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Educative Web-Based Virtual as a Learning Media For Training Scientific Attitude In High School Student

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Abstract

Media is important in learning, especially with the development of science and technology. This study aims to design and develop a virtual laboratory based on web education as a learning media and to train the scientific attitudes of high school students. The type of research used in Research and Development (R&D) refers to the nine stages of Borg and Gall. The feasibility test of web education uses a validation questionnaire of material experts, language experts, media experts, and educator response questionnaires. The study results showed that material experts comprised 87.5%, language experts comprised 94%, media experts comprised 91.5%, and educator response questionnaires comprised 85.33%. So, web-educative biology is a very feasible category. The effectiveness of the media in training scientific attitudes is known to have an average n-gain value of 0.59 (moderate) for the experimental class and 0.39 (moderate) for the control class. Based on the results of the t-independent test, a sig of 0.00 <α value (0.05) was obtained, which means that H1 is accepted and H0 is rejected. It is concluded that the web-based educational Virtual Laboratory is effective in training the scientific attitudes of high school students and is suitable for use as a biology learning medium.

Key Word: Biology, Virtual Laboratory, Scientific Attitude, Educative Web

Laboratorium Virtual Berbasis *Web Educative* Sebagai Media Pembelajaran Untuk Melatih Sikap Ilmiah Pada Peserta Didik

Abstrak

Penelitian ini bertujuan merancang dan mengembangkan laboratorium virtual berbasis web edukasi sebagai media pembelajaran dan melatih sikap ilmiah Media pembelajaran merupakan hal yang penting dalam pembelajaran terutama dengan perkembangan ilmu pengetahuan dan teknologi. Tujuan penelitian ini merancang dan mengembangkan laboratorium virtual berbasis web-edukasi sebagai media pembelajaran dan melatih sikap ilmiah siswa SMA. Jenis penelitian yang digunakan Research and Development (R&D) mengacu pada sembilan tahapan Borg dan Gall. Uji kelayakan web-edukatif menggunakan angket validasi ahli materi, ahli bahasa, ahli media, dan angket respon pendidik. Hasil penelitian menunjukkan ahli materi 87,5%, ahli bahasa 94%, ahli media 91,5% dan angket respon pendidik 85,33%. sehingga web-educative biologi memiliki kategori sangat layak. Efektivitas media dalam melatih sikap ilmiah diketahui nilai rata-rata n-gain sebesar 0,59 (sedang) untuk kelas eksperimen dan 0,39 (sedang) untuk kelas control. Berdasarkan hasil uji t-independent diperoleh sig sebesar 0,00 < nilai α (0,05) yang berarti H1 diterima dan H0 ditolak.

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Disimpulkan Laboratorium Virtual berbasis web edukasi efektif melatih sikap ilmiah siswa SMA dan layak digunakan sebagai media pembelajaran biologi siswa SMA

Kata Kunci: Biologi, *Laboratorium Virtual*, Sikap Ilmiah, *Web Educative*

INTRODUCTION

Biology learning aims to develop students' understanding of biological concepts and the skills needed to apply these concepts in real-world situations (Hendrawati; 2011; NRC (National Research Council), 1996). Learning biology is essential in students' understanding and applying biological concepts in everyday life. In today's modern era, biological knowledge is necessary in various fields, such as health, the environment and technology. An adequate understanding of biological concepts makes it easier for someone to understand and make the right decisions in real-world situations (Kristyowati & Purwanto, 2019; Permatasari, 2022).

