JPPIPA 10(10) (2024)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

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

Development of Salt Hydrolysis Module Based on Problem Based Learning Integrated with TPACK to Improve Numeracy Literacy Skills of Phase F SMA Students

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Received: July 23, 2024
Revised: August 18, 2024
Accepted: October 25, 2024
Published: October 31, 2024

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DOI: 10.29303/jppipa.v10i10.8615

Abstract: This research aims to analyze the validity, practicality and effectiveness of the salt hydrolysis module based on problem based learning integrated with TPACK on students numeracy literacy skills. The development model used is the 4-D model. The module developed was validated by two lecturers and three chemistry teachers. The practicality testing of the module was carried out by three chemistry teachers and 32 SMA students. Testing the effectiveness of the module was carried out using a pre-experimental method with a non-equivalent control group design. The validity test was analyzed using the Aiken's V formula where content and construct validity were obtained respectively 0.91 and 0.92 with the valid category. The practicality test was analyzed using the Aiken's V formula where the practicality scores for teachers and students were obtained respectively 0.94 and 0.86 in the practical category. The module effectiveness test was analyzed using N-Gain where an N-Gain value of 0.76 was obtained in the high category. Based on the results of data analysis, it can be concluded that the salt hydrolysis module based on problem based learning integrated with TPACK developed is valid, practical and effective to improve the numeracy literacy skills of Phase F SMA students.

Keywords: Module; Numeracy literacy skills; Problem based learning; Salt hydrolysis; TPACK

Introduction

Chemistry is one of the subjects studied at the SMA level. In chemistry learning, students are trained to conduct simple research on various real-world life phenomena. This starts from finding problems, making hypotheses, designing and conducting experiments, analyzing and communicating the results of the experiments (Kemdikbud, 2023). In order for learning to run effectively, a learning model is needed. One learning model that can be applied is problem-based learning (PBL) (Syamsidah & Suryani, 2018).

The PBL model is a learning model that uses contextual problems to integrate new knowledge into students (Indarta et al., 2022). In the PBL model, the teacher provides a problem, then students are expected to be able to analyze and find solutions to the problem. The application of the PBL model in chemistry learning can improve learning outcomes, critical thinking skills, motivation and interest, creativity, problem-solving skills, democratic attitudes and conservation soft skills of students (Hamid et al., 2022). The application of the PBL model requires teaching materials. One of the teaching materials that can be used is a module. Several PBL-based chemistry modules have been developed and can be used in the learning process, such as in the material on buffer solutions (Asda et al., 2023), reaction rates (Sembiring & Sutiani, 2022), acids and bases (Pebrianti et al., 2024), and colloids (Sari et al., 2022). The use of PBL-based modules in learning can improve

How to Cite:
Febrila, P. Z., Yerimadesi, Andromeda, & Alizar. (2024). Development of Salt Hydrolysis Module Based on Problem Based Learning Integrated with TPACK to Improve Numeracy Literacy Skills of Phase F SMA Students. *Jurnal Penelitian Pendidikan IPA*, *10*(10), 7861–7872. https://doi.org/10.29303/jppipa.v10i10.8615

learning outcomes (Aufa et al., 2020), critical thinking skills (Wulandari & Supiah, 2023), problem-solving skills (Wisic & Makiyah, 2022), science process skills (Serevina et al., 2018), science literacy (Pane & Siahaan, 2022), and students' metacognitive skills (Ramdoniati et al., 2018).

However, one of the demands of 21st century learning is the integration of digital technology in the learning process. Teachers are expected to be able to use technology to make learning more creative and innovative (Muhtadi, 2019). Technological pedagogical content knowledge or known as TPACK is an approach that emphasizes technology, learning strategies, and curriculum competencies. TPACK can be integrated into teaching materials (Triwahyudi et al., 2021). The integration of TPACK in teaching materials equipped with learning models has been carried out and has shown valid results in the reaction rate material (Irmita & Atun, 2017). The integration of TPACK in teaching materials is also effective in improving students' critical thinking skills in the colligative properties of solutions (Mairisiska et al., 2014). Another chemical material studied in SMA is salt hydrolysis. Salt hydrolysis is a contextual chemical material (Oetary, 2022) and contains mathematical calculations. Salt hydrolysis is also an abstract material (Irawati, 2019), so media such as images, animations and videos are needed to visualize the material so that it is easy for students to understand.

