrations and waves in everyday life. The PCK component can be seen in the teacher's teaching strategy in applying scientific learning steps to study vibrations and waves in everyday life. The TPACK component itself can be seen in the overall use of Liveworksheets which can be used in learning activities that use scientific learning models on vibrations and waves in everyday life. The TPACK component applied to this E-worksheet can encourage students to be more innovative. Dewi et al. (2022b) state that TPACK can support learning in a more innovative direction.

The next aspect of the assessment is digital literacy with the results presented in Table 4 declared valid because the value is ≥ 0.87. The value obtained is because the E-worksheet presented is in accordance with digital literacy indicators according to the Ministry of Education and Culture (2017), namely finding digital information, understanding digital information, evaluating digital information, creating digital information, and communicating digital information. Digital literacy indicators are clearly written in each activity in the E-LKPD, so they are included in the valid criteria. Indicators of finding digital information can be seen in the activity of finding digital information related to learning materials that are in accordance with the events that occur. Indicators of understanding digital information can be seen in the activity of analyzing information that has been found on the internet to answer existing problems. The evaluate indicator can be seen in the online experiment activity to evaluate or prove the truth of the information that has been found and understood. Indicators of making digital information can be seen in discussion activities that are required to make a conclusion from the practicum that has been carried out. The last indicator is communicating digital information seen in presentation activities or when uploading experimental results through digital media.

The last assessment aspect is HOTS. The results of the assessment analysis can be seen in Table 4 which states that the HOTS aspect is in the valid criteria. This is because it presents concrete examples from the surrounding environment (contextual). The E-worksheet product is also equipped with KKO which directs students to achieve HOTS, wherein each activity and instructions given refer to HOTS indicators which include analyzing (C4), evaluating (C5), and creating (C6).

The readability results of students on E-worksheet products with the TPACK approach were obtained by distributing readability questionnaires to 10 class XI students obtaining an average percentage of 85.63% which was included in the very good criteria, this shows that the E-worksheet product with the TPACK approach received a very good response from students, so that E-worksheet products can be used in learning, especially in training students' digital literacy and high-level thinking abilities. The readability test results are very good, showing that the product developed is very suitable for use (Pebriani et al., 2022).

Profile of Digital Literacy of Learners

Literacy is the ability to process various digital information by finding, using, utilizing, evaluating, creating, creating, communicating, collaborating, adhering to ethics and rules, and wisely using information technology to achieve goals (Fitriani et al., 2022). Digital literacy analyzed in this study uses digital literacy indicators according to the Ministry of Education and Culture (2017) which consist of finding digital information, understanding digital information, evaluating digital information, creating digital information, and informing digital information. The results of the average percentage of digital literacy students in class VIII A at SMPN 36 Semarang obtained for each indicator can be seen in Table 5.

Table 5. Achievement of the Average Percentage of Digital Literacy for Each Indicator

Indicator	Average percentage (%)	Criteria
Finding digital information	69.91	Good
Understanding digital information	77.78	Good
Evaluating digital information	62.27	Enough
Creating digital information	58.64	Enough
Communicating digital information	58.33	Enough

The overall average digital literacy achievement of students based on Table 5 is 63.08% so it can be stated that the digital literacy of class VIII A students is in good criteria. The overall digital literacy profile of 27 students is presented in Figure 2.

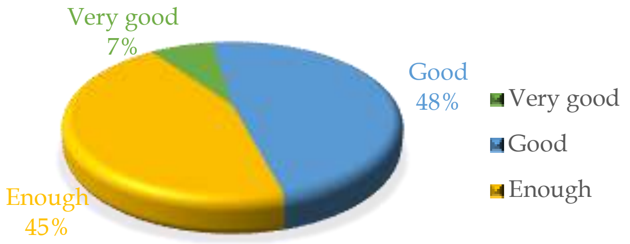

Figure 2. Digital literacy profile

Profile participants' digital literacy educates whole the indicator by 7% in criteria very good, 48% in criterion good, and 45% in category enough. Next, this explanation profiles digital literacy in every indicator:

The first indicator which is finding digital information gets an average achievement of 69.91% is included in the good criteria. The digital literacy profile of 27 students on this indicator can be seen in Figure 3.