Learning Media is any effort or form of conveying information that facilitates the delivery of scientific information. More specifically, the definition of media in the teaching and learning process is defined as graphic, photographic or electronic tools for capturing, processing and reconstructing visual or verbal information. Heinrich and friends put forward the term medium as a medium that conveys information between a source and a recipient. So, television, film, photos, radio, audio recordings, projected images, printed materials, and the like are communication media (Arsyad, 2017). One of the innovative learning media is a virtual laboratory-based web education, which makes science possible virtually via the internet. Virtual practicum is done online using Android, laptops, computers, and others. Virtual practicum is a development to improve technical, theoretical, conceptual and moral abilities according to needs through education and training. Development is an activity to produce a stone product or provide new learning logically and systematically to determine everything that will be implemented in the learning activity process by considering students' potential and competence (Hidayah et al., 2020). A virtual practicum is referred to as an interactive multimedia object. Multimedia objects comprise various computer formats, including text, hypertext, sound, images, animation, video and graphics. Web-Educative is a website, a collection of site pages summarized in a domain or subdomain located within the Internet's World Wide Web (WWW). A website can also be interpreted as a page containing text, images, sound and other data that can be accessed online-meanwhile, Web-Educative, namely, virtual learning pages (Virtual Learning Environment). The learning environment provided by the web is equipped with several facilities that we can combine to support the learning process, including discussion forums, chat, online assessments, and administration systems. However, remember, as great as the web facilitates learning, the main focus that needs attention is the students themselves because technology is only a means for us to make the learning process easier (Rusman, 2012).

In biology learning, it is essential to train students to have good scientific attitudes, such as curiosity, critical thinking, analytical thinking, and creativity. An excellent scientific attitude can help the students better understand biological concepts and develop the skills to solve complex biological problems. The scientific attitude of each student is different, and this requires a way for students to have at least several indicators from the six indicators of scientific attitude (Astalini et al., 2020; Mantoviana et al., 2020). Based on information obtained through observations, one of the high schools in South Lampung has a good laboratory, but the chemistry and biology laboratories use the room simultaneously. However, in its implementation, there are obstacles, namely that it requires time starting from laboratory usage hours, which must be conditioned and adjusted, tools and materials must be available, practice is carried out in the classroom and during the pandemic until now there has been no practicum implementation, it has only been replaced with assignments, discussion or just explained. During the pandemic, practicums were not carried out at all, and the current conditions in the state of recovery from the pandemic certainly mean that practicums need to be running better. Limited practicum tools and materials and the effectiveness of practicum implementation time are the obstacles most often faced by teachers. Virtual-based practicums have never been used with power and are still the mainstay of media mastered by teachers who use websites, and blog learning has not been fully implemented due to the lack of introduction to manufacturing through training for teachers in schools (Darma et al., 2020; Riska et al., 2022; Tjipto & Dewantoro, 2022).

The development of a virtual-based practicum web educative aims to be an alternative to actual practicum, which cannot be carried out due to several things such as limited space, time, practicum obstacles and experimental accidents that can occur during practicum (Riska et al., 2022). Virtual practicum itself has many advantages, including being able to produce student performance that is equal to or better than actual practicum, reducing the need for equipment, materials and laboratory space so that it can save costs, save practicum time, is more flexible because students can carry out practicum anywhere, even outside school, can avoid experimental accidents. Hence, it is safer (Kristanto, 2016). Practicums have a significant role, especially in science learning. Practicum activities include practical methods which provide direct experience to students regarding learning material. Practicums are an essential part of the learning process.

Nowadays, with the development of very advanced technology, learning media that can support student learning are also needed, such as in the implementation of practicums, which still have many obstacles. Previous studies have stated that virtual practicums can be an alternative to these obstacles and are easy to access, and indirectly, the existence of virtual practicums supports technology-based learning (Fanani et al. 2024; Meilina et al. 2023; Jumiarni et al. 2024). Previous studies have developed android-based practicum media and websites, but they have yet to develop them in the form of websites with Protista material, with their development adjusting scientific attitude indicators. Meanwhile, this scientific attitude is essential for students, especially regarding practicums with abstract material.

Obstacles such as the absence of a laboratory and incomplete tools so that practicums cannot be carried out are a concern for creating virtual practicum products. The novelty of this product is that it is used without downloading the application and can be accessed via a website link so that it does not burden storage on smartphones (Mirawati et al. 2021; Muhajarah and Sulthon 2020). There is complete material in the form of a summary of the material with concept maps, videos, and writings by supporting student literacy or student curiosity and the learning style of each student; of course, with various choices in studying the material, understanding will increase because it is adjusted to the learning style of students (Defianti, Hamdani, and Syarkowi 2021; Eviota & Liangco, 2020) The practicum process is carried out carefully, such as selecting tools; if you choose the wrong one, it will not go to the next stage; not only the practice questions in the product but all questionnaires regarding the product and scientific attitudes can be accessed via the website The scientific attitude indicators develop the product because it aims to improve scientific attitudes that cover six indicators. Two types of practicums are carried out: making Paramecium cultures and observing Protista with the same tools and materials. The product section is designed like a natural laboratory (Fanani et al., 2024).