Based on the results of interviews conducted with chemistry teachers in several schools, information was obtained that the teaching materials used in the salt hydrolysis material are dominated by printed books from publishers that have not integrated digital technology. These teaching materials are not equipped with learning models so that they do not facilitate students to learn independently. The material presented in printed books also does not accommodate the achievement of learning objectives, so teachers must summarize material from various sources. Therefore, a complete and interesting teaching material is needed to facilitate students to learn independently and to achieve learning objectives. One of the teaching materials that can be developed is the TPACK integrated module. Based on the results of the questionnaire analysis, students generally use smartphones and access the internet with high intensity, so this can be used to integrate technology in learning according to 21st century skills.

In order to prepare students to have 21st century skills, the government conducted a minimum competency assessment (AKM). One of the competencies in the AKM is numeracy literacy. Numeracy literacy is related to reasoning and the use of mathematical abilities to explain a phenomenon. The reason for choosing numeracy literacy competency in the AKM is due to the low level of numeracy literacy of students in Indonesia based on the 2018 Programme for International Student Assessment (PISA). Indonesia's PISA results for the numeracy literacy category were ranked 73 out of 80 countries with an average score of 379 while the OECD average score was 487 (Haryani et al., 2023). Thus, students' numeracy literacy skills need to be improved for the advancement of the quality of education in Indonesia (Jusmirad et al., 2023).

Referring to the background of the problem above, it is necessary to develop teaching materials based on integrated technology learning models that can support 21st century learning. The developed module integrates TPACK which contains elements of technology, pedagogy and content. The technological element lies in various applications that can be accessed in the module such as YouTube and Quizziz to support learning activities. The application can be accessed by students using smartphones via the barcode on the module so that learning is more interesting and not monotonous. The pedagogical element lies in the learning model used, namely problem-based learning which is centered on students. The content element lies in the completeness of the material presented in the module to facilitate students to learn independently. The developed module also supports the AKM program which contains numeracy literacy competencies to prepare students to have 21st century skills. Based on this, a study was conducted with the aim of developing a salt hydrolysis module based on problem-based learning integrated with TPACK to improve the numeracy literacy skills of phase F SMA students.

Method

The type of research conducted is research and development (R&D) with a 4-D development model. The 4-D development model consists of four stages, namely define, design, develop and disseminate (Thiagarajan et al., 1974). The define stage consists of five steps, namely: front-end analysis, learner analysis, task analysis, concept analysis, and formulation of learning objectives.

The front-end analysis step was conducted by interviewing chemistry teachers in several schools. The instrument used was an interview sheet to find out problems related to learning and teaching materials used in salt hydrolysis learning. The student analysis step aims to find out the characteristics of students. The instrument used was a questionnaire. The data from this analysis is used to design teaching materials that are in accordance with the characteristics of students so that they can be used in the learning process. The task analysis step is carried out by analyzing learning outcomes into learning objectives. This aims to find out what competencies must be achieved by students. The concept analysis step is carried out by analyzing the concepts in the salt hydrolysis material which are stated in the concept analysis table and arranged hierarchically on a concept map. The last step at this stage is the formulation of learning objectives. Learning objectives derived from learning outcomes in the previous stage are arranged to form a flow of learning objectives which will later become a guideline when organizing learning.

The second stage is design, which is the stage of designing a salt hydrolysis module based on problem-based learning integrated with TPACK for SMA students. At this stage there are four steps that must be taken, namely: compiling a criterion test, selecting teaching materials, selecting a format, and an initial design. The first step is compiling a criterion test. This test aims to determine the initial abilities of students and as an evaluation tool after the implementation of the use of the developed teaching materials. The next step is selecting teaching materials. The selection of teaching materials is carried out to identify teaching materials that are relevant to the characteristics of the material and in accordance with the needs of students. The format selection step is carried out to determine the learning resources, approaches, and learning models used. Considerations for selecting a format are also related to the layout and fonts used. The last step in the design stage is to create an initial design of the module to be developed. The initial design consists of a cover, learning instructions, competencies to be achieved, supporting information, student worksheets, and evaluations.

The third stage is the develop stage. There are three assessments carried out on the developed module, namely validity, practicality, and effectiveness. The validity test consists of content validity and construct validity. The validity test was carried out by two chemistry lecturers and three chemistry teachers. The validity test instruments are in the form of a content validity questionnaire and a construct validity questionnaire. Validity test data were analyzed using the Aiken's V formula. The next stage is the revision of the developed module according to input and suggestions from the validator. If the module is valid, it is continued with the practicality test stage. The practicality test was carried out by three chemistry teachers and 32 SMA students. The instruments used for the practicality test were the teacher practicality questionnaire and the student practicality questionnaire. Practicality test data were analyzed using the Aiken's V formula (Aiken, 1985). The effectiveness test was carried out by involving 33 phase F SMA students. The instrument used was in the form of numeracy literacy questions that had been tested for their feasibility. The numeracy literacy questions used were 13 multiple-choice questions with reasons. The effectiveness test data were analyzed using N-Gain. The fourth stage is the disseminate stage. This stage is the stage of using teaching materials that are developed on a wider scale. This is done so that the products developed can be utilized by others.

Results and Discussion

Define Stage

At the front-end analysis stage through literature studies and interviews in several schools, information was obtained including: teaching materials used in schools are dominated by printed books from publishers that have not integrated digital technology, printed books available in schools are not equipped with learning models so that they do not facilitate students to learn independently, and the material presented in printed books does not accommodate optimal achievement of learning objectives, so teachers must summarize material from various sources. At the student analysis stage, information was obtained that students generally have smartphones. In addition, the intensity of students in accessing the internet is also relatively high. Students are interested in using digital technology-based teaching materials in the learning process. Based on the analysis of the tasks that have been carried out, several learning objectives for the material on salt hydrolysis were obtained. The learning objectives formulated are: analyzing the concept of salt hydrolysis, analyzing the types of salt hydrolysis, analyzing the properties of hydrolyzed salts, calculating the pH of hydrolyzed salt solutions, conducting experiments to demonstrate the properties of hydrolyzed salts, and reporting the results of experiments on the properties of hydrolyzed salts. At the concept analysis stage, several important concepts were obtained in the salt hydrolysis material, including salt hydrolysis, partial hydrolysis, total hydrolysis, cation hydrolysis, anion hydrolysis, weak bases, and weak acids. These concepts are presented in a concept analysis table and arranged hierarchically in a concept map. At the learning objective analysis stage, a learning objective flow was obtained. The learning objective flow is used as a guideline in learning salt hydrolysis. Based on the results of the analysis at the define stage, the development of a salt hydrolysis module based on problem-based learning integrated with TPACK was carried out to improve the numeracy literacy skills of phase F SMA students.

Design Stage

The salt hydrolysis module was developed based on the syntax of the problem based learning model. This learning model uses contextual problems to integrate knowledge into students. The problems in question are real problems in everyday life. The problems presented must meet the criteria of being authentic, easy to understand and useful (Syamsidah & Suryani, 2018). The steps of the problem based learning model are: orienting students to the problem, organizing students to learn, guiding individual and group investigations, developing and presenting work results, and analyzing and evaluating the problem-solving process (Saputra, 2020).

The first stage is to orient students to the problem. At this stage, the teacher motivates students to be actively involved in problem-solving activities presented in the module. Students observe pictures, read discourses or listen to audio presented. The discourse contains contextual problems regarding the material on salt hydrolysis in everyday life. The next stage is to organize students to learn. The teacher helps students organize learning tasks related to the problems presented. Thus, the teacher becomes a facilitator who directs students in learning activities. The third stage is to guide individual and group investigations. The teacher encourages students to collect information or conduct experiments. Students are expected to be able to obtain information in the form of facts to solve the problems presented in the previous stage. At this stage, there is collaboration between students, both in small and large groups, in discussing solutions to problem solving. The next stage is to develop and present the results of the work. The teacher directs students to plan and prepare work that is in accordance with the learning objectives being studied. The work produced can be in the form of reports, videos, or other forms according to the characteristics of the material. The work which is the result of group discussions is then presented in front of the class, so that discussions occur between individuals/groups in learning activities. The final stage is analyzing and evaluating the problem-solving process. At this stage, students reflect or evaluate the investigation and problem-solving process under the guidance of the teacher. At the end of the learning, students are expected to find solutions to the problems presented at the beginning of the learning so that they can develop students' thinking skills.

