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DEVELOPMENT OF E-LABORATORY INSTRUCTION USING MICROSOFT SWAY FEATURES IN ETHNO-STEM LOADED ACID-BASE PRACTICUM

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Abstract

Microsoft Sway is a feature that can be used as a practicum learning media to equip the skill lab creativity of students. In this study, an E-laboratory instruction was produced using Microsoft Sway media. E-laboratory instruction is prepared by integrating ethno-STEM. The purpose of this research is to examine the level of feasibility, practicality, and effectiveness of the developed e-laboratory instruction. Model development used a 4D model from Thiagarajan (Define, Design, Develop, and Disseminate), with test subjects being high school students in 11th grade. Data collection techniques used expert validation sheets, user response questionnaires, observation sheets and test questions. The data analysis technique uses percentage descriptive statistics. The study results show that based on the expert's assessment, e-laboratory instruction is deemed appropriate by both material and media experts. The results of the student response questionnaire showed that the e-laboratory was declared "Very practice", with a percentage of 86.15% in small-scale tests and 86.33% in large-scale tests. The average of skill lab creativity based on indicators of planning skills, implementation-interpretation skills, also communication skills show a percentage of 87.19. These results indicate that e-laboratory instruction using Microsoft Sway features is feasible, practical, and adequate for acid-base practicum learning.

Keywords: E-laboratory Instruction, Ethno-STEM, Microsoft Sway, Skill Lab Creativity

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INTRODUCTION

The 21st century requires someone to have competencies, as stated by the US-based Partnership for 21st-century Skills (P21), including Creative thinking, Communication, and Collaboration (Supena et al., 2021). Practicum learning as part of the chemistry learning process aims to provide opportunities for students to test and apply theory using the tools and instruments available inside and outside the laboratory. Practicum activities can also improve skill lab creativity, which is one way to reach the creative thinking stage (Wasahua, 2021). Creativity lab skills can be interpreted as learning that teaches creative thinking skills with laboratory work. Indeed, for someone with skill lab creativity, aspects of students' creative thinking will emerge during the practicum.

Referring to the results of research conducted by Khoiri et al. (2017), the results showed that the laboratory work learning method positively affected students' creative thinking. Creative thinking can be raised by allowing students to experiment and explore so that aspects of creative thinking such as fluency, flexibility, originality and elaboration can be developed in students (Khumaeroh & Sumarni, 2019).

Practicum implementation requires practicum instructions, Munir (2018) states that practicum instructions are guidelines that must be followed by all students who will carry out practicum. The practicum guidebook or practicum textbook is a supporting book for practicum activities which contains material and a series of work procedures to be carried out in practicum (Nikmah & Binadja, 2015). Of course, the existence of this textbook or practicum manual can affect the success of learning in the laboratory, including if the teacher will increase creativity in lab skills and meet the demands of 21st-century skills, including creative thinking skills and digital literacy. Digital practicum instructions or e-laboratory instruction will make learning more interactive and accessible whenever and wherever needed. However, based on observations at the research object schools, this e-laboratory instruction is unavailable.

E-laboratory instruction is a technology-based practical learning media. With E-laboratory instruction, practicum learning can be done apart from face-to-face as well as through the sway application, a feature in Microsoft 365 that educators can use to create interactive learning materials. E-laboratory instruction also helps educators overcome old problems in learning where students can design practical work outside of class hours with the directions contained in this media (Damanik and Susatyo, 2021). Nikmah and Binadja (2015) stated that e-laboratory instructions are supporting books for practical activities that contain materials and a series of work procedures that will be carried out in the practical work, so that the existence of these practical instructions can influence the success of learning in the laboratory, this is because the practical instructions are a reference for students when carrying out practical work in the laboratory.

The Sway application is a presentation tool made online on the sway.com page. Kress & Bezewr in Huda (2017) stated that Sway is an internet-based presentation tool with various features that it combines text, images, video and audio when running presentations. According to Istiqomah (2016), the advantages of the Sway application compared to other presentation applications are: (1) it has excellent design features that make it easier for users to download various content such as YouTube videos, images, tweets, and other multimedia content; (2) can select content such as photos and videos stored in the cloud because the Sway application is connected to the cloud application; (3) being able to reformat slides when the presenter opens them via a smartphone, laptop or PC (4) equipped with an application that makes it easy for users to collaborate with other users when creating projects so that sways can also be used as innovative products from project-based learning methods. The Sway app can make it easy to add text, images, documents, videos, graphics or any other type of content. Also, Sway will make it look great in just a few easy steps (Sudarmoyo, 2018).