Development of virtual practicums using Protista material, namely practicum material, is abstract; visualization of the material requires laboratory equipment such as a microscope. Protista material is very contextual to the surrounding environment, so knowing the form and comprehensively studying protists' morphology, physiology, and metabolic processes is necessary. Students also struggled to understand Protista material, classified as abstract because it had never been experimented on before. For this reason, the development of a web-based educative virtual laboratory product is the best solution that aims to create a product that can improve students' scientific attitudes and overcome all obstacles during learning that require practicums but are hampered by limited laboratory resources, accessible, flexible use of laboratories, without eliminating controlled conditions such as in the laboratory. (Lestari et al., 2023;Mahrawi et al., 2023)

The research conducted is undoubtedly different and has newness and refinement from previous studies, as explained above, especially in implementing practicums; there are two types of practicums, designed based on indicators of students' scientific attitudes, all questionnaires, questions, or exams have been included in the website, apparent materials including concept maps that are designed very well. Research conducted by Rahel and friends entitled The use of virtual laboratory phet simulation as a solution for mid-life practicums using existing websites. Then, the study of Deni and friends entitled The Development of Virtual Laboratories in Integrated Smartphone Chemical Synthesis Practicums differs from those developed, namely accessed in the form of a website and a menu. There are also differences in concept maps and descriptions before practicums, and two practicums are to be carried out. With the explanation above, this research aims to develop web-educative-based virtual practicums to improve the scientific attitudes of class X high school students. (Marpaung et al., 2021;Rokhim et al., 2020)

RESEARCH METHOD

This research was conducted at SMA Negeri 1 Natar School from June 2023 until completion. The technique used in this study is research and development aimed at producing a product and testing its effectiveness. The product produced is web-educative, and its efficacy is tested to improve students' scientific attitudes. The research stages use the Borg and Gall design, which consists of 10 stages (Gall et al., 2003; Sugiyono, 2017). However, the research process is limited to using nine stages of development; the reduction of this stage is allowed with consideration without reducing the essence of the research (Sanjaya, 2013); according to Borg and Gall, the nine phases of development consist of Research and Information Collection, Planning, Developing a preliminary form of product, Preliminary field testing, Main product revision, Main Field testing, Operational product revision, Operational field testing, and Final Product revision. The study used class X students at SMA Negeri as the population. A random sampling technique was used to select research samples in limited-scale tests with ten students and large-scale tests with 30 students. Research instruments are tools for measuring and collecting research data. The instruments used in this study are expert validation questionnaires, language experts, media experts, student response questionnaires, and student scientific attitude questionnaires. Then, it is analyzed using the average technique to obtain a percentage value to see the feasibility level (Table 1). The questionnaire contains positive and negative questions about the product being developed and a column for comments or suggestions from the validators. Then, the scientific attitude questionnaire uses the same Linkert scale, which contains scientific attitudes in students.

The steps in developing this web-educative use the Borg and Gall research and development model, which consists of nine stages, namely (1) conducting observations or identifying problems and potentials in the place where the research is conducted. (2) Collecting information or literature studies to increase knowledge of the product to be developed. (3) The media is designed according to the applicable curriculum, needs, and learning objectives. (4) Expert validation conducted by experts in material, language, and media consisting of 2 experts each. (5) Initial product revisions were conducted because the expert trials provided suggestions and input for the product to be better and the product could be used. (6) The product was tested on a large and small scale for 10 class X students at Natar 1 high school, South Lampung. (7) The product trial stage on a limited scale was conducted, and revisions were obtained that needed fixing to become a better product. (8) large-scale trials involving 30 class X high school students. (9) Final revisions were conducted based on the results of large-scale trials when things needed to be fixed.

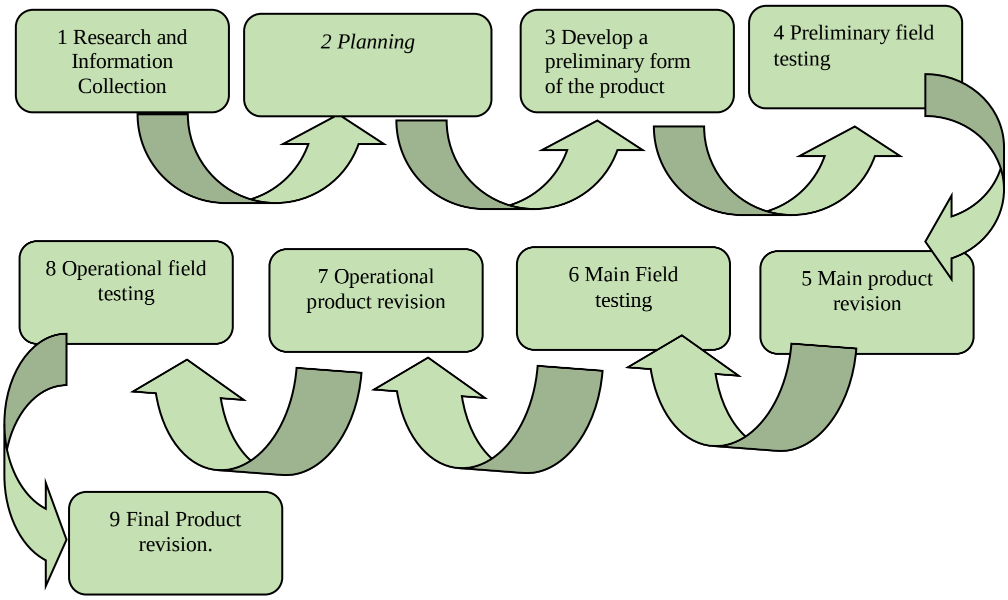

Figure 1. Stages of Virtual Lab Product Development with Web-Educative (Gall et al., 2003)

Figure 1 shows that this development research will go through 9 stages to obtain a product that is suitable for use. This research used questionnaire instruments from language experts, media experts, material experts, student and teacher response questionnaires, scientific attitude questionnaires, teacher and student interviews, as well as documentation in the form of photos and videos during the research implementation. Experts validated the entire questionnaire to see the readability and suitability of language construction in the research instrument (Suharsimi, 2009; Sukardi, 2011). For data analysis techniques on expert questionnaire instruments that assess product suitability, as well as teacher and student response questionnaires using the formula (Suharsimi, 2010)

$$P = \frac{S}{N} \times 100\%$$

Information : P = Percentage, S = Scrore of research result components,
N = maximum number of score

Tabel 1 Eligibility Criteria (Suharsimi, 2010)

Eligibility/Attractiveness Criteria	Category
KK ≤ 21 %	Very Inadequate/Very Attractive
21 < KK ≤ 40%	Unworthy/Unattractive
40 < KK ≤ 60%	Fairly Decent/Fairly Attractive
60 < KK ≤ 80%	Worthy/Interesting
80 < KK ≤ 100%	Very Worth It/Very Interesting

Interpretation of the product feasibility percentage can be seen in table 1. Questionnaires for media experts, language experts, material experts, and student and teacher response questionnaires were all designed with a Linkert scale using favourable and unfavourable items. This is different from the product feasibility and attractiveness questionnaire. The attitude scale questionnaire, in the form of a closed questionnaire, was developed with Scientific Attitude indicators according to Carin (Arthur A Carin. & Sund, 1997; Olua, 2022). The results of using the product to train scientific attitudes in students were analyzed using gain normalization (Deadmond et al., 2018; Hake, 1998). The N-gain results in the wide-scale test are calculated using the independent t-test, with the prerequisite that the n-gain value meets the standard and homogeneous criteria.