The developed module also integrates TPACK. This is in accordance with the demands of 21st century learning which demands the integration of digital technology in the learning process (Haryani et al., 2023). Technological pedagogical content knowledge or commonly abbreviated as TPACK is a learning approach that emphasizes technology, learning strategies and competencies according to the curriculum (Wahyuningtyas & Oktamarsetyani, 2023). The technological aspect integrated into the module lies in the barcode that can be used to access videos on YouTube and work on evaluations connected to quizziz. The barcode can be scanned by students via smartphone to access learning videos. In addition, the barcode can be used to answer evaluation questions more interestingly because it has been connected to the quizziz application.

Learning using the TPACK integrated module can support differentiated learning according to students' learning styles, both visual, auditory and kinesthetic (Supit et al., 2023). Students with a visual learning style can observe images, read discourse, and watch the learning videos presented (Prafitasari, 2023). Students with an auditory learning style can learn by listening to audio and watching the videos presented (Ritonga & Rahma, 2021). Students with a kinesthetic learning style can do practical work according to the practical instructions in the module (Dari et al., 2021). Each learning style is also adjusted to the characteristics of the material being studied (Derici & Susanti, 2023). Pedagogical aspects are related to the learning model used (Pratama & Lestari, 2020). This module uses a problem-based learning model. Problem-based learning can facilitate students to learn independently and actively build their own knowledge (Saputra, 2020). The content aspect is a component related to the completeness of the material presented (Destiansari et al., 2022). The material presented in the module uses clear language so that it is easy for students to understand. In addition, the material presented in the module is also broad and in accordance with learning objectives. All information regarding salt hydrolysis material is presented in one complete, flexible and user-friendly module according to the characteristics of the module (Kosasih, 2021).

Develop Stage

At the develop stage, validity, practicality, and effectiveness tests were conducted on the salt hydrolysis module that was developed. The effectiveness test was limited to the fourth learning objective, namely calculating the pH of the hydrolyzed salt solution. The results obtained at the develop stage are explained as follows.

Validity Test

The validity tests conducted are content validity tests and construct validity tests. The content validity test consists of the suitability of the module with the syntax of problem based learning and the suitability of the module content with the content of chemical science.

The results of the content validity analysis can be seen in Table 1 below.

Table 1. Results of Content Validity Analysis

Aspect	V Value	Category
Module conformity with PBL syntax	0.91	Valid
Suitability of module content to chemical science content	0.91	Valid
Average	0.91	Valid

The assessment of content validity for the aspect of the suitability of the module content with the problem based learning model obtained an average Aiken's V of 0.91 with a valid category. Thus, it can be stated that the salt hydrolysis module developed is in accordance with the syntax of problem based learning which consists of five stages, namely orienting students to problems, organizing students to learn, guiding individual and group investigations, developing and presenting work results and analyzing and evaluating the problem-solving process (Saputra, 2020). The assessment of the aspect of the truth of the module content with chemical science content also obtained an average Aiken's V of 0.91 with a valid category. Thus, it can be stated that the salt hydrolysis module developed is in accordance with the chemical science content. Overall, for the aspects assessed in the salt hydrolysis module based on integrated problem based learning TPACK, an Aiken's V value of 0.91 was obtained with a valid category. Thus, the module developed can be declared valid based on content validity. This shows that the module developed is in accordance with the curriculum or a strong theoretical basis (Haviz, 2013). The construct validity test of the module consists of four components, namely the content component, presentation component, language component, and graphic component (Depdiknas, 2008). The results of the construct validity analysis can be seen in Table 2 below.