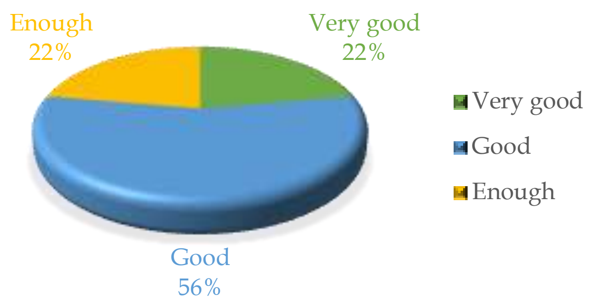

Figure 3. The percentage of indicators finding digital information

The indicator for finding digital information in question is the ability of students to find digital information through various digital learning sites, especially in science learning. This indicator can be seen in the developed E-worksheet product where there are activities that direct students to access various learning sites to find digital information that can solve existing problems. This activity influenced students in finding digital information so that out of 27 students, there were 22% of students in the very good category and 56% in the good category. The indicator of finding digital information shows the integration of digital technology with learning materials in the form of TCK where students can use digital information technology to find solutions to solving problems in science material and help students to be able to use or access internet sites properly in supporting science learning activities. Muttaqiin (2023), states that the integration of technology with learning can support learning activities both when using digital devices or digital applications to find information in the learning process. Meanwhile, of the 27 students who fell into the sufficient category, 22% could be influenced by the background information knowledge of students in searching for digital information. Irhandayaningsih (2020) states that students' information knowledge background which leads to the ability to find, select, and compare digital information with the context of learning materials can affect students' digital literacy. The solution is to provide guidance and training related to students' information technology knowledge. Nendya et al. (2021) states that training can improve a person's ability to understand the basic use of digital information technology.

The second indicator that is understanding digital information obtained an average achievement of 77.78% in good criteria. The digital literacy profile of the 27 students obtained on this indicator is presented in Figure 4.

Figure 4. The percentage of indicators understand digital information

The indicator of understanding digital information gets the highest score of the other indicators. This shows that students better understand digital information obtained in solving existing problems by utilizing the use of digital technology in science learning activities literacy profile of students on the indicator of understanding digital information is 45% in the very good category and 44% in the good category is obtained because there are digital information analysis activities that have been obtained by students to solve the problems presented in the E-worksheet product. This activity aims to enable students to use digital media to understand the information that has been obtained, so that students' knowledge, especially in learning science, can increase. This indicator leads to TCK where students can understand the use of digital technology to solve problems in the science material being studied. Students' understanding of the effective use of digital technology can build students' understanding in learning (Donaldson et al., 2019). The integration of technology with this learning material helps students to be able to make good use of digital technology in understanding science material. In line with Susilawati's research (2021), which states that the integration of technology in the TPACK approach can help students understand the use of digital technology, so that it can increase students' understanding of learning material. Digital literacy profile on understanding indicators digital information included criteria enough by 11%. This is because there are some students whose basic literacy skills in reading and understanding the information are still lacking. Irhandayaningsih, (2020) states that students' basic literacy skills in reading and understanding various digital features can affect digital literacy. The solution offered is in the form of increasing the basic literacy skills of students. Nashirulhaq et al. (2022) state that basic literacy skills are very important to master because they can improve students' ability to understand the information they read.

The third indicator that is evaluating digital information gets an average achievement of 62.27% in enough criteria. This indicator derives from the digital literacy profile of 27 students presented in Figure 5.