RESULTS AND DISCUSSION

The product development process begins by analyzing the potential and problems in schools regarding the implementation of learning, practicum implementation and management, use of learning media, use of textbooks and use of Student Worksheets to accompany the practicum process. Needs analysis data was obtained based on interviews with study field teachers. Based on the results of the needs analysis questionnaire and potential problems, it is known that the most critical problem is the implementation of practicums and the use of learning media, which has yet to be able to bring out better scientific attitudes in students. Student high school class ten in age range fifteen And sixteen is generation Z with the characteristics of excellent technological literacy, creativity, accepting differences, good socialization, like expression, good multitasking, open to change, happy to share ideas and contribute (Husnul Abdi, 2024; Nur, 2021). However, the findings in the field are that teachers have not been able to respond quickly to changes in Generation Z, the design of teaching materials uses school textbooks without any modification to the latest, only the addition of video access via YouTube, the practicum process is carried out with limited tools, materials, and space which often becomes an obstacle. Routine so that some biology material is rarely carried out in practice. The use of learning media that is inflexible, timeless, and interactive has not become a primary consideration for teachers in schools, so PowerPoint is always the ultimate solution that is said to be technology-based, even though it is presented in the form of written descriptions and images only. Learning is currently based on the 21st century, and Generation Z, which has unique characteristics with good potential, will excel if it is facilitated by learning infrastructure and quality teachers that support the development of 21st-century competencies (Auliyak et al., 2022).

The skills of teachers who are alert in various matters, especially in adapting to technology, are essential for designing biology learning that is adaptive to changing times. The use of technology is vital in learning today. The development of technology-based learning media products that train scientific attitudes, critical thinking, and scientific literacy is essential at this time (Maritsa et al., 2021; Priyambodo & Saputri, 2021; syelvia putri & Syafitri, 2023). Therefore, the development of Educative Web-based virtual laboratory products is very appropriate to accommodate the characteristic characteristics of Generation Z and 21st-century learning in biology subjects, not only. Web-based educational virtual practicum media is a solution to school problems, especially for practicums. Technology is very suitable for the learning characteristics of Generation Z in class X high school students, especially for practising scientific attitudes in learning biology.

The product selection in this research is reinforced by the novelty of previous relevant research, which shows that the use of virtual labs is greater with applications installed on Android smartphones (Haka et al., 2020; Ilyas et al., 2020; Muchson et al., 2019; Nasution et al., 2023; Riska et al., 2022). The limitations of more flexible access have not been used optimally. Users are not required to download and install applications that require more device space but can simply access them via the website. Development of web-based educational virtual lab practicum media adapting indicators of an integrated scientific attitude to protist material. The following is the product design in Figure 1.

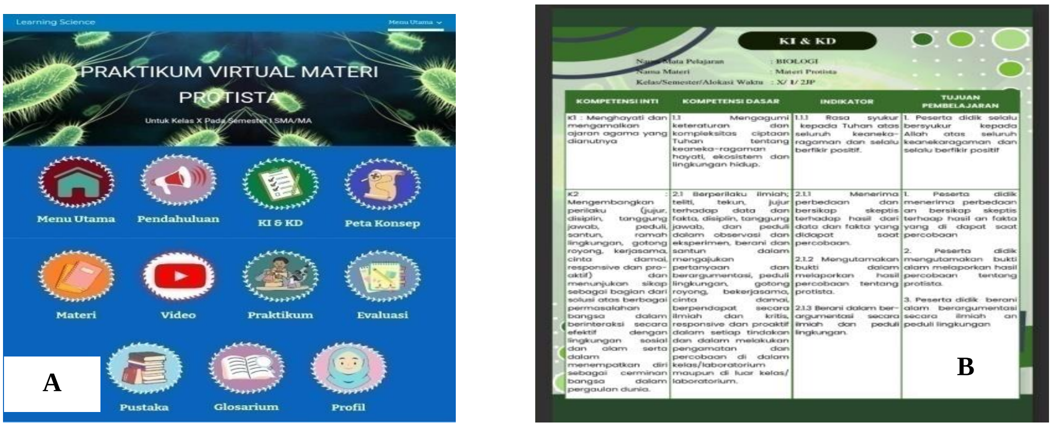

Figure 2. Display of the main menu of the educative web-based virtual lab (A) and the Curriculum Menu (B)

