JPPG
Jurnal Pemikiran Pendidikan dan Keguruan
Vol. 1, No. 1, Bulan Juni, Tahun 2025, pp. 1-19
E-ISSN : XXXXXX | Email : https://terranovajournal.com/JPPG
Website: https://jurnal.kalimasadagroup.com/index.php/JPPG

DEVELOPMENT OF SKETCHFAB-BASED INTERACTIVE LEARNING MEDIA TO SUPPORT BIOLOGY LEARNING

Luhur Adi Prasetya[1*], Abdur Rahman Frima[2], Nabil Achmad Aufani[3]
[1]Master of Vocational Education, Postgraduate School, State University of Malang
[2]Master of Teacher of Arabic, Faculty of Letters, State University of Malang
[3]Master of Islamic Education Management, Postgraduate Program, UIN Maulana Malik Ibrahim
*Corresponding Author: luhur.adi.2305518@students.um.ac.id

Received: 2 April 2025 **Revised:** 28 April 2025 **Accepted:** 15 Mei 2025 **Published:** 2 Juni 2025 **DOI:**

ABSTRAK

Penelitian ini bertujuan mengembangkan media pembelajaran berbasis Sketchfab untuk mendukung pembelajaran Biologi di Madrasah Aliyah menggunakan model ADDIE (Analysis, Design, Development, Implementation, Evaluation). Subjek penelitian meliputi siswa kelas X, XI, dan XII di Madrasah Aliyah Unggulan Techno Scientist Malang, dengan validasi dilakukan oleh ahli materi dan ahli media. Hasil penelitian menunjukkan media ini sangat layak digunakan dengan skor rata-rata validasi ahli materi 3.75 dan ahli media 3.64 dari skala 4. Media ini efektif dalam meningkatkan pemahaman siswa, yang ditunjukkan melalui rata-rata peningkatan skor posttest sebesar 19.03%. Selain itu, tingkat kepuasan siswa terhadap media mencapai skor rata-rata 3.62, dengan aspek terbaik pada daya tarik visual dan kemudahan navigasi, sementara guru memberikan skor kepuasan rata-rata 3.57, terutama pada efektivitas media dalam membantu menjelaskan konsep Biologi yang kompleks. Media ini memiliki fitur navigasi sederhana, visual yang menarik, dan kuis interaktif yang mendukung pembelajaran mandiri, namun perlu penyederhanaan bahasa dan optimalisasi kompatibilitas untuk perangkat dengan spesifikasi rendah. Secara keseluruhan, media pembelajaran berbasis Sketchfab ini menjadi inovasi yang efektif dalam meningkatkan pemahaman dan motivasi belajar siswa.

Kata kunci*:* Pengembangan Media Pembelajaran, Sketchfab, Biologi, ADDIE, Pembelajaran Interaktif

ABSTRACT

This research aims to develop Sketchfab-based learning media to support Biology learning in Madrasah Aliyah using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The research subjects included X, XI, and XII grade students at Madrasah Aliyah Unggulan Techno Scientist Malang, with validation carried out by material experts and media experts. The results showed that this media is very feasible to use with an average score of 3.75 material expert validation and 3.64 media expert from a scale of 4. This media is effective in improving student understanding, which is shown through an average increase in posttest scores of 19.03%. In addition, students' satisfaction level with the media reached an average score of 3.62, with the best aspects on visual appeal and ease of navigation, while teachers gave an average satisfaction score of 3.57, especially on the effectiveness of the media in helping explain complex Biology concepts. This media features simple navigation, attractive visuals, and interactive quizzes that support independent learning, but needs language simplification and compatibility optimization for devices with low specifications. Overall, this Sketchfab-based learning media is an effective innovation in improving students' understanding and motivation to learn.

Keywords: *Learning Media Development, Sketchfab, Biology, ADDIE, Interactive Learning*

Copyright © 2025, Author
This is an open-access article under the CC BY 4.0

INTRODUCTION

Education in the 21st century faces great challenges in adapting teaching methods to technological developments and student needs. One of the main challenges in learning Biology is conveying abstract concepts such as cell structure, organ systems, and ecosystems, which are often difficult to visualize through conventional methods. Jiang et al. (2022) noted that lecture and textbook-based methods are less effective in providing in-depth learning experiences, especially for complex visual materials. Low student engagement in the Biology learning process has also been a global concern, as noted by Banihashem et al. (2022) who mentioned that students tend to be passive when learning media is not designed to actively engage them.

Various innovations have been implemented to address this challenge, including the use of digital technologies such as animated videos, computer simulations, and augmented reality (AR)-based applications (Prasetya et al., 2024). reported that 60% of students experienced improved understanding when using digital visualizations for Biology materials. In addition, three-dimensional (3D) based technologies have become a promising alternative to enhance the learning experience. Research by Arslan et al. (2020) and Hansen et al. (2020) showed that the use of AR and 3D printing technology not only makes learning more interesting, but also provides opportunities for students to explore the material from various perspectives. This is reinforced by the findings of Prasetya, Rofiudin, et al. (2025) who noted that interactive technologies allow students to learn independently at their own pace, providing the flexibility that is indispensable in 21st century learning.

Platforms such as Sketchfab become one of the widely recognized solutions in supporting 3D technology-based learning. Through Sketchfab, students can manipulate 3D models directly, such as rotating, zooming, or studying the details of the object structure from different angles. Abouhashem et al. (2021) mentioned that interactive learning based on this platform has been shown to improve student understanding in subjects that require visual analysis, such as Biology. However, while this technology has great potential, its implementation does not always go smoothly. Atabek (2019) identified that limited technological infrastructure and lack of training for teachers are major barriers to adopting these technologies, especially in developing countries. Therefore, a structured and theory-based development approach is necessary to maximize the benefits of learning technologies.

Madrasah Aliyah Unggulan Techno Scientist Malang, as an educational institution that has a vision of developing technology in learning, requires media that can answer these challenges (Prasetya, Aufani, et al., 2025). In the process of learning Biology, students need an approach that supports a deep understanding of the material while providing an interesting learning experience. This research aims to develop Sketchfab-based learning media that can visualize Biology material interactively and increase student involvement. The development of this media is expected to be a solution to the gap between complex learning needs and the availability of adequate learning media in schools (Prasetya, Widiyawati, et al., 2025).

The ADDIE model is a framework that has proven effective in developing learning media. Dede & Richards (2020) highlighted that the flexibility of this model allows revisions at each stage of development, so that the resulting media is more relevant to the needs of students and teachers. In the context of Biology learning, Teplá et al. (2022) and Aslan et al. (2024) found that the ADDIE approach not only helps to create engaging learning media, but is also able to meet the needs of students in understanding complex material. By utilizing the Sketchfab platform and the ADDIE approach, this research is expected to increase student engagement while creating a more immersive and effective learning experience. This designed learning media also has the potential to be adapted for other educational institutions that face similar challenges, especially in integrating modern technology in learning.

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

METHOD

Research Design

This study uses a research and development method with the ADDIE model, which includes five main stages: Analysis, Design, Development, Implementation, and Evaluation. (Branch, 2009). This model was chosen because it provides a systematic structure that allows developers to sequentially design, create, and evaluate the resulting learning media. The main advantage of the ADDIE model is its flexibility, where revisions can be made at each stage of the development process to ensure the quality of the resulting product is in accