

## The Development of Scratch Software-Based Interactive Learning Media on Regulatory System Material

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### Abstract

*Interactive learning media is a learning program that integrates and synergizes text, images, graphics, sound, video, animation, and simulation with the aid of computer devices or the like to achieve specific learning objectives and allows users to actively interact with the program. Interactive learning media can improve student and teacher skills and transform students into active learners. The research aims to develop interactive learning media based on software scratch on the material of the regulatory system and to know the validity, practicality, and efficacy of the media. The research and development method with the ADDIE model is used in this research. The research instruments used are needs analysis in the form of teacher interview guides and student questionnaires, validation sheets consisting of media and materials expert validation sheets, and implementation tools in the form of effectiveness sheets, namely pre-test and post-test, and practicality sheets, namely teacher and student response questionnaires. Based on the results and discussion, the media expert's validity test result is 87.33%, and the material expert's result is 87.50%, indicating that it is very valid. Then, the practicality test results of the teacher's responses received a percentage of 97.50%, which is very practical. The practicality test of student responses on a small scale yielded a rate of 93.25%, which is very practical, while the field test yielded a rate of 84.30%, which is quite practical. In the effectiveness test, the percentage of n-gain obtained was 84%, which means it was effective. The results show that scratch-based interactive learning media have proven to be valid, practical, and effective. This learning media can be implied as one of the supporting media for teachers in biology subjects, particularly on regulatory system material that may boost students' motivation for learning and academic success.*

**Keywords:** ADDIE, Development, Interactive Learning Media, Regulatory System, Scratch



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### INTRODUCTION

In today's era of globalization, technological developments are becoming more advanced and sophisticated to be used in various areas of life, including education (Nurmaulidina et al., 2022). The field of education is critical in dealing with the advancement of science and technology (Ariningtias, 2017). According to Mashudi (2021), today's expected

education is to produce students who have 21st-century skills. Based on this, teachers must be capable of preparing their students to live in the digital age. (Tridiana & Rizal, 2020). One is that teachers can apply 21st-century skills to the learning process. According to Trilling & Fadel (2009), life and professional skills, learning and innovation skills, and information media and technology skills are all required for 21st-century teachers. One of the 21st-century skills teachers must have is using media, technology, information, and communication (Intana et al., 2018). Thus, education, as one of the fields affected by technological and information development, is expected to be used to communicate between teachers and students in learning, including the development of learning media (Sejati & Koeswanti, 2020).

Learning media is very important for educators because it can be used as an intermediary in conveying material so students can easily understand it and improve student learning outcomes (Wahyuningtyas & Sulasmono, 2020). Learning media can engage and motivate students by clarifying learning messages and presenting information (Dewi et al., 2018). Furthermore, Nasir et al. (2019) outlined how learning media can aid students in fully grasping academic concepts. Learning difficulties in students can also be addressed by educational media (Muthy & Pujiastuti, 2020).

An educator must be able to use information technology to create learning media in order to build exceptional human resources with global competency in the field of education (Sembiring et al., 2022). Learning media continue to evolve, starting with media that can only display images, audio, and audiovisual. There are now interactive learning media that can provide two-way communication (Sahronih et al., 2019). According to Surjono (2017), interactive learning media is a learning program that integrates and synergizes text, images, graphics, sound, video, animation, and simulation with the aid of computer devices or the like to achieve specific learning objectives and allows users to actively interact with the program. Kustayarini et al. (2020) explained that interactive learning media aim to convey knowledge in an entertaining, engaging, understandable, and straightforward way. Information or material is also easily understood using interactive learning media because the senses, especially the ears and eyes, can absorb information during learning. Interactive learning media can improve student and teacher skills and transform students into active learners (Sahronih et al., 2019; Kustayarini et al., 2020).

The Qur'an, Surah an-Nahl, verse 44, also provides the basis for using educational media in the teaching and learning process:

بِالْبَيِّنَاتِ وَالرُّبُيَّةِ وَأَنْزَلْنَا إِلَيْكَ الذِّكْرَ لِتُبَيِّنَ لِلنَّاسِ مَا نُزِّلَ إِلَيْهِمْ وَلَعَلَّهُمْ يَتَفَكَّرُونَ ٤٤

Meaning: “[We sent them] with clear proofs and written ordinances. And We revealed to you the message that you may make clear to the people what was sent down to them and that they might give thought”.