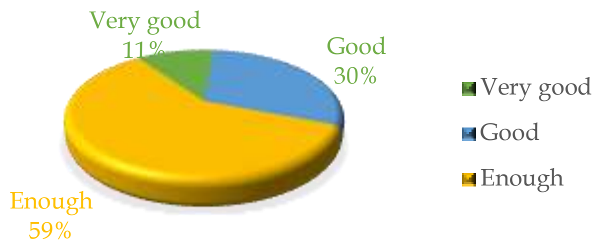

Figure 5. The percentage of indicators evaluates digital information

The evaluation indicator in question is the ability of students to evaluate digital information obtained through the internet by distinguishing true and false information, and being able to compare and select the information needed from various learning sites. The indicator evaluating digital information is 11% in very good criteria and 30% with good criteria is obtained because there are evaluation activities seen in the E-worksheet product in the section proving the correctness of information obtained from the internet through practicum using a virtual laboratory. This indicator directs the TPK component in the form of student's ability to use virtual laboratories in learning activities to prove the correctness of the information obtained so that students can find and evaluate digital information according to their needs. This indicator helps students to be able to choose the correct information according to their needs. In line with Pasani's research (2018), which states that the integration of technology in the TPACK approach can increase students' digital literacy in using digital information according to their needs. Students who are included in the criteria are quite good at 59%, this is influenced by the time needed by students to understand various features of digital media, especially in the use of virtual laboratories, which affects students' understanding of the material studied because students have time to study which is quite limited in improving the basic capabilities of digital media. Irhandayaningsih (2020) states that the basic ability of students to use digital media is an important factor affecting digital literacy, where students must master the various features available in digital media to make it easier to understand learning material. The basic ability of students towards digital media needs to be improved first so that learning can run smoothly according to the allotted time.

The fourth indicator that is making digital information obtain an average achievement of 58.64% in the criteria of enough. The digital literacy profile obtained from 27 students on this indicator is presented in Figure 6.

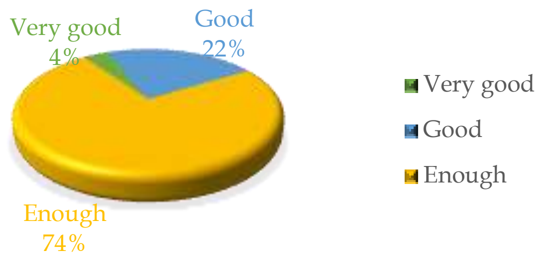

Figure 6. The percentage indicator makes digital information

The indicator of creating digital information directs students to create digital information and summarize it into science learning content after experimenting with a virtual laboratory, then making it into uploads in the form of science learning videos. In this indicator, there are 4% in the very good category and 22% in the good category. These results were obtained because there was an activity of making digital information visible on the E-worksheet section of discussion questions or experimental results where students would discuss and make analysis results by answering questions or writing down the results of experiments that had been carried out with the virtual laboratory, as well as at the end of the student chapter create simulation tools in groups which are then made into content that is uploaded via the internet. This indicator leads to the PCK component which is in accordance with the teaching strategy used by the teacher in the form of the syntax of the learning model presented on the E-worksheet, so that students independently or in groups will discuss learning material according to the learning steps. Students who are included in the criteria are enough at 74% which is caused by the lack of cooperation of students in experiments and discussions where only active students do the work so that students who are less active do not understand the material being taught. The solution needed is that the teacher must be able to guide the discussion well. Sholihah et al. (2022) stated that the solution to overcoming obstacles to discussion activities is to provide directions to students, take a personal approach to students, and re-explain the material that has been explained.

Fifth indicator that is informing digital information gets an average achievement of 58.33% in the criteria of enough. This indicator derives the digital literacy profile of 27 students presented in Figure 7.