Table 2. Results of Construct Validity Analysis

Component	V Value	Category
Content components	0.93	Valid
Linguistic components	0.91	Valid
Presentation components	0.91	Valid
Graphics components	0.93	Valid
Average	0.92	Valid

The assessment of the content component is related to the content of the salt hydrolysis module developed. Based on Table 2, the validity value of the module content component is 0.93 with a valid category. This shows that the module developed is in accordance with the learning achievements, learning objectives and scope of the salt hydrolysis material. The images, audio and videos presented are in accordance with the material presented (Febrila, 2021). The assessment of the language component is related to the author's use of language in presenting the material in the module. Based on Table 2, the validity value of the language component is 0.91 with a valid category. This shows that the language used in the module is appropriate, easy to understand, and in accordance with EBI (Melya & Irhasyuarna, 2022). The assessment of the presentation component is related to the appearance of the module presentation. Based on Table 2, the validity value of the presentation component is 0.91 with a valid category. This shows that the compilation of the module is in accordance with the guidelines for compiling modules based on Depdiknas (2008). In addition, the compilation of the module is also in accordance with the syntax of the problem-based learning model. The module presentation is also equipped with TPACK which can support the learning process (Hanik et al., 2022). The assessment of the graphic component is related to the graphics of the developed module. Based on Table 2, the graphic validity value is 0.93 with a valid category. This shows that the overall design of the developed module is attractive. The images and videos presented can be observed clearly. The audio presented can be heard clearly. The type and size of the letters used are clearly readable. In addition, the overall layout of the module is neat (Azhari et al., 2024). Based on Table 2, the average Aiken's V for construct validity is 0.92 with a valid category. Thus, the salt hydrolysis module developed is valid in terms of module construct. Construct validity shows that one component with another component in the module is interrelated and supports the learning process (Haviz, 2013).

Referring to the discussion above, it can be stated that the salt hydrolysis module based on problem-based learning integrated with TPACK that was developed is valid both in terms of content and construction. Several chemistry modules on other materials have also been validated and can be used in learning such as stoichiometry (Manurung, 2021), reaction rates (Fitri & Iryani, 2023), and compound nomenclature (Mellyzar et al., 2021).

Practicality Test

The module practicality test involves teachers and students. The module practicality analysis includes aspects of ease of use, efficiency of learning time, and benefits (Depdiknas, 2008). The results of the practicality test analysis for each aspect can be seen in Table 3 below.

Table 3. Results of the Analysis of Teacher and Student Practicality

Aspect	Teacher	Learners	Category
Ease of use	0.93	0.89	Practical
Time efficiency	0.96	0.83	Practical
Benefit	0.93	0.88	Practical
Average	0.94	0.86	Practical

The assessment of the ease of use aspect by teachers and students showed an Aiken's V value of 0.93 and 0.89 with a practical category. This shows that the material presented is clear and easy to understand. In addition, the learning steps presented in the module are clear. The module is easy to use in learning (Wahyuni & Yerimadesi, 2021). The assessment of the learning time efficiency aspect by teachers and students showed an Aiken's V value of 0.96 and 0.83 with a practical category. This shows that the developed module can help students learn according to their learning speed (Yerimadesi et al., 2016). The use of modules in learning makes learning time more efficient (Yerimadesi et al., 2018; Mareza & Yerimadesi, 2021). The assessment of the benefits aspect by teachers and students showed an Aiken's V value of 0.93 and 0.88 with a practical category. This shows that the module helps students understand the material, especially salt hydrolysis material. The videos and audio presented can make it easier for students to understand the material. The salt hydrolysis module developed makes the learning process fun and increases students' curiosity (Yerimadesi et al., 2019). Based on Table 3, the average Aiken's V value by teachers and students was 0.94 and 0.86, respectively, with the practical category. This is reinforced by the results of the analysis of students' answers to the module which can be seen in Table 4 below.