Figure 2 shows the main display includes a significant title of virtual practicum on protist material. The website has menu icons: the main menu, introduction, curriculum (core competencies and essential competencies), concept maps, materials, videos, practicums, evaluations, libraries, glossary and developer profiles. Scientific attitude indicators are directly integrated during the virtual practicum process. Concept maps are displayed to make it easier for students to analyze any biological material studied in the product. Furthermore, after students have studied the concept map, they can access the virtual lab practicum on the website as follows:

Figure 3. The initial appearance of the Virtual Lab and Virtual Lab Theme for Creating Paramecium Culture and Protozoa Observations

Figure 3 shows the virtual practicum menu with the initial display. Students are asked to log in first and read the practicum instructions, the theoretical basis, and the practicum theme before starting. Practical work was carried out first on theme one, about making paramecium cultures, followed by theme two, observing protozoa.

Figure 4. Virtual Lab Practical Menu Display

Figure 4 shows the practical menu for making paramecium cultures and the menu for selecting tools and materials. Each practice material menu has tools and materials, practice objectives, and other menus. When choosing practice tools and materials, you have to make the right ones; otherwise, the tools and materials will not move or move, so before carrying out the practical process, students must understand the tools and materials and how the practical works.

An evaluation menu contains concept mastery test questions and scientific attitude questionnaires. To train the growth of a scientific attitude, each stage of the virtual laboratory is integrated with scientific attitude indicators, including curiosity, working together, scepticism, optimism about failure, accepting differences, and prioritizing evidence. Curiosity training on web-educative The Student Worksheet (LKPD) is displayed; students are stimulated by literacy before starting the practicum and after the practicum process is carried out, the entire observation results are filled in the LKPD. Next, train students to prioritize evidence with reading material in the material menu and proof of what type of protist was found, including the correct reasons. Being sceptical is fostered by cross-checking the observations' results in pictures of the observed objects outlined in the LKPD and detecting morphological and physiological characteristics in source books (references). A scientific attitude that is willing to accept differences is trained by respecting the opinions and observational findings of other students, which are displayed through an online media jam board; this media is used to accompany during the practicum process; all students can comment and see the conclusions they understand during the practicum process. Training indicators to work together: by creating practicum groups, students are trained to discuss, practicum, and present practicum results collaboratively. The process of positive thinking about failure is strengthened by training students not to give up easily and always to be optimistic, which is generated through reading practical materials and instructions for implementing virtual laboratories via the educative web when selecting valuable tools and materials that must be correct. If the selection of tools and materials is invalid, the practicum process cannot continue; students who have difficulty are asked to try more often and cross-check the practicum stages.

All scientific attitude indicators have been trained with an educative web-based virtual practicum process. I hope that developing a scientific attitude in students will help students become scientists and have a high curiosity. A scientist gets used to following the stages of the scientific method systematically, does not hide failures, develops a positive mentality, thinks logically, and is careful because students are stimulated to observe, make predictions and problem solvers (Mantoviana et al., 2020; NRC (National Research Council), 1996; Olua, 2022). Product development is done by considering the field's needs and potential analysis stages, relevant research results, and curriculum review of protist material. Products are made in the form of media by design with the advantage of saving time, energy and costs, and teachers and experts can be directly involved in designing media according to student needs and learning objectives. The involvement of teachers and experts in media design is intended to produce media whose validity and reliability are tested through a series of product prototype validation stages (Kristanto, 2016). Educative web-based virtual practicum products developed with Adobe Animate. This educative web-based virtual laboratory is equipped with protist material, learning videos, integration of scientific attitudes in practicum simulations, concept mastery test questions, scientific attitude questionnaires, a reading room, and a practicum room. Six experts were involved in the product validation stage, including material, media, and language experts, with two review stages for the research product. The review process uses a feasibility questionnaire shown in Table 4.