From this verse, it can be interpreted that a teacher must create an exciting learning atmosphere, one of which is using creative and innovative learning media to take place more optimally and be oriented toward student learning achievement (Wulandari, 2020).

However, the reality in the field shows that teachers have not fully used interactive learning media in the teaching and learning process. It can be seen from the interviews with several students from different high schools conducted by Nurhalizah et al. (2022). Based on these interviews, it is known that the teacher's learning resources are only in the

form of textbooks and student worksheets. Teachers rarely use learning media and only occasionally use PowerPoint learning media. Then, the observation results of [Triyanti & Suswati \(2015\)](#) in SMAN 4 Lubuklinggau explained that learning media in schools are still limited, especially interactive media. The learning process only uses pictures, teacher explanations, textbooks, and PowerPoints. As well as the results of observations by [Danaswari et al. \(2013\)](#) at SMA Negeri 9 Cirebon City found that teaching materials are only in the form of textbooks, not learning media. Based on this, an interactive learning media that is interesting for students and easy for teachers to make is needed.

Interactive learning media can be created using various computer software. Software, according to [Bratha \(2022\)](#), is a collection of programs used to run computers or specific applications on a computer. There are many application software to create interactive learning media, such as PowerPoint, Adobe Flash, Prezi, and Scratch ([Rohaeti et al., 2019](#)). PowerPoint, Adobe Flash, and Prezi are already popular among biology educators, but each has drawbacks. The disadvantages of PowerPoint media are monotonous, boring, and sometimes uninteresting ([Xingeng & Jianxiang, 2012](#); [Špernjak, 2014](#)). The disadvantages of Prezi media are that good features are only available in the paid version, require an internet connection, and require a high-spec computer ([Špernjak, 2014](#)). Meanwhile, the disadvantage of Adobe Flash media is that it is challenging to create, especially for beginners, because many features need to be memorized, and it also needs to be connected to the Internet ([Fandini et al., 2021](#)). Based on this, interactive learning media is needed that has good media quality and is easy to make. The media is Scratch ([Bernard & Setiawan, 2020](#)).

Scratch is a visual programming language based on code blocks designed by the Lifelong Kindergarten research group at the MIT Media Lab to introduce basic programming concepts in an interactive and fun way ([Nikmah & Ellianawati, 2019](#)). Scratch is easy to use, only by programming blocks that can be clicked, dragged, and dropped ([Bernard & Setiawan, 2020](#)). Scratch allows teachers to easily create interactive stories, games, and animations ([Sudihartinih et al., 2021](#)). The advantages of Scratch are that it is freeware, so it is free to use; it can be used online or offline; it has an image and sound editor; it is easy to learn; it is educational; and it is attractive because the tools have colors ([Nuraeni et al., 2021](#)).

[Hansun \(2014\)](#) states that Scratch facilitates learning activities and concept understanding. Game-based learning is intended to combine theoretical content with game-based learning. Students can explore rigorous environments, concepts, and desired learning outcomes through game-based learning ([Chen et al., 2018](#)). Scratch learning media can help students understand abstract or micro materials well and make learning more enjoyable ([Nugraha & Widiyaningrum, 2015](#)).

Abstract and micro-learning materials are often found in Biology learning, one of which is regulatory system material. The regulatory system is the material considered the most difficult for students ([Raida, 2019](#)). This is due to abstract concepts and the lack of learning media to help students understand ([Syamsurizal & Ardianti, 2021](#)). Based on research by [Hidayati \(2015\)](#), students' difficulties in understanding regulatory system material impact low student test results. In line with the results of interviews at SMA Negeri 1 Hamparan Perak, where the average daily test score on the material of the regulatory system of XI IPA 2 students in the 2016–2017 learning year is 70, which means

that it does not reach the Minimum Completion Criteria standard, which is 75 (Napitupulu et al., 2019).

Based on this, a scratch-based learning media on regulatory system material is required. The development of scratch learning media in biology subjects has not been done much. A study by Arfiansyah et al. (2019) developed scratch learning media on optical device physics materials. Then Setiawan et al. (2021) developed scratch media in the mathematics subject of trigonometry. Then there is the development in chemistry subjects on chemical equilibrium material (Astriadi & Lazulva, 2021).

Thus, this study aims to develop scratch software-based learning media on regulatory system material and determine the learning media's validity, practicality, and effectiveness. The findings of this study are expected to result in the development of scratch software-based learning media on regulatory system material that is valid, practical, and effective in the teaching and learning process.