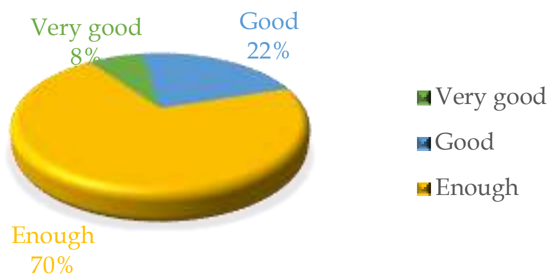

Figure 7. Percentage indicator provide digital information

The indicator of informing digital information directs students to exchange ideas online related to science subjects by sharing links related to science learning and working on online quizzes about science learning available on E-worksheets then uploading or presenting the results online. Students who are included in the very good criteria are 8% and those who are in the good category are 22%, this is because there are activities that communicate practical results and discussions where students are directed to upload online or present results in front of the class using existing technology such as projector. This activity leads to the TCK component where students can use digital technology in presenting the material they have learned. This indicator gets the lowest score where there are 70% of students who are in the fairly good category, this is due to limited study time which hinders presentation activities in front of the class.

The results of digital literacy obtained as a whole show that the indicator that gets the highest score is the indicator of understanding digital information while the indicator that gets the lowest score is the indicator of communicating digital information. Factors that influence the low score on the indicator of communicating digital information are ICT skills that lead students to design and create digital content, especially in science learning (Irhandayaningsih, 2020). This factor is very necessary because students are required to be skilled in using digital media to compile reports or digital content in learning. Another influencing factor is the attitude and perspective of information users related to how to communicate content to other sources (Irhandayaningsih, 2020).

The use of E-worksheets with the TPACK approach as teaching materials can train students' digital literacy. Digital literacy can improve students' ability to search, understand, evaluate, create, inform digital information in making the right decisions in life, so that having digital literacy in the 21st century can help students think at a high level about technology and digital information which exists. Assidik's research (2018), states that digital literacy integrated with information technology can improve students' high-level thinking skills. Naufal (2021), states that students' digital literacy abilities can be used to utilize digital media in developing themselves so that they are more productive not for consumptive activities or even activities that are destructive or harmful. Mishra et al. (2006), explained that one of the advantages of the TPACK approach is that it can increase students' digital literacy because their learning is integrated with technology. The link between the use of E-worksheets with the TPACK approach and digital literacy based on the results obtained is that E-worksheets with the TPACK approach can help train digital literacy. The ability of students in digital literacy can also support the achievement of HOTS students.

HOTS Profile of Learners

Higher-order thinking ability is the ability to process students' thinking in interpreting knowledge to solve problems in making decisions through the process of analysis, evaluation, to create an idea (Desiriah et al., 2021). The HOTS analyzed in this study used indicators of Bloom's Taxonomy from C4 to C6, namely analyzing (C4), evaluating (C5), creating (C6). The results of the average HOTS score of students for each indicator can be seen in Table 6.

Table 6. Average HOTS Score for Each Indicator

Indicator	Average Score	Criteria
Analyze (C4)	65.74	Good
Evaluate (C5)	58.52	Enough
Create (C6)	62.96	Good

Table 6 shows the average HOTS achievement as a whole of 63.52 so it can be concluded that the HOTS class VIII A students are in the good category. The overall HOTS profile of the 27 students is presented in Figure 8.

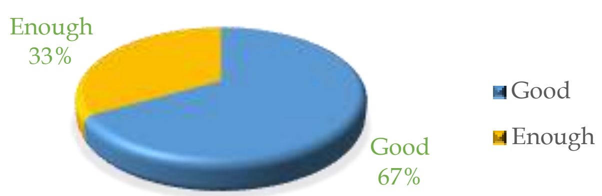

Figure 8. Profile of digital literacy of learners

Overall digital literacy profile tends to be good with a score of 67%. The following is the result of the HOTS profile analysis of students for each indicator:

First indicator that is analyzing has an achievement score of 65.74 in the good category. Figure 8 shows that the HOTS profiles of 27 students on analyzing indicators.

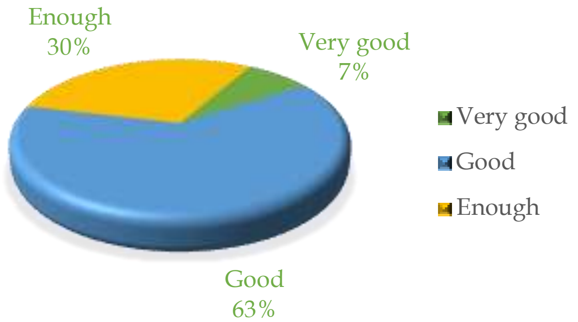

Figure 9. HOTS profile percentage on analyze indicators (C4)

The analyzing indicator is in the form of students' ability to analyze existing problems and relate them to the material being studied. Students who are included in the very good criteria are 7% and in the good category are 63%. These results are influenced by the analyzing activities contained in the E-worksheet on contextual problems where students independently solve problems that occur by utilizing existing information technology and linking it to vibration and wave material in everyday life, so that it can direct students to think high level. This activity leads to the TCK component where students are able to utilize existing information technology to study vibration and wave material in everyday life. Hastuti et al. (2021) states that the application of learning with the TPACK approach can support the creation of student HOTS. This indicator gets the highest score than the other indicators, indicating that students are able to analyze a problem related to learning material using the available information technology. Students who are included in the criteria are quite good as much as 30% obtained due to several factors, one of which is due to internal factors of students in the form of interest in learning and motivation of students in learning, besides that it can occur due to external factors in the form of school background such as facilities and infrastructure that inadequate so that the brain development of students is limited to the theory conceptualized by the teacher. Teachers also very rarely conduct experiments, especially experiments that utilize existing technology, but teachers only provide data and then ask students to analyze it, so this habit makes many students not good at analyzing data or a phenomenon (Mari'a et al., 2021).

The second indicator is evaluating obtaining a score of 58.52 in the criteria of enough. The HOTS profile of this indicator is shown in Figure 10.

This evaluation indicator is in the form of students' ability to evaluate an event or problem which then concludes it to be an answer to the solution of the event that occurred. Students who fall into good criteria at 26% are obtained because of the activities in the E-worksheet containing HOTS which direct students to carry out evaluations related to experiments and analyzes that have been carried out through joint discussions. This activity leads to the PCK component where students follow the learning strategy implemented by the teacher in the form of joint discussions to understand the vibration and wave material being taught. This indicator gets the lowest score compared to other indicators where there are 74% of students including sufficient criteria and 33% of students in less criteria, this is because students are less able to interpret events properly so that the conclusions obtained by students are still not quite right. Iswanto et al. (2022), which states that the process of concluding a problem requires several other supporting skills such as interpreting, comparing, and explaining, so students will have difficulty if they have not mastered these supporting skills.

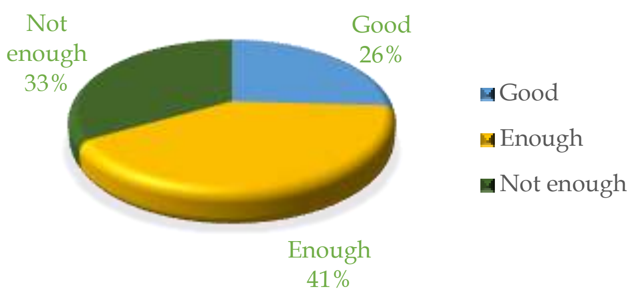

Figure 10. HOTS profile percentage on evaluate indicators (C5)

Third indicator that is create obtains an average achievement of 62.96 in the good category. Figure 11 shows that the HOTS profile on the creating indicator.

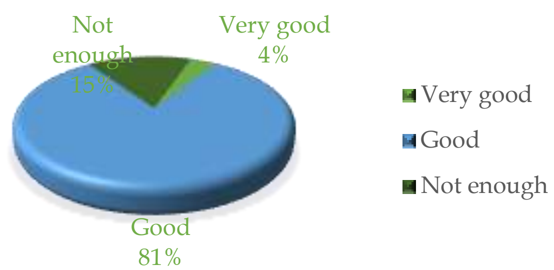

Figure 11. HOTS profile percentage on create indicator (C6)