Table 4 Data from Validation Results of Media Experts, Material Experts and Language Experts in Educative Web-based Virtual Laboratory Media

Information	**Media Expert**				**Material Expert**			
	Level 1		Level 2		Level 1		Level 2	
	ANS	RO	ANS	RO	OPW	AOSP	OPW	AOSP
Mark %	63%	75%	89%	94%	75%	81%	86%	89%
Criteria	Worth it	Worth it	Very Worth it	Very Worth it	Worth it	Very Worth it	Very Worth it	Very Worth it
Rates	69%		92%		78%		88%	
Criteria End	Worth it		Very Worth it		Worth it		Very Worth it	

Information	**Language Expert**			
	Level 1		**Level 2**	
	JU	**IH**	**JU**	**IH**
Mark %	87%	83%	96%	92%
Criteria	Very Worth it	Very Worth it	Very Worth it	Very Worth it
Rates	85%		94%	
Criteria End	Very Worth it		Very Worth it	

Table 4 displays the final criteria value from media experts in the test in stage 1 of 69% (worth it) and stage 2 of 92% (very worth it), meaning that the product developed is very suitable for use as a virtual practicum medium with a media display that makes it easier for users, completeness instructions for use, detailed and varied product menus, use of colours and image displays that are attractive, flexible, interactive, and can stimulate students for self-directed learning, attractive practical simulation displays, and train students' scientific attitudes. Meanwhile, the material expert assessment results at stage 1 were 78% (worth it), and stage 2 was 88% (very worth it). This shows that the protist material displayed on the product is relatable to the curriculum (Basic Competencies, Core Competencies, Learning Objectives, and Indicators), the delivery of the material is precise, there are no misconceptions, it is systematic, involves accurate examples, precise facts and principles, displays pictures and videos as an explanation of the material, easy to understand, trains a scientific attitude, and presents practicums with relevant themes to verify the concept of protist material. Based on the language expert's assessment at stage 1 of 85% (very worth it) and stage two of 94% (very worth it), this educative web-based virtual laboratory product has adopted excellent and correct language spelling, correct use of punctuation, and simple sentence construction. Moreover, unambiguous, making it easier for students to understand the material.

Next, the limited scale trial stage for the product was given to 10 students, with the result that 84.5% of students responded positively to the use of educative web-based virtual lab practicum media in training scientific attitudes and stated that the media developed was very interesting. Next, a wide-scale test involved 30 students who were given an initial scientific attitude questionnaire, using educative web-based virtual laboratory media on protist material and providing a final scientific attitude questionnaire. The results of the scientific attitude questionnaire are known in Table 5.

Table 5. Data on Scientific Attitude Values on Wide-Scale Tests

Class	Pretest Rates	Postest Rates	N-gain	N-gain Criterion	Uji t Independent
Control	55,06	71,83	0,37	Currently	Nilai sig (2 tailed) 0,000 < α 0,05 (H_0 rejected dan H_1 accepted)
Experiment	54,84	80	0,56	Currently	

Based on the data results in Table 5, it is known that using educative web-based virtual laboratory media influences the improvement of students' scientific attitudes. Using media that trains scientific attitude indicators in all menus on the website helps students develop good habits. Moreover, if a particular learning model accompanies this media, it will significantly impact training scientific attitudes. Also, 85.33% of students responded positively and considered this product interesting in learning about protists. This development product can be a solution for providing practicums hampered by the minimal availability of practicum equipment, materials, and laboratory space. Educative web-based virtual labs provide actual conditions in the laboratory where practicums take place and train students in scientific attitudes through cyberspace without reducing the learning experience for students in the slightest. Behavioristic theory strengthens the findings of this research that teachers' efforts to shape desired behaviour are by providing an environment or stimulus (Dahar, 2012). In 21st-century learning, interactive media design is needed to accommodate Generation Z's characteristics as students. Products designed with systematic material and detailed and strict planning, precise sequence, practice, and direct feedback are provided as an interactive response to the developed media. Skinner stated that "teaching machine" based media provides feedback to students directly on correct answers on tests or activities carried out on the media (Ilyas et al., 2020; Tim Walker, 2021). However, behind all the advantages, there are, of course, obstacles; teachers still have to provide complete control over the use of virtual laboratory media, and practising a scientific attitude during the learning process must also be carried out because learning with machines will still be limited if a teacher does not accompany it as a facilitator (B.F Skinner, 2021; Skinner, 1958).

