Development of Biology Learning Media Assisted by Construct2 to Improve Critical Thinking Skills

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Abstract: The construct2 software is an HTML5 based Game Builder Tool. Construct2 can be used in the development of biology learning media assisted by construct2 or HTML5 to improve critical thinking skills. This type of research is research and development (Research and Development) which is accommodated from Sugiyono (2008) which was developed according to the conditions and situations. The research data instruments consist of assessment instruments by validators (material, language, and media), and media-based questionnaires based on teacher and student responses. The research data is in the form of media data validation from a team of experts, the results of the virtual laboratory media feasibility test, and the results of the learning media effectiveness test. The research population consisted of 5 SMA 1 BELO classes consisting of IPA 1, IPA 2, IPA 3, IPA 4 with a total of 130 students. The research subjects consisted of 67 students from Senior High School Negeri 1 Belo, West Nusa Tenggara, Indonesia. The result of the research is an application-based virtual laboratory application that can be programmed using Construct2 or HTML5 software. The results of the validity test according to experts ranged from 97%, while the exact location was 87%. The implications of this research are expected to be able to contribute to researchers, practitioners, to be able to optimize construction in making 3-dimensional virtual laboratory media.

Keywords: Biology Learning Media; HTML5; Media Validity; Software Construct2

Introduction

Learning media is an important instrument that supports learning success. Good learning media can be the main reason for the creation of cooperative learning and have a real impact on increasing achievement through student learning outcomes. Learning media is indeed an important control for the success of learning outcomes. One of the new learning styles that are accommodated by teachers is to develop media or instruments. E-Learning learning utilizes software as a medium of information and communication (Ameen et al., 2019). The importance of online-based learning greatly influences the level of competency possessed by students. Digital-based learning is a challenge for teachers and students to meet the needs of the times in the era of society 5.0. One of the competencies that must be possessed is mastery of technology (Rahmat et al.,

2021). Therefore, it is important to change the learning paradigm from face-to-face to digital-based learning as a form of effort to create learning transformation in a new era that requires super skills (Goodyear & Armour, 2021; Kivunja, 2015; Reyna, 2021).

Learning the excretory system requires a contextual understanding by doing some basic practicum related to the site's excretion process (Noris et al., 2021). Science or biology learning materials require practices that support the creation of some conceptual understanding such as laboratories. At the junior high school level, the use of laboratories is still very minimal, so that student learning outcomes are inconsistent and relatively not increasing (Banjarani et al., 2020). Therefore, there is a need for a new learning style transformation by accommodating software such as construction2 to create application-based laboratory learning media. New reforms in the digital world by involving students, teachers, and the community to be

actively involved in the digital era both permanently and holistically (Hoe, 2020). Technology is expected to be able to change many aspects, especially in the field of education to distribute curriculum and learning media (Mershad & Wakim, 2018).

In Indonesia, learning activities during the pandemic are carried out online by utilizing online platforms such as Whatsapp Group, Google Meeting, Google Zoom, and Classroom. However, learning activities using several online platforms above are deemed not able to represent learning that requires practicum. The laboratory is an important component of student support facilities to carry out scientific findings. The development of a virtual laboratory has a good impact on students as a form of interpretation of online learning problems (Kapilan et al., 2021). The use of software in conceptual learning has become a new trend recently and has a fairly high effectiveness value so that it can be used as a good alternative to improve the performance of biology learning (Arslan et al., 2020). The application of application-based information systems is very feasible in supporting learning (Widodo et al., 2020). Software such as construct2 that can make applications suitable for developing learning media such as virtual laboratories (Rosen, 2019).

Construct 2 is a desirable HTML5 based game creation tool for 2D platforms. The utilization of the construct 2 software in learning can provide students' own learning experiences (Syam & Izzati, 2020). Contruct2 software can be optimized in the development of learning platforms that can improve student understanding (Agung Saputro et al., 2018).

The development of virtual laboratory-based media helps teachers and students to create feedback in the form of interactive dialogue (Adie et al., 2018). Applications that support interactive learning are HTML-based constructs. This application is not only compatible (Enokida et al., 2017). But also believed to improve communication skills (Ho & Binh, 2014). But also believed to improve communication skills The form of the learning revolution includes the provision of unlimited teaching materials, and real-time class organization, not limited by time, place, and conditions (Hariadi et al., 2016).

Therefore, researchers take advantage of building 2 in the development of learning media in the form of a virtual laboratory for learning the biology of the excretory system concept

Method

This type of research is research and development (Research and Development) which is accommodated from Sugiyono (2008) which was developed according to the conditions and situations. This type of research is research and development (Research and Development)

which is accommodated from Sugiyono (2008) which was developed according to the conditions and situations. As for the stages of development according to Sugiyono, namely: (1) Identification of potential and problems, (2) Data collection, (3) Product design, (4) Design validation, (5) Design revision, (6) Product testing, (7) Product revision, (8) Usage trials, (9) Product revision, and (10) Mass production.

The research data instruments consist of assessment instruments by validators (material, language, and media), and media-based questionnaires based on teacher and student responses. The research data are media data validation from a team of experts, the results of the virtual laboratory media feasibility test, and the learning media effectiveness test results. The study population consisted of 5 SMA 1 BELO classes consisting of IPA 1, IPA 2, IPA 3, IPA 4 with a total of 130 students. The research subjects consisted of 67 students from SMA Negeri 1 Belo, West Nusa Tenggara, Indonesia. Operational trials to determine the effectiveness of HTML5-based learning media assisted by construct2. Operational trial design can be seen in the following table:

Table 1. One Group Pretest-Postest Design

Class	Pretest	Treatment	Posttest
Eksperimen	O_1	X_1	O_2

(Sugiyono, 2012)

Description:
X_1 : Treatment with HTML5-based Biology Learning Media
O_1 : Pretest value before treatment
O_2 : Posttest value after treatment

The eligibility criteria for construct2-assisted biology learning media are presented in the Table 2.

Table 2. Media eligibility criteria

Score	Criteria
81-100	Very good
61-80	Good
41-60	Quite good
21-40	Pretty good
0-20	Not good

(Arikunto, 2013)

Criticisms and suggestions from the validator team become the basic reference in developing a better media.

Result and Discussion

Literature Study and Field Study

The literature study includes an analysis of core competencies, basic competencies, problem-based learning models, learning resources and media, and practical implementation on human excretory system materials carried out in schools. The literature study includes the competence of data, problem-based

learning models, virtual laboratory forms of media, as well as practical implementation processes. The field study was conducted at SMP 2 BELO, Bima district, West Nusa Tenggara, Indonesia. The results of interviews with science teachers are as Table 3.

Table 3. Results of Interviews with Science Teachers

Question Items	SMA Negeri 1 Belo
Frequently used method?	Cooperative, lecture (dominant), discussion
What material is difficult for the majority of class IX students?	Excretory system material is one of them
Is a teaching media needed to help students' difficulties?	Teacher's handbook
What are the facilities and infrastructure at the school?	computer laboratory, student android, science laboratory but rarely used, LCD, computer
Does the practicum utilize the laboratory?	Rarely used almost not used at all
How to explain material that requires practicum?	Done with a video presentation, or students are asked to find their own.

After conducting interviews with teachers, researchers then summarized the results of the analysis of teacher needs. After the researchers conducted preliminary studies and identified potential problems in the field, they found solutions to overcome these problems. The main solution is to develop Construction Software Assisted Biology Teaching Materials 2. The teaching materials developed are in the form of digital-based software media that can be used by students when studying biology, especially in material on the excretory system in humans, the respiratory system, and the movement system. future orientation is to create an online-based learning platform

Table 4. Results of Teacher Needs Analysis

Question	SMA Negeri 1 Belo
Learning resources used	Teachers use the internet, handbooks and teaching materials from other sources. However, teachers need media that can be operated by students and teachers
Implementation of learning	➢ Learning based on 2013 curriculum ➢ Less than optimal in laboratory use ➢ Students are less enthusiastic because learning with the lecture method dominates
Limitations and difficulties of teachers in learning the excretory system	➢ Limited time ➢ Limited materials and laboratory equipment ➢ Limitations in learning material concepts and excretory system practicum
Teacher needs and alternative solutions	➢ Already using power paint but still need other media Need an alternative virtual laboratory-based media

The results of the analysis of teacher needs indicate that teachers have difficulty explaining the concept of Biology learning materials that require practice in the form of observations or experiments correctly, teachers cannot carry out practice optimally because of the shortcomings and limitations of laboratory equipment, and the materials provideb by the school. The teacher suggests that researchers develop a product in the form of a virtual laboratory that can support students' practical needs. From the results of the interview, a temporary conclusion was generated that teachers need the help of online-based learning instruments due to the lack of available facilities that support learning. Therefore, it is necessary to develop online-based media that can be accessed by teachers and students on one platform. This effort is made to support the success of students in understanding concrete biology learning.