## **METHOD**

### **Research Design**

The method used in this study is a research and development method with the ADDIE model. The ADDIE model consists of five steps, namely: (1) Analysis, (2) Design, (3) Develop, (4) Implement, and (5) Evaluate (Branch, 2009).

### **Participants and Instruments**

The validation was followed by a learning media expert and a subject matter expert. Students in grade XI conducted the field tests at SMA Cerdas Murni Tembung. The research instruments used are a needs analysis in the form of teacher interview guides and questionnaires for students to collect data on the media used in learning. Then, validation sheets, consisting of media expert validation sheets and material expert validation sheets, are used to collect data about learning media reviews from validators. Furthermore, implementation instruments in the form of effectiveness sheets, namely pre-test and post-test, and practicality sheets, namely teacher and student response questionnaires used to collect responses on student understanding of the material and the attractiveness of the learning media. The measurement scale for each indicator on the validation sheet and student response is measured through a Likert scale with a score of 1-4.

### **Procedure**

This Scratch software-based interactive learning media was developed in five stages: Analysis, Design, Develop, Implement, and Evaluate. The analysis stage defines what students will learn by conducting a needs analysis and a curriculum or materials analysis. The design phase involves storyboarding, preparing materials, creating assessment instruments, and determining learning strategies. Then, the development stage begins with making interactive learning media based on scratch software, validity testing, and small-scale product trials before implementation by distributing teacher response questionnaires and student responses. The next stage is the large-scale implementation with field trials, effectiveness tests, and practicality tests. The fifth stage of the ADDIE development model is the evaluation stage. In this stage, an evaluation is carried out from

the beginning of the creation of interactive learning media based on Scratch software to the implementation stage.

### **Data Analysis Technique**

The research data was obtained in both qualitative and quantitative data. Qualitative data were obtained from interviews with teachers and critiques and suggestions from validators. Quantitative data was obtained through assessments using validation sheets, pre-test and post-test assessments, and student response questionnaires. The data obtained were then analysis and processed through qualitative and quantitative descriptive. Qualitative descriptive analysis is a method of interpreting or processing data that involves systematically compiling categories regarding a subject (objects, symptoms, or certain variables) in the form of sentences or words so that general conclusions can be drawn. In contrast, quantitative descriptive analysis is a method of processing data that involves systematically compiling numbers or percentages about an object under study in order to draw broad conclusions (Agung, 2012).

There are two data in this research, namely qualitative and quantitative data. Qualitative data were obtained from teacher interviews and suggestions and comments from the validator. Quantitative data were obtained through assessment using validation sheets, pre-test and post-test assessments, and student response questionnaires. The data obtained were then analysis and processed by qualitative and quantitative descriptive. Qualitative descriptive analysis interprets or processes data by systematically assembling sentence/word categories about a subject (objects, symptoms, specific variables) to reach general conclusions. Quantitative descriptive analysis, on the other hand, is a data processing method that systematically compiles numbers or percentages about the object under study in order to draw general conclusions (Agung, 2012).

Data analysis aims to obtain valid, practical, and effective scratch media. Validity analysis is based on the results of the validation sheets from media experts and material experts. Validation sheet data will be analysis for validity by:

$$\text{Percentage (\%)} = \frac{\text{score received}}{\text{maximum score}} \times 100\% \quad (1)$$

Learning media is considered valid if it has achieved more than 60% validity. Practicality analysis is conducted by analyzing data obtained from student response questionnaires. Learning media is considered practical if it has reached a reasonably practical level above 70.01%. An effectiveness analysis is obtained based on pre-test and post-test results. N-gain calculation is used to see whether the developed media effectively improves student learning outcomes.

## **RESULTS AND DISCUSSION**

Based on research on developing Scratch software-based interactive learning media on regulatory system material, the research results and discussion for each stage are as follows. The analysis stage was carried out in two stages, the needs analysis and the curriculum analysis. In the needs analysis stage, interviews with teachers and questionnaires were given to students in three different schools. The results of the



interview with the teacher explained that learning media are needed to support students' understanding of biology material, especially the material on the regulatory system. The interview results also found that the teacher had not fully developed interactive learning media. The teacher only used learning media in the form of PowerPoint slides. Based on the student needs questionnaire results, there is 100% student agreement that interactive learning media are necessary to deliver biology material, especially regulatory system material. Furthermore, 96.7% of students agree that information technology (IT)-based learning media like Scratch can help them learn and understand regulatory material.