Ethno-STEM integration in learning can be done in various forms, such as integrating learning media, learning models, and learning instruments (Al Idrus, 2022). The integration of the ethno-STEM approach is learning that is integrated with the four fields of science, technology, engineering, and mathematics based on local culture (Sumarni & Kadarwati, 2020). This integration can develop students' critical, creative, innovative, and collaborative thinking skills. Then when it has collaborated with community knowledge or ethnoscience, it is considered capable of developing student character (Primadianningsih et al., 2023).

Ethno-STEM learning can materialize in situations involving authentic problem-solving activities in social, cultural, and functional contexts (Khoiri & Sunarno, 2022). Several studies have found that ethno-STEM in science learning can hone cognitive abilities, apply knowledge, design, and use technology (Sumarni et al., 2019). Ethno-STEM integrated learning can also measure cognitive and psychomotor knowledge abilities (Hoque, 2017). Students' psychomotor abilities in chemistry learning can be improved by learning practicum (Sumarni et al., 2016). With these ethno-STEM advantages, ethno-STEM is also integrated into developing e-laboratory instruction to improve skill lab creativity.

Practical learning with integrated ethno-STEM begins by advising students to see the culture of the surrounding community, and then from the results of these observations, a common thread is drawn related to specific scientific material, such as the use of natural materials for natural indicator practicum. The ethno-STEM pattern that can be formed is that students associate natural materials believed to contain a substance rich in benefits, which is then proven by experiments on a natural substance to identify acid-base solutions. Based on a series of experimental processes, it can be seen that STEM patterns are formed from the selection of indicators, specific methods and techniques, and the composition of natural materials used.

In this study, acid-base indicator material was chosen because it is often continuous with everyday life, so it can be observed using the ethno-STEM concept. In identifying acid-base solutions, educators often carry out practical learning to facilitate students' understanding of the material. Acid-base practicum uses natural materials to produce creative products through natural indicators that can observe students' creative mindset in both cognitive and psychomotor aspects. Natural media is used with the aim that students are mentally intelligent and sensitive to their surroundings (Sari et al., 2018). (Sari et al., 2018). According to Amalia et al. (2019), natural materials are directly obtained from nature as natural materials that can be utilised, such as rocks, wood or twigs, seeds, leaves, flowers, fruit and others.

Musbikin in Sari et al. (2018) state that using natural materials will make it easier for students to see and understand what is being taught. Plants that can be used as a source of natural acid-base indicators have some colour pigments, including anthocyanins (Mahmud et al., 2018). Some natural ingredients with anthocyanin pigments are purple cabbage, dragon fruit skin, red apple skin, onion skin, and purple sweet potato, so natural ingredients can be used as acid-base indicators.

Munir (2018) states that practicum instructions are guidelines that must be followed by all students who will carry out the practicum. In order to meet the demands of the 21st century that students must have high creativity, it is necessary to have digital practicum instructions that make learning more interactive, requires creative thinking and can be accessed anytime and anywhere. Based on the research results above, developing an integrated ethno-STEM e-laboratory instruction using Microsoft sway media has been carried out to improve skill lab creativity.

This research was implemented by lecturers using Project-based learning, which collaboratively produces creative products in the form of natural indicators. As a form of practicum results, reports are presented using Sway media and for reporting results. Therefore, this study aims to produce e-laboratory instruction with Sway media that is feasible, practical, and effective for improving creativity lab skills in a series of learning processes for the practicum of natural acid-base indicators.

METHOD

The research used the R&D type (research and development) with 4D models. 4D models are used to develop learning tools. The 4D model developed by Thiagarajan et al. (1974), with the stages of research are definition, design, development, and dissemination. The choice of the Four-D model is due to its advantage of not taking a long time because the stages are relatively not too complicated (Maydiantoro 2021). At the define stage, research is a needs analysis and literature study.

Design

The design phase is carried out by developing e-laboratory instruction products using Microsoft Sway media. Several tests were carried out in the development stage, such as a feasibility test by media and material experts, small-scale tests, and large-scale tests. From these three tests, various inputs will be obtained from both validators and users to make improvements to the e-laboratory instructions that have been developed. The practicality and effectiveness test of using e-laboratory instruction with Sway media is carried out by knowing students' skill lab creativity. This study uses a quantitative approach that presents data in numeric and analyzed using descriptive statistical methods.

Subject

The research subjects were 15 students in a small-scale trial and 28 in a large-scale trial at one of the public high schools in Semarang. The data collection instruments were expert validation sheets, student response questionnaires, creative thinking test questions and observation sheets to analyse creativity lab skills. Test questions in descriptions measure creative thinking in the cognitive domain. In comparison, the observation sheet of learning activities is used to assess skill lab creativity with a creative mindset in the psychomotor domain. The e-laboratory instruction expert validation sheet refers to the BSNP standard validation sheet. The content and construct validity of the instrument were based on expert judgment, with the reliability of the questionnaire instrument being 0.947, while the reliability of the test items and the observation sheet was 0.72 and 0.738, respectively.

Assessment is carried out throughout the practicum learning process until the results of students' creative products are obtained through natural acid-base indicators and practicum reports via Microsoft Sway. The results of tests and observations later show the effectiveness of e-laboratory instruction on the results of the practicum learning carried out.

Data Analysis

Data analysis techniques include descriptive analysis of expert validation sheets and user response questionnaires to assess the feasibility of e-laboratory instruction.

$$\overline{X} = \frac{\sum X}{n}$$

Details:

$\overline{X}$: average score.

$\sum X$: total score of each component

n : number of appraisers

Converting scores into a four-Likert scale is used to determine eligibility criteria. E-laboratory instruction is feasible if ≥51% includes the suitable category. E-laboratory instruction is effective if overall > 75% of students in one class get suitable to excellent criteria.

RESULT AND DISCUSSION

This study aims to produce e-laboratory instruction using the Microsoft sway feature on an acid-base concept that is feasible based on expert judgment, practical according to user responses, and effective in increasing skill lab creativity when applied in practical learning. According to media and content experts, the resulting e-laboratory is included in the criteria for being used as a tool in practicum learning. Several suggestions and input from experts have been followed up by revising the e-laboratory instructions that were developed.

After being declared feasible by experts, a small-scale trial was conducted to test students' readability and practicality of e-laboratory instruction. A total of 15 students were involved in the small-scale trial process, and as many as 28 were involved in the large-scale trial. During the trial, students were asked to read and practice the instructions following those listed in the e-laboratory instruction. In addition to filling out the questionnaire, students were guided in its implementation during the trial process. Students can also convey if there are problems in operating the media, difficulties in understanding the reading, or a discrepancy between the explanation and the practice to be carried out.

From this activity, input from students and teachers will be obtained, which is helpful to refine further the product being developed. After being declared feasible, practical and having good legibility, the e-laboratory instruction product is used in actual classes in acid-base practical learning, namely obtaining natural indicators from natural materials, especially plants around students' homes or in the school environment. Learning design refers to learning with project assignments whose results are in the form of products in the form of natural acid-base indicators.

The material contained in the e-laboratory instruction focuses on natural acid-base indicator materials. Acids-bases are abstract materials often irrational in everyday life (Andriani et al., 2019). In helping acid-base solutions, educators often carry out practicums to facilitate students' understanding of the material. Usually, in carrying out exercises, students free their creative thinking by exploring an object they will like (Rosdiana et al., 2016). It is relevant to the Sariatun et al. (2018) that the development of creativity can be done by providing tools and materials to encourage students to experiment and giving students time to analyze, discuss, and conduct experiments that can strengthen the theory. The demand to work creatively, interactively, and conductively becomes necessary in implementing practicum. Because in practicum activities, competencies will emerge, which include the cognitive, affective, and psychomotor domains (Damanik & Susatyo, 2021).

E-laboratory instruction is technology-based practicum learning media. This learning combines face-to-face practicum using Microsoft Sway, adapted to educational developments and field conditions. Based on Damanik & Susatyo's research (2021), which developed an e-laboratory instruction using google classroom with a guided inquiry model based on blended learning, it was feasible as a learning medium.

Ethno-STEM integration in the Project-based learning model can develop students' critical thinking, creative, innovative and collaborative thinking skills (Sumarni & Kadarwati, 2020). Practicum learning can be used to analyze creativity lab skills, including identifying students' creative mindsets. It is relevant to the results of Khoiri et al. (2017), who stated that the laboratory work learning method positively affects students' creative thinking.

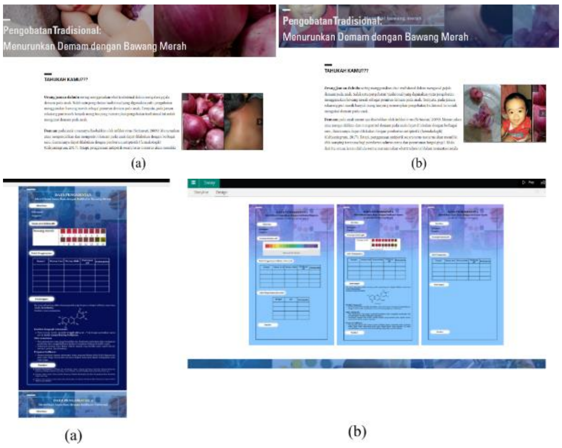

Figure 0. E-laboratory instruction layout

Feasibility of E-laboratory instruction using Media Sway

Validation and validity play a role in testing the validity of an instrument. A valid significance test can be used to determine the feasibility of an item used if it correlates significantly with the total score (Dewi, 2018). Validity testing was done using a questionnaire sheet with a Likert scale interpretation. The validity of E-laboratory instruction is validated based on media and content aspects. Each aspect was validated by media expert validators, material experts, and chemistry teachers from the high school where the research was conducted. Recapitulation of media and content aspects shows an average of 59.5 points out of a total score of 64, equivalent to 92.96% in percentage terms. Determination of eligibility criteria is determined by Mardapi & Setiawan (2018) so that, based on these criteria, the media and material aspects are included in the “excellent” category.

Regarding the feasibility analysis of the ethno-STEM-based E-laboratory instruction product using sway media, it is said that it is suitable for use in trials to determine the practicality and effectiveness of the media being developed. The recapitulation of the validation results experts is shown in Figure 2 and Figure 3. The input results from the expert validator have been followed up, which were then corrected according to the suggestions. Expert validation is used as research data and can be considered for further revision (Berlian et al., 2023).

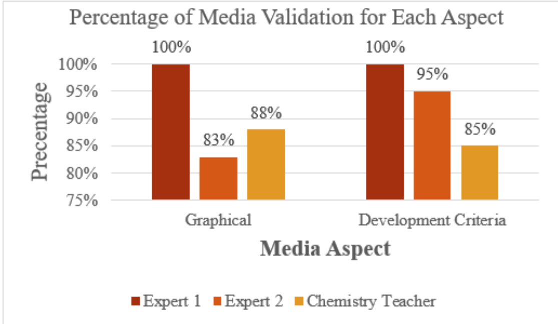

Figure 2. Media validation results

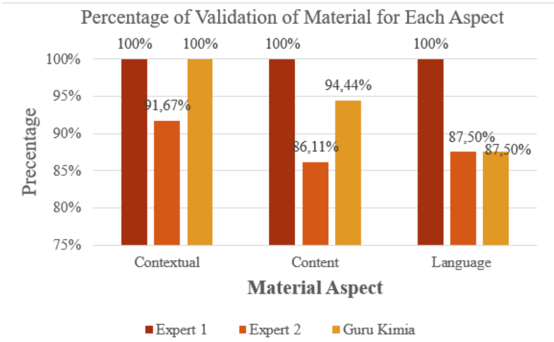

Figure 3. Content validation results

The Practicality of E-laboratory Instruction with Sway

The practicality of E-laboratory instruction was analyzed using the implementation questionnaire sheet in small-scale trials and student response questionnaires to media and learning in large-scale trials. Previously, the questionnaire items were tested on a small scale to determine their validity and reliability. The implementation questionnaire on small-scale trials has one indicator: the practicum implementation using the E-laboratory instruction and the legibility of the E-laboratory instruction media. Whereas in the large-scale trial response questionnaire, the questionnaire was divided into four aspects of assessment, is regarding the effects of learning strategies, communication, implementation, and technical design of the developed media, which have been adapted to the circumstances of students, PjBL learning models, as well as natural indicator material with integration ethno-STEM which uses Microsoft sway as a learning medium.

The accumulation of small-scale implementation questionnaires to measure practicality obtained an average of 55.13 or 86.15% as a percentage. The average is included in the category “Very practical”. Small-scale trials accommodate suggestions and input from students on e-laboratory instruction using sway media. The suggestions are used as a form of evaluation and revision to improve the E-laboratory instruction with this sway media. The results of practicality analysis in large-scale tests show an average score of 55.25, equivalent to 86.33% in percentage terms. Based on observations and comments from students during the learning process, students like practical activities using this E-laboratory instruction because they are considered more varied and exciting.

Students consider e-laboratory instruction to have more value because the design looks attractive and gives a new color to the practicum implementation. Thus, in the practicality analysis of E-laboratory instruction using sway media, it can be concluded that ethno-STEM-based E-laboratory instruction using sway media is acceptable and appropriate for use in the learning process with the applicable criteria of "very practical" in both trials. The practical value recapitulation of the two trials showed in Figure 4.

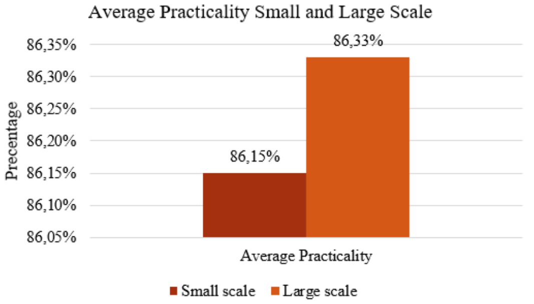

Figure 4. Practical recapitulation

Effectivity of E-laboratory Instruction on Students' Creative Thinking

The cognitive and psychomotor domains measure the effectiveness of ethno-STEM-based E-laboratory instruction with Microsoft sway media. In the cognitive domain, effectiveness is assessed based on the results of tests done by students when they have finished carrying out the practicum. While the psychomotor domain is assessed using observation sheets during a series of learning processes.

Hoque (2017) states that the cognitive domain determines the most dominant learning abilities related to students' thought processes. The psychomotor domain helps assess students' motor development when faced with the environment in different settings, contexts and situations (Balsalobre et al., 2021).

Observation sheets are used to measure creativity lab skills during the learning process. They are compiled based on skill lab creativity indicators, including planning, implementation-interpretation, and communication skills. This creativity lab skill indicator also contains aspects of creative thinking. The results of the analysis of students' creativity lab skills using the observation sheet results are presented in Figure 5.

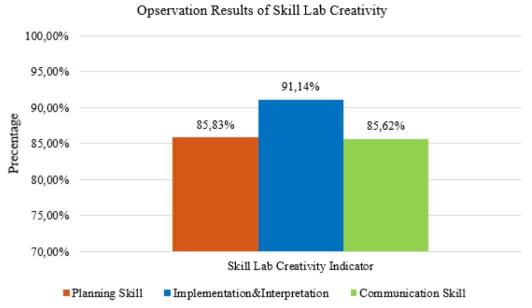

Figure 5. Analysis of skill lab creativity

Figure 5 shows the students' skill lab creativity reaching 87.19% in the "excellent" category. The analysis results show that the highest skill lab indicator is in the implementation-interpretation skill indicator, with a percentage of 90.14%. This skill contains the four aspects of creative thinking, scilicet aspects of fluency, flexibility, originality, and elaboration. Overall, the implementation-interpretation skills show fluency in the practicum implementation. It also shows flexibility, prudence and thoroughness of students, originality in practicum results, and time management during practicum implementation. This skill lab indicator is in the "excellent" category.

The lowest skill lab is an indicator of communication skills which gets a percentage of 85.62%. This indicator contains aspects of creative thinking fluency, flexibility, and elaboration. Communication skills focus on interactions between individuals that bring up the ability to think fluently, flexibly and in detail. Overall, this aspect describes the interaction between students and shows the depth of students' thoughts regarding the material and practicum. Apart from that, it also focuses on the analysis of practicum results with theory as a reference for practicum implementation, details in the discussion of practicum reports, and details and tidiness of report designs using Microsoft Sway. Even though this aspect is still in the "excellent" category, in practice, students get a little difficulty regarding some experimental results that are slightly different from the theory found. Some students also lacked exploration in using sway media to explain and communicate experimental results. However, this is covered by implementation-interpretation skills, which show high flexibility in students, especially when finding ideas and other alternatives to correct mistakes.

Analysis of creative thinking aspects in the skill lab creativity showed in Figure 6.

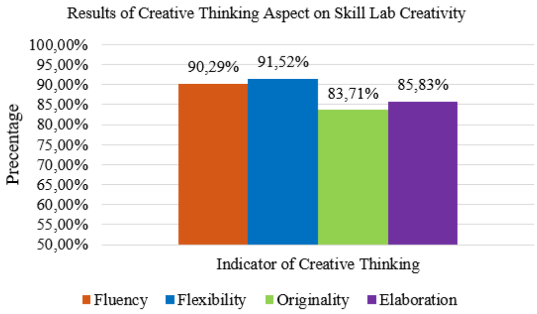

Figure 6. Creative thinking aspects in skill lab creativity

Observation of creative thinking aspects in creativity lab skills, shows that flexibility is the aspect of creative thinking with the highest acquisition. The flexibility aspect in the psychomotor domain gets a percentage of 91.52%. It is also matched to acquiring the percentage of flexibility in the cognitive domain of 82.14%. Overall, this indicator shows the flexibility of students who can suggest other alternative possibilities during practicum implementation so that it is more efficient, smooth use of tools and materials, and can find ideas, innovations, and correct mistakes made during practicum implementation. This aspect is in the "excellent" category.

Aspects of originality on creative thinking got the lowest results in observing creativity lab skills. The acquisition of originality gets a percentage of 83.71%. This result is also related to the lowest cognitive assessment of students, in the aspect of originality, only getting 67.68%. These results said that the originality of students is still considered lacking, in which students do not show original thoughts. Several factors can cause this limitation, including limited references, misconceptions about the information obtained, communication and discussions that could be going better, and limitations in analyzing a problem.

During the learning process, elements of ethno-STEM concepts are inserted. The concept of ethno-STEM in learning can be known from preparing products in the form of natural indicators. The concept of ethnoscience can be seen based on natural materials that students find in the surrounding environment based on the culture of the community. These natural materials have unique functions and benefits, such as to medicine, cooking spices, or decoration. The concept of ethno-technology can be seen in students' using tools and techniques or methods to produce natural indicators. The concept of ethno-engineering arises when students carry out the process of extracting natural indicators to get the best results.

Meanwhile, the concept of etno-mathematics appears in the composition, comparison, or recipe students use to make natural indicators. Besides that, the ethno-STEM concept is also applied by students to the practicum report using sway media. Examples of creative products in the form of natural indicators and practicum reports using sway showed in Figure 7.

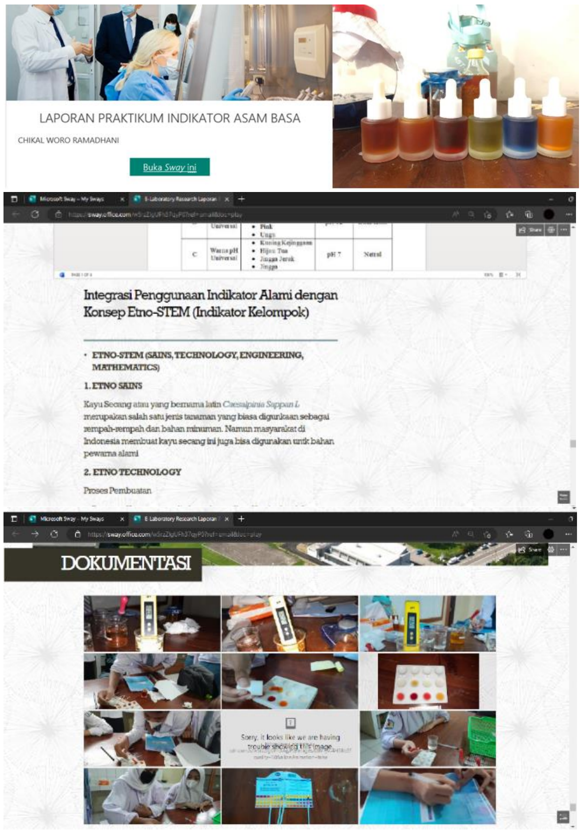

Figure 7. Student creative products

The analysis results of students' test scores obtained an average percentage of creative thinking with an understanding of ethno-STEM concepts, namely 85.27%, with the lowest score being 75.00 and the highest being 91.67. The recapitulation of the analysis of creative thinking aspects showed in Figure 8.

The aspect of creative thinking with the highest percentage is the fluency aspect, which is 86.90%. The fluency aspect in the skill lab creativity is found in the three skill lab indicators (planning skills, implementation-interpretation, and communication skills). This aspect emphasizes the use of methods to extract a natural substance. The results of the student's answers, on average, chose to do the extraction process with the maceration method because it was considered simple and easy to do at home although it takes a long time. The high achievement in fluency is because the E-laboratory instruction exemplifies the indicators extracted using the maceration method, namely in the section on understanding the ethno-STEM concept of shallots as a fever reducer in toddlers. Ethno-STEM learning can support students in integrating knowledge into everyday life so that students can easily understand the material presented (Sudarmin et al., 2019).

Aspects of the creative mindset with the lowest percentage in the cognitive domain are originality, with 67.68%. Originality indicators can build students' creative thinking skills to produce something original (Sumarni et al., 2019). The originality aspect focuses on students so that they can predict hypotheses regarding the results of trials of natural indicator designs that will be tested with acid-base solutions. Based on the students' post-test answers, they had difficulty determining the type of unknown sample solution. Some students also experienced difficulties because the indicators they used did not show significant colour changes, aka the natural indicators they developed were not universal indicators. So, from this idea, changes must be made according to the literature rather than based on the results of one's thinking.

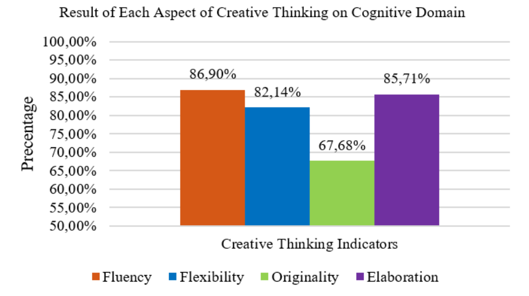

Figure 8. Creative thinking in the cognitive realm

Based on the analysis of creative thinking, the cognitive aspect has an average of 85.27%, which is lower than the observation of creative thinking on the psychomotor aspect, which is 87.83%. As for the assessment of creativity lab skills, 87.19% was obtained.

The effectiveness of the media used during the learning process is assessed by analyzing the results of the assessment on the cognitive aspects of students and the results of psychomotor observations of students. Overall, the post-test results of 28 students in one class showed that 25% got "suitable" results and 75% got "excellent" results. Then the results of observing 28 students showed that 100% were in the "excellent" category. So, it can be seen that the ethno-STEM integrated E-laboratory instruction using Microsoft Sway is said to be very effective for use in the learning process of natural acid-base indicators practicum because the data shows that overall > 75% of students in one class get suitable to excellent criteria.