While the results of the analysis of student needs given to SMAN 1 Belo teachers through a questionnaire are as Table 5.

Table 5. Results of the analysis of student needs

Question	SMA Negeri 1 Belo
Learning resources used	The average student does not have a handbook 100% of students have android
Implementation of learning	➢ Teachers focus on lecture-based learning ➢ 50% of students are enthusiastic in participating in excretory system learning ➢ Students have difficulty in understanding the concept of an excretory system
Limitations and difficulties of students in learning the excretory system	➢ 70% of students said the excretory system material is part of the difficult material ➢ 100% of students have never done practicum
Student needs and alternative solutions	➢ Students want the learning material to be easy to understand ➢ Students want to occasionally carry out practicals

The results of the preliminary study were carried out by finding out about the condition and learning situations in the field through observation, interviews, and distributing questionnaires about potential problems in the field. The learning needs analysis should be from several aspects including looking at the selection, and use of media in the form of abstract images that represent concepts, goals, conditions, facilities, and time allotted for learning needs. done safely teaching and learning process takes place (Noris et al., 2021). Modernization of computerized distance learning can help students to empower self-competencies such as students' critical thinking skills (Can & Yungul, 2018).

Based on the expert that the developed virtual laboratory media has media validity values ranging from 97%, language validity 98%, and material validity 97%, this proves that the media is considered feasible to be tested in the field. based on teacher and student assessments of test results and media accuracy, it shows that the media has a value of 87%. Therefore, the use of HTML-based constructs in Biology Learning is considered effective to improve student learning outcomes.

The use of construct2 is believed to be able to develop virtual laboratory media with a high level of feasibility as a learning medium that supports increasing students' critical thinking skills. Construct2 is HTML5 software. In addition, construct2 is believed to be effective for creating a virtual laboratory (Saputra et al., 2021), Development of comics and websites (Amasha et al., 2021), and apps (Shabani, 2016). Contruct2 provides powerful event system services, build apps, multiple expectations, chrome based like web and apps, and multiple export platforms. Utilization of HTML5-based software Can also be applied to some materials that require experimental exploitation.

Media Development Stage

Suggestions and inputs from validators and teachers are used as a basic reference for the improvement of problem-based learning-based virtual laboratory media. Sharing input and suggestions is very useful for the progress and development of learning media so that it is suitable to be used as a learning medium that can empower students' critical thinking skills. The questionnaires distributed were student and teacher response questionnaires on problem-based learning-based virtual laboratory media. The results of the questionnaire at the trial stage were used as a basis for making improvements to the media used which was developed in accordance with the suggestions and inputs obtained.

Figure 1. Biology Learning Media Content

The Figure 1 is a display of biology learning media which is conceptualized on the material of the human excretory system, reproductive system, virus, and biotechnology material. The developed media presents various materials that are considered difficult in conducting experiments, therefore researchers use digitization as a form of semi-experiment for teachers and students. The materials presented are based on the results of inclusive interviews with teachers and students. In the virtual laboratory media display that has been developed, it can be accessed by teachers and students equipped with features that make it easy to access.

Characteristics of good learning media include 1) the media presents attractive graphics, is easy to reach, and does not require maintenance costs. 2) the media has good presentation and graphics. 3) accessible to both teachers and students. 4) integrated scientific methods. 5) media that supports HTML5 so it's easy to access. In addition, the developed media must also be accessible and published to the public. there are at least three ways 1) publish directly on the website, 2) publish as a mobile application, 3). Publish directly manually (Noris et al., 2021).

There are many ways to gain access to media, which can be shared as a mobile application via Google Playstore, Google Drive, or shared directly with students and teachers (Noris, M., Saputro, S., 2021). The millennial generation is now a technology literate generation so that the opportunity to access and operate biology learning media software can be accessed easily. Virtual laboratory has unique advantages over other media besides being developed with HTML5-based construct2 software, it can also display attractive 2-dimensional graphics that can provide good legibility to students.

Virtual laboratory developed with construct2 software is basically software for making game applications. However, along with the times, it does not rule out the possibility of optimizing digital-based learning such as its use in making learning platforms (Epinur & Yusnidur, 2015; Noris et al., 2022; Priem et al.,

2011). The advantages of Construct 2 include being able to create 2D games, multiplatform (HTML5 Web, Android, etc.). Construct 2 includes a game engine that has a free license. Construct 2 makes it easy for you to make games without having to understand coding (Priestnall et al., 2020; van der Kolk et al., 2013).

The virtual laboratory media is said to be feasible to be used as a research instrument to support students' critical thinking skills. The construct2 application has several advantages that can integrate the creation of instruments in the form of websites, applications, e-learning, and e-module (Noris et al., 2021). Contruct2 provides a powerful event system service, creating applications, multiple expect, chrome-based such as web and applications, and multiple export platforms. The media developed is relatively simple to operate by students and teachers, because the media is integrated with critical thinking skills syntax, problem based learning syntax, the media is equipped with student activity sheets (known with LKPD), the media is equipped with learning objectives, core competencies, basic competencies, learning indicators , evaluation test questions, and motion animations that support students' conceptual understanding.

Table 6. Recapitulation of the implementation of the syntax of students' critical thinking skill.

Cognitive Aspect	Implementation of the syntax of students' critical thinking skills		
	1st meeting	2nd meeting	3rd meeting
Interpretation	√	√	√
Analysis	√	√	√
Inference	√	√	√
Evaluation	√	√	√
Explanation	√	√	√
Self Regulation	√	√	√

The results of the recapitulation of the implementation of the syntax of the critical thinking ability aspect show that students experience problems in interpreting data and self-regulation. This is influenced by the nature of students who have not been able to show self-regulation in learning. As a result, students tend to be passive. While students who stand out can be seen in the analysis, inference, evaluation, and explaining sections. The dominance of students to explain began to appear because the media that was developed was designed and programmed so that students were able to explain the findings conceptually based on the data.

Not all inputs and suggestions from validators and practitioners are used as references, but several components that support the development of media that are worthy of being used as alternatives for today's learning. The following is a recapitulation of suggestions and input from the validator. The results of the

assessment of the feasibility of learning media by teachers on a wide-scale trial, namely 87% with a very worthy category to be used as a reference for the development of similar media. Media and technology a complex set of learning support (Türel & Dokumaci, 2022).

The characteristics of the learning media developed with the help of construct2 have the advantages of 1) virtual lab media. based on android/smartphone, 2) offline/online based media, 3) interactive and non-linear media, 4). Media is equipped with posttest and pretest, 5) media is integrated with problem-based learning models, 6) media supports HTML5. The virtual laboratory media is said to be feasible to be used as a research instrument to support students' critical thinking skills. Problem-based learning models can be constructed explicitly on computer-based media such as applications (Pike et al., 2017).
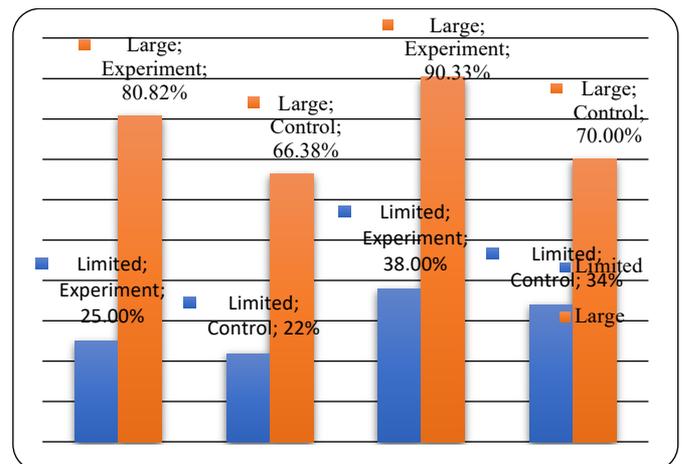

Figure 2. Media Feasibility Test Results Graph

The construct 2 application has several advantages that can integrate the creation of instruments in the form of websites, applications, e-learning, and e-modules. Contruct2 provides a powerful event system service, creating applications, multiple expect, chrome-based such as web and applications, and multiple export platforms. Mobile application design is rapidly improving, so security threats are increasing (Riad et al., 2021). Contruct2 software also certainly has weaknesses, while construct2 weaknesses can only be developed in the aspect of 2-dimensional computerized devices.

Conclusion

The media has a high degree of feasibility based on the assessment of experts andstudent and teacher responses in ability improvement learning orientationstudents' critical thinking. The virtual laboratory application is designed to be published in 3 ways, namely: 1) publish directly on the website. 2) publish as a mobile application. 3)share apps manually.

The development of application-based virtual laboratories for learning media is considered very practical when using construction tools. This is evidenced by the results of student and teacher responses. The implications of this research are expected to be able to contribute to researchers, practitioners, academics to be able to optimize constructs in making 3-dimensional virtual laboratory media.

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