Table 4. Results of Student Answer Analysis

LK	Material	Mark	Category
1	Concept and types of salt hydrolysis	87	Very high
2	Properties of salt hydrolysis	86	Very high
3	pH value of salt solution	83	Very high
Average		85	Very high

Based on the results of the analysis of students' answers in the module, it can be stated that in general students are able to understand the material in the module well, thus providing an average learning outcome of 85% with a very high category based on formula in Riduwan (2015). One example of a student's answer in the salt hydrolysis module developed related to numeracy literacy skills can be seen in Figure 1 below.

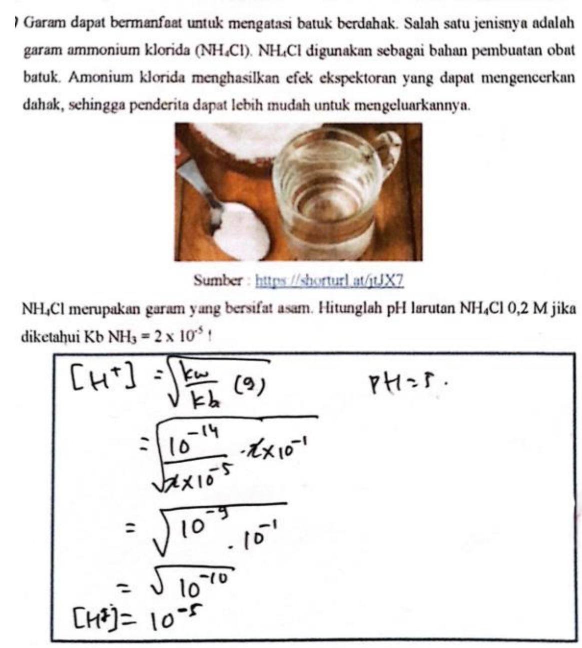

Figure 1. Example of Student Answers in the Module

Figure 1 above shows the students' answers in answering the numeracy literacy questions on the salt hydrolysis material. The questions presented are in accordance with the fourth learning objective, namely calculating the pH of a hydrolyzed salt solution. Based on these answers, it can be stated that students have been able to apply the formula to calculate the pH of a hydrolyzed salt solution. The questions present data on the molarity of NH_4Cl salt and the Kb value. To calculate the pH value, students first calculate the H^+ concentration value. After that, students can calculate the pH value of the NH_4Cl salt. The pH value of the NH_4Cl salt obtained is 5, which indicates that the pH of the salt is < 7 and is acidic.

Based on the results of the data analysis carried out, it was found that the salt hydrolysis module based problem-based learning integrated with TPACK that was developed was valid and practical to be used as an alternative teaching material for SMA students and its effectiveness could be tested in the learning process. Several chemistry modules based on problem-based learning are also valid and practical and can be used in the learning process such as acid-base modules (Hidayanti et al., 2022) and colloids (Khairah et al., 2023).

Effectiveness Test

This stage aims to determine the level of effectiveness of the salt hydrolysis module based on problem-based learning integrated with TPACK developed on the numeracy literacy skills of SMA students. Analysis of students' initial numeracy literacy skills was carried out by conducting a pretest. The results of this pretest are very useful for teachers to see which materials should be taught in more depth in the learning process so that the time used in learning is more effective (Yerimadesi et al., 2019; Asda & Andromeda, 2021). After participating in learning with the salt hydrolysis module developed, students were given a posttest to measure students' numeracy literacy skills. Based on the results of the analysis, the pretest score was 11.66 and the posttest score was 78.67. The posttest score of students was higher than the pretest score. This shows that there is an increase in students' numeracy literacy skills after learning to use the salt hydrolysis module that was developed. This increase can be seen from the results of the N-Gain analysis where a score of 0.76 was obtained with a high category.