CONCLUSIONS AND SUGGESTIONS

Conclusion

E-laboratory instruction using Microsoft sway media integrated with ethno-STEM was declared suitable for use and received positive student responses. Feasibility was assessed from the validation of media and material experts, showing an average of 59 and 60 in the "Very feasible" category. Practicality was measured from the student questionnaire with a percentage of 86.15% in the small-scale test and 86.33% in the large-scale test in the "efficient" category. The creativity lab skill analysis results showed a percentage of 87.19%. Aspects of creative thinking that were successfully analyzed in the skill lab got a percentage of 87.83%. Cognitive assessment analysis with aspects of creative thinking shows a percentage of 85.27%. These results indicate that the e-laboratory using the Microsoft sway feature is "very effective" in the practicum learning process.

E-laboratory instructions with Microsoft Sway media can be accessed anytime and anywhere using a smartphone, laptop or PC. However, accessing it using a device will slightly change the original design. Besides that, e-laboratory instruction presents a new face in practicum learning. This media attracts students' interest in reading because it is presented with a varied sway display. The e-laboratory instruction media is intended as a practicum guide with the addition of ethno-STEM integration. It encourages students to love people's culture and understand more about the material because it relates to everyday life.

Suggestion

This media is intended as a practicum guide, so it would be better if it only needs a little material, sections, units, or student activity less related to experimentation. This will make the e-laboratory instruction look like an e-module or e-LKPD. E-laboratory instruction also allows it to be used in other learning methods.

REFERENCE

Al Idrus, S. W. (2022). Implementasi STEM Terintegrasi Etnosains (Etno-STEM) di Indonesia: Tinjauan Meta Analisis. *Jurnal Ilmiah Profesi Pendidikan*, vol. 7, no. 4.

Amalia, L., Nurhanisah, H., & Muftianti, A. (2019). Pemanfaatan Media Bahan Alam Melalui Metode Buzz Group (Diskusi Kelompok Kecil) dalam Meningkatkan Kemampuan Peserta didik Berkarya Seni Rupa Mozaik Dikelas III. *Journal Of Elementary Education*, vol. 2, no. 4.

Andriani, M., Muhali, M., & Dewi C. A.(2019). Pengembangan Modul Kimia Berbasis

Kontekstual Untuk Membangun Pemahaman Konsep Siswa Pada Materi Asam Basa. *Hydrogen: Jurnal Kependidikan Kimia*, vol. 7, no. 1, pp. 25-34.

Balsalobre, F. J. B., Moreno, A. M., Baños, V. M., & Suárez, A. D .(2021). Influence of the Psychomotor Profile in the Improvement of Learning in Early Childhood Education. *International Journal of Environmental Research and Public Health*, vol. 18, no. 23, pp. 12655. https://doi.org/10.3390/ijerph182312655.

Berlian, L., Taufik, A. N., Mulyani, A. M., Nulhakim, L., & Juansah, D. E. (2023). Validity of Research-Oriented General Physiology Learning Tools to Support Science Process Skills. *Jurnal Penelitian dan Pembelajaran IPA*, vol. 9, no. 1. pp. 124-138.

Damanik, Y. F., & Susatyo, E. B. (2021). Pengembangan E-laboratory instruction Berbasis Blended Learning dengan Model Guided Inquiry pada Materi Titrasi Asam-Basa.*Jurnal Inovasi Pendidikan Kimia*, vol. 5, no. 1.

Dewi, D. A. N. N. (2018). *Modul Uji Validitas dan Reliabilitas.* Universitas Diponegoro. Semarang.

Hoque, M. E. (2017). Three Domains of Learning: Cognitive, Affective and Psychomotor.*The Journal of EFL Education and Reasearch*, vol. 2, no. 2.

Huda, K. (2017). Pengembangan Media Pembelajaran IPS Melalui Aplikasi Sway Berkonten Indis di SMP Negeri 8 Madiun.*Jurnal Historia*, vol. 5, no. 2, pp. 125-141.

Istiqomah. (2016). The Development of Learning Material: Explanation Text Based on Multimodal by Using Sway App in 11th Grade of SMA N 1 Batu.*International Journal of Education and Research*, vol. 4, no. 9, pp. 305-314.

Khoiri, A., & Sunarno, W. (2022). Pendekatan Etnosains dalam Tinjauan Fisafat (Implementasi Model Pembelajaran STEM: Science, Technology, Enginering, and Mathematic).*Jurnal Kajian Pendidikan Sains (SPEKTRA)*, vol. 4, no. 2.

Khoiri, N., Riyadi S., Kaltsum U., Hindarto N., & Rusilawati, A.(2017). Teaching Creative Thinking Skills with Laboratory Work.*International Journal of Science and Applied Science: Conference Series*, vol. 2, no. 1, pp. 256. DOI:10.20961.