Then, in curriculum analysis, the steps taken are observing the curriculum used, analysing core competencies, basic competencies, and developing indicators of competency achievement on regulatory system material. Furthermore, collecting regulatory system material that is in accordance with the core competencies and basic competencies in several student textbooks or relevant biology books. Then, determine the form of assessment and the type of test conducted to see student learning outcomes. The last is calculating the time allocation and preparing a lesson plan for the implementation stage.

The next stage is the product design, based on the needs analysis results. In this stage, the storyboard of interactive learning media based on Scratch software will be designed and developed according to the 2013 curriculum, namely, the design and development of learning media based on the suitability of core and basic competencies in the content standards of the 2013 curriculum in combination with textbooks and relevant biology books. After that, write and compile a draft of regulatory system materials using PowerPoint, which will be saved as a PNG file and used in the media development stage. Then, search for images related to the regulatory system materials and media backgrounds that will attract students' attention, create multiple-choice assessment instruments with ten questions on each regulatory system sub-material, and determine the learning strategy in the Learning Implementation Plan.

The media development stage begins with creating interactive learning media based on Scratch software, tailored to the designed storyboard and the compiled material. The results of this Scratch interactive learning media development are shown in Figure 1.





Figure 1. Media Development Results

After making interactive learning media based on scratch software is complete. Furthermore, the validation test was carried out by media experts, namely Mr. Widi Cahya Adi, M.Pd., and material experts, namely Mrs. Miza Nina Adlini, M.Pd. The results of media validation are presented in Table 1. The average assessment for appearance, presentation, and programming is above 87%, which means that Scratch software-based interactive learning media is very valid. There are several comments and suggestions from media experts, namely that the background needs to be changed to make it more attractive, the font of the text is too thick, the images on the media are of low quality, the buttons on the media are too large and unattractive, and the order of the buttons is not correct.

Table 1. Media validation results

| Aspects      | Percentage | Criteria   |
|--------------|------------|------------|
| Appearance   | 82.14 %    | Very Valid |
| Presentation | 86.11 %    | Very Valid |
| Programing   | 93.75 %    | Very Valid |
| Average      | 87.33 %    | Very Valid |

Then, the results of the material validation are presented in Table 2. The aspects assessed focus on material coverage, material accuracy, as well as recency and contextuality. From these aspects, an average rating of 87.50% is obtained, which is very valid. Material experts gave comments and suggestions, namely adding material to the brain that is still incomplete and correcting some of the spelling errors that still exist.

Table 2. Material Validation Results

| Aspects                   | Percentage | Criteria   |
|---------------------------|------------|------------|
| Material coverage         | 87.50 %    | Very Valid |
| Material accuracy         | 85.00 %    | Very Valid |
| Recency and contextuality | 90.00 %    | Very Valid |
| Average                   | 87.50 %    | Very Valid |

After the learning media are declared valid, a small-scale trial is conducted by distributing teacher response questionnaires and student responses. The results of the teacher response questionnaire are shown in Table 3. In terms of materials and media, it shows an average percentage result of 97.50%, which is very practical. At the same time, the results of the small-scale student response questionnaire obtained from introducing interactive learning media to five students received an average assessment of 93.25%, which means very practical.

**Table 3.** Results of the Teacher Response Questionnaire

| Aspects  | Percentage | Criteria       |
|----------|------------|----------------|
| Material | 97.50 %    | Very practical |
| Media    | 97.50 %    | Very practical |
| Average  | 97.50 %    | Very practical |

The implementation stage is carried out after conducting a small-scale trial. In the implementation stage, field trials are carried out by implementing interactive learning media based on scratch software in learning that has been adjusted to the steps in the Learning Implementation Plan. The results of the practicality and effectiveness tests will be obtained from the field trial. The practicality test was conducted by distributing student response questionnaires to 30 students. Questionnaires were distributed after the learning process using interactive learning media based on scratch software was completed. The results of the student response questionnaire in the field trial are presented in Table 4. The average assessment on the aspects of programming, appearance, and use benefits is 84.30%, meaning that scratch-based interactive learning media is quite practical.