One of the factors that greatly influences the improvement of students' numeracy literacy skills is the teacher's pedagogical aspect in managing active, innovative, fun and easily absorbed learning by students (Sela & Dinatha, 2024). The pedagogical aspect of the salt hydrolysis module developed lies in the problem-based learning model used. The PBL model is one of the learning models that can improve numeracy literacy skills (Abbas & Bito, 2024). The PBL model is student-centered so that it can increase student activeness in the learning process (Syamsidah & Suryani, 2018). The application of the PBL model can increase student motivation and learning outcomes (Safitri et al., 2023). In addition, the application of the PBL model can also increase student participation, especially in science learning (Kamala et al., 2022). The PBL model encourages students to collaborate to solve contextual problems. Students can also communicate problem-solving solutions resulting from collaboration (discussion) with their groups. Problem-based learning that is applied encourages students to collaborate and practice communication skills according to the demands of 21st century learning (Haryani et al., 2023). The use of the PBL model can also improve creative thinking skills (Suryawati et al., 2020; Iftitah et al., 2023), problem-solving skills (Gultom & Rohaeti, 2024), scientific literacy (Meidiana & Pertiwi, 2024) and students' science process skills (Salfina et al., 2021). The PBL model can also increase students' motivation to excel (Sukriyatun et al., 2023).

The PBL model integrated into the module requires other alternative media to support the learning process. TPACK in the form of digital technology needs to be integrated into 21st century learning so that students can more easily understand learning concepts and solve contextual problems given. Integrating TPACK into teaching materials can improve students' digital literacy and critical thinking skills (Niswah & Dewi, 2024). Teachers need to understand the importance of TPACK in learning that integrates technology to improve the quality of learning (Hayati et al., 2022). In addition, the importance of TPACK in the form of using digital technology also makes the implementation of learning more flexible, learning can be done anytime and anywhere even though they are separated by distance (Kartimi et al., 2021). Digital technology can be integrated into the learning media used, so that learning becomes more varied (Adnan et al., 2017). The integration of digital technology makes learning more interesting so that it encourages students to be active in learning which can improve learning outcomes (Sumanik et al., 2023). In addition, the use of digital technology can improve the quality of learning management by teachers (Nurdin et al., 2023). The use of digital technology in learning can be an excellent opportunity to improve 21st century skills (Oktasari et al., 2019). One of the media integrated into the developed module is YouTube (Putra et al., 2018). YouTube is an audio-visual media that is currently popular and growing rapidly that can be used to increase student creativity in learning.

The use of digital technology in modules makes it easier for students to explore information that can provide understanding for students (Febrila, 2021). The presence of learning videos makes learning more interesting and not monotonous in textbooks alone. The integration of digital technology in the form of videos in modules can improve students' numeracy literacy, including students being able to represent information related to problem solving and students are also required to work and reason in understanding the videos presented. Through the videos presented, students can pay attention to how to apply formulas to calculate the pH of hydrolyzed salt solutions, analyze information in various forms (tables and graphs), and interpret the results of the analysis to make decisions in solving problems presented in problem-based learning modules. The urgency of numeracy literacy skills needs to be increased by providing a practice process through numeracy questions in various subjects including chemistry (Aini et al., 2024).

In addition, the evaluation tools in the module are also integrated with digital technology by utilizing the quizziz application. Teachers can create numeracy literacy questions on the application and then share the barcode with students. This also includes efforts to improve students' numeracy literacy by utilizing digital technology (Ambarwati & Kurniasih, 2021; Darwanto & Putri, 2021).

Disseminate Stage

The dissemination stage is the stage of disseminating the use of the salt hydrolysis module that has been developed. The dissemination stage is carried out by submitting a salt hydrolysis module based on problem-based learning integrated with TPACK that has been validated, practical, and effective to SMA chemistry teachers. The goal is that the developed module can be utilized on a wider scale.

Conclusion

Based on the results of the data analysis, it can be concluded that the salt hydrolysis module based on problem-based learning integrated with TPACK which was developed has been valid, practical, and effective to improve the numeracy literacy skills of phase F SMA students.

Acknowledgements
The authors would like to thank Lembaga Penelitian dan Pengabdian Masyarakat, Universitas Negeri Padang for funding this work with a contract number: 1703/UN35.15/LT/2024.

Author Contributions
P.Z.F.: writing—original draft preparation, conceptualization, methodology, and investigation. Y., and A.: validation, formal analysis, resources, data curation. A.: writing—review and editing, visualization.

Funding
This research was funded by Lembaga Penelitian dan Pengabdian Masyarakat, Universitas Negeri Padang with a contract number: 1703/UN35.15/LT/2024.

Conflicts of Interest
The authors declare no conflict of interest.

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