The development of this educative web-based laboratory is expected to solve learning problems experienced by students and overcome cost problems in procuring practicum equipment and materials and the availability of laboratory space in virtual form as a solution for carrying out practicum activities for underprivileged schools. Virtual labs are more interesting and interactive, making teaching time allocation more effective because the practicum process is repeated and carried out anywhere, anytime, saving research costs (Ahmed & Hasegawa, 2021; Lee et al., 2023). During the product validation process through experts, limited-scale analysis and wide-scale analysis on students, as well as the ability to train a scientific attitude without significant obstacles. Virtual lab products with educative web provide many advantages, including using it very easily and not requiring a large capacity to download the program because it is not installed on the user's smartphone device. By designing a platform using the educative web, students no longer need to install software on computers or cell phones and ensure laboratory environment compatibility in online teaching and learning activities. This is reinforced by research findings that show that the use of a web-based virtual platform has good scalability, supporting large numbers of students in completing direct laboratory activities online. The survey shows that students are elementary to use the web-based platform, which very useful for online learning, and teachers are very enthusiastic reuse the web-based virtual lab platform, and students intend to continue using it after learning is completed (Andriani et al., 2024; Boel, 2024; Hamoud et al., 2024; Handayani et al., 2024; Ahmed & Hasegawa, 2021; Lee et al., 2023; Lewis et al., 2024; Lui et al., 2024; Vahdatikhaki et al., 2023).

The research found various findings, starting from students who enjoy learning using media and have never experienced direct practicum in the laboratory or online; students are thrilled that there is media that does not need to be accessed through the application but in the form of a website. Then the disadvantages are that with good results from this product, of course, until now, the direct practicum is still much more effective, and to access it requires a good internet network. This access system still needs to be visible to anyone who accesses the website (Haniyyah & Rambe, 2024). This research is conducted by Haka et al. (2020), entitled Development of Online Websites Based on Blended Learning to Improve Mastery of Science Subject Concepts. Research by Ilyas, An Nisaa Al Mu'min Liu, and Hamsah Doa (2020), namely the Effect of Using Virtual Lab on Learning Outcomes and Scientific Attitudes of Students of the Physics Education Study Program, University of Flores. Research by Ni Ketut Rahayu, Andri Suherman, and Firmanul Catur Wibowo (2019) with the research title Development of a Website-Based

Virtual Physics Laboratory on the Subject of Dynamic Electricity. Research by Mirawati, Zulfani Sesmiarni, Supratman Zakir, and Iswantir (2021) with the research title Development of an Android-Based Virtual Laboratory in Biology Subjects at Sman 1 Abung Semuli, North Lampung. Research is based on online media in the form of Android or website, and the media can be improved and perfected by adjusting the research indicators to produce excellent results. This study concluded that Web-educative can improve students' scientific attitudes and can be a solution when the laboratory and its tools are inadequate (Ni Ketut Rahayu, Andri Suherman, 2019)**.**

CONCLUSION

Media-based virtual laboratory practicum web-educative is very suitable for use in biology subjects, proven by media experts stating that 91.5% of the media is very suitable, and 87.5% of material experts stated that biology material is very suitable and easy to learn. Linguists say it is very suitable at 94%. 85.33% of students and teachers responded positively and stated that using virtual laboratories' web education as a learning medium to train students' scientific attitudes was very interesting. The average value n-gain knows the effectiveness of the media in training scientific attitudes. The experimental class was 0.59 (medium), and the control value was 0.39 (medium). Meanwhile, based on test results, the t-independent test earned value selves $0.00 < \alpha$ value (0.05), which means H1 accepted and H0 rejected, so it can be concluded that the virtual laboratory is based on educative effective in training high school students scientific attitudes. Access educative web-based virtual laboratory media via a linkhttp://learnsains.my.id/.

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