This indicator of creation is in the form of students' ability to combine various understandings into an idea or solution. Students who are included in very good criteria are 4% and 81% with good criteria, this is because there are activities that direct students to create the results of their thinking in the form of making conclusions and making simple simulation tools related to the application of the concept of vibrations and waves in life every day by utilizing available technology and digital information. This activity leads to the TCK component where students are able to utilize existing technology and digital information to create ideas or a tool related to the application of vibration and wave material concepts in students' daily lives, then the results are made into a simulation video and uploaded on social media. The creation activity on the E-worksheet which is seen at the end of the meeting directs students to create a tool, so that this activity helps students to think at a higher level where through the tools created are able to provide a more real conceptual understanding. Sambite et al. (2019) states that students are able to understand the concept of the material being studied from making the tools they make so that they can increase students' HOTS where from making these tools students are able to absorb information, be responsive and able to relate theory to its application. This indicator has 4 students at 15% who fall into the less criteria, this is due to several factors one of which is the understanding of students in managing thinking processes is still lacking where in the E-worksheet developed there is no special column for self-reflection students, where reflection students themselves is done orally only at the end of learning. The solution that needs to be implemented is to provide a special column for self-reflection related to the learning that has been done. Utami et al. (2022) state that learning that involves students in self-reflection is related to the learning process, so that students are able to regulate and supervise their own thinking processes so that students' higher-order thinking skills can increase.

The HOTS results obtained show that the indicator that gets the highest score is the analyzing indicator, while the indicator that gets the lowest score is the evaluating indicator. The use of E-worksheets with the TPACK approach as teaching materials can train students' HOTS abilities. This is supported by Pasani's research (2018) which states that TPACK can improve higher-order thinking skills. In line with the research by Sahidin et al. (2022), which states that the integration of TPACK in learning can support HOTS-oriented learning.

The advantage shown in the application of the TPACK approach to the developed E-worksheet product is that the TPACK approach is able to provide a more interactive and interesting learning experience for students. Technology integration in TPACK can encourage students' digital literacy, where students can make proper use of technology in learning activities by following existing learning steps, students can also use the right information technology in solving various existing problems so as to encourage abilities students' higher order thinking. The weakness is that it causes a gap in the learning experience because not all students have adequate technology, besides that it can cause a risk of students' dependence on existing technology so that it can reduce students' ability to learn independently without the help of technology.

Conclusion

The E-worksheet with the TPACK approach is valid for training students' digital literacy and HOTS because it has an average *Aiken's V score* of 0.94. The digital literacy profile after using the E-worksheet with the TPACK approach in class VIII A at SMPN 36 Semarang shows that out of a total of 27 students, there are 7% of students in very good criteria, 48% of students in good criteria, and 45% of students in enough criteria. The average achievement obtained as a whole is equal to 64.88% with good criteria. The HOTS profile of students after using the E-worksheet with the TPACK approach shows that out of a total of 27 students, 67% of students are in the good category and 33% of students are in the sufficient category. The average score obtained by students is 63.52 which is categorized as good. The conclusion obtained is that the E-worksheets with the TPACK approach is valid and can be used to train students' HOTS digital literacy.

Acknowledgments

Praise be to Allah SWT who has given his grace and guidance so that I can complete this research. I would like to thank my advisor, Mrs. Dr. Novi Ratna Dewi, S.Si., M.Pd. who has provided direction, support, and guidance so that I can complete this research. I am also very grateful to my parents who always provide support, love, and prayers. Thank you also to all those who helped me in writing this article.

Author Contributions

Conceptualization, P.U.N. and N.R.D.; methodology, P.U.N. and N.R.D.; software, P.U.N.; validation, N.R.D.; formal analysis, P.U.N. and N.R.D.; investigation, P.U.N.; resources, P.U.N.; data curation, P.U.N. and N.R.D.; writing—original draft preparation, P.U.N.; writing—review and editing, P.U.N. and N.R.D.; visualization, P.U.N. and N.R.D.; supervision, N.R.D.; project administration, P.U.N.; funding acquisition, P.U.N. and N.R.D.

Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

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