Kumaeroh, N., & Sumarni, W. (2019). Kreativitas dan Pengetahuan Peserta Didik pada Materi Asam-Basa Melalui Penerapan Project Based Learning dengan Produk Kreatif Teri Puter.*Jurnal Edusains*, vol. 11, no. 2.

Mahmud, N. R. A., Ihwan, I., & Jannah, N. (2019). Inventarisasi Tanaman Berpotensi Sebagai Indikator Asam-Basa Alami di Kota Kupang.*Bionature*,DOI:10.35580/bionature .v19i1.7306.

Mardapi, D., & Setiawan, A. (2018). *Teknik Penyusunan Instrumen Tes dan Nontes. Parama Publisihing*. Yogyakarta.

Munir, M. (2018). Pengembangan Petunjuk Praktikum Matlab dan Uji Efektivitasnya pada Mahasiswa Semester IV Jurusan Pendidikan Matematika IAIN Mataram. *Jurnal Al-Muta`Aliyah: Pendidikan Guru Madrasah Ibtidaiyah*, vol. 3, no. 1, pp. 56 – 69.

Nikmah, R. & Binadja, D. (2015). Pengembangan Diktat Praktikum Berbasis Guided Discovery-Inquiry Bervisi Science, Environment, Technology and Society.*Jurnal Inovasi Pendidikan Kimia*, vol. 9, no. 1, pp. 1506–1516.

Primadianningsih, C., Sumarni, W., & Sudarmin, S. (2023). Systematic Literature Review: Analysis of Ethno-STEM and Student’s Chemistry Literacy Profile in 21st Century.*Jurnal Penelitian Pendidikan IPA*, vol. 9, no. 2, pp. 650–659.

Rosdiana, D., Subarjah, H., & Isrok’atun, I. (2016). Pendekatan Eksploratif untuk Meningkatkan Kemampuan Berpikir Kreatif dan Disposisi Matematis.*Jurnal Pena Ilmiah*, vol. 1, no. 1.

Sari, R., Ali, M. & Yuniarni, D. (2018). Analisis Pemanfaatan Bahan Alam Sebagai Media Pembelajaran Meningkatkan Kreativitas Anak TK Islamiyah Pontianak.*Jurnal Pendidikan Dan Pembelajaran Khatulistiwa*, vol. 7, no. 10. Doi:Http://Dx.Doi.Org/10.26418/Jppk.V7i 10.29309.

Sariatun, S., Ellianawati, E., Hardyanto, W., & Milah, I. L. (2018). Analisis Kemampuan Berpikir Kreatif Siswa pada Praktikum Asas Black Berbasis Problem Based Learning dan Berbantuan Makromedia Flash. *Physics Communication Journal*, vol. 2, no. 1, pp. 70-75.

Sudarmin, S., Sumarni, W., Pujiastuti, R. S. E., & Sumarti, S. S. (2019). Implementing the Model of Project-based Learning: Integrated with Ethno-STEM to Develop Students’ Entrepreneurial Characters.*Journal of Physics: Conference Series*, vol. 1317, no. 1. DOI 10.1088/1742-6596/1317/1/012145.

Sudarmoyo, S. (2018). Pemanfaatan Aplikasi Sway untuk Media Pembelajaran.*Edudikara: Jurnal Pendidikan Dan Pembelajaran*, vol. 3, no. 4, pp. 346–352.

Sumarni, W., & Kadarwati, S. (2020). Ethno-STEM Project-based Learning: Its Impact to Critical and Creative Thinking Skills.*Jurnal Pendidikan IPA Indonesia*, vol. 9, no. 1.

Sumarni, W., Wijayanti, N., & Supanti, S.(2019). Kemampuan Kognitif Dan Berpikir Kreatif Siswa Melalui Pembelajaran Berbasis Proyek Berpendekatan STEM.*Jurnal Pembelajaran Kimia*, vol. 4, no. 1, pp. 18-30.

Sumarni, W., Wardani, S., Sudarmin, S., & Gupitasari, D. N. (2016). Project Based Learning (PBL) to Improve Psychomotoric Skills: A Classroom Action Research.*Jurnal Pendidikan IPA Indonesia*, vol. 5, no. 2, pp. 157-163.

Supena, I., Darmuki, A., & Hariyadi, A. (2021).The Influence of 4C (Constructive, Critical, Creativity, Collaborative) Learning Model on Students' Learning Outcomes.*International Journal of Instruction*, vol. 14, no. 3, pp. 873–892.

Thiagarajan, S. (1974). *Instructional Development for Training Teachers of Exceptional Children: A Sourcebook*. University Bloomington. Indiana.

Wasahua, S. (2021). Konsep Pengembangan Berpikir Kritis dan Berpikir Kreatif Peserta Didik di Sekolah Dasar.*Jurnal Horizon Pendidikan*, vol. 16, no. 2, pp. 72-82. ISSN 1829-7498.