**Table 4.** Results of Student Response Questionnaires in the Field Trial

| Aspects      | Percentage | Criteria        |
|--------------|------------|-----------------|
| Programming  | 82.08 %    | Quite practical |
| Appearance   | 85.48 %    | Very practical  |
| Use benefits | 85.33 %    | Very practical  |
| Average      | 84.30 %    | Quite practical |

Then, the effectiveness test results were conducted by instructing the students to work on pre-test questions before learning and post-test questions after learning with interactive learning media based on Scratch software. The results of the effectiveness test are shown in Table 5. The n-gain value of 0.84 is obtained, which means that the effectiveness test results are in the very high category. When expressed as a percentage, the n-gain effectiveness test results are 84%, which means that this Scratch software-based interactive learning media effectively improves students' learning outcomes.



**Table 5.** Pre-test and Post-test Results

| Data            | Score    |           |
|-----------------|----------|-----------|
|                 | Pre-test | Post-test |
| Sum of scores   | 2,216.68 | 2,880.03  |
| Average score   | 73.89    | 96.00     |
| N-gain          | 0,84     |           |
| Criteria n-gain | High     |           |

The final stage is evaluation. Several improvements are made to the Scratch software-based interactive learning media during the evaluation stage. Suggestions and input from validators, as well as teacher and student responses, are used to improve the Scratch software-based interactive media. Based on the needs analysis results in high schools, learning media can help students' understanding, especially in the regulatory system material. According to the research conducted by [Nugraha & Widiyaningrum \(2015\)](#) and [Martanti et al. \(2013\)](#), learning media based on scratch software can make it easier for students to understand the material provided by the teacher.

The results of the practicality test on a small scale derived from teacher and student responses showed that the media was very practical. Similarly, students' responses in the field trial received quite practical criteria, where students' suggestions and comments on the questionnaire showed that they were interested in this scratch interactive learning media. This is in line with the research of [Arfiansyah et al. \(2019\)](#), which shows that scratch learning media is enough to make students interested, as indicated by the number of students' comments on the questionnaire and the learning process, which shows students' interest. Not only that, based on the results of the research of [Chaerunnisa & Bernard \(2021\)](#), also shows that the interest of primary school students is in a strong category when learning mathematics using scratch media.

The effectiveness test results found that Scratch interactive learning media can improve student learning outcomes, so it is very effective to use in learning. This is consistent with the findings of [Permatasari et al. \(2018\)](#) that scratch media can improve learning outcomes, as indicated by the percentage of completeness of student learning outcomes that increases from cycle one to cycle two, and scratch media can also increase student motivation. In addition, other studies also show that there are differences in learning outcomes using scratch media with simple media, scratch media has a positive effect on learning outcomes because by using scratch media, students get higher scores ([Husna et al., 2019](#); [Ortiz-Colón & Romo, 2016](#)).

This Scratch software-based interactive learning media has several advantages, a combination of text, images, animation, and games. So that it can help students understand concepts well. Therefore, this Scratch software-based interactive learning media can improve students' learning outcomes. They are supported by the opinion of [Diyana et al. \(2020\)](#), which states that through a combination of components such as text, images, and integrated animation, the media is very appropriate to clarify abstract concepts to be more concrete. Then, the research conducted by [Korkmaz \(2016\)](#) states that scratch-based games increase students' academic achievement scores.

Based on the results of the validity, practicality, and effectiveness tests, the interactive learning media based on scratch software on the material of the regulatory system is declared to be valid, practical, and effective so that this learning media can be utilized by teachers in the learning process.

## CONCLUSION

The research aims to develop interactive learning media based on software scratch on the material of the regulatory system and to know the validity, practicality, and efficacy of the media. Based on the results and discussion, it can be concluded that the results of the validity test by media experts amounted to 87.33%. In comparison, the material expert amounted to 87.50%, which means very valid. Then, the teacher response practicality test results obtained a percentage of 97.50%, which is very practical. The practicality test of student responses on a small scale got a percentage of 93.25%, which means the media is very practical. In comparison, the results of student responses in the field trial got a percentage of 84.30%, which means the media is quite practical. As well as in the effectiveness test, it was found that the percentage of the n-gain value obtained was 84%, which means it was effective. So, this Scratch software-based interactive learning media on regulatory system material is valid, practical, and effective. However, this study still has limitations; this learning media requires additional use of Google Forms to collect results and evidence of students' pre-test and post-test work. In addition, this learning media is also limited to regulatory system material. Based on this, the development of interactive learning media based on scratch software can be done on other biological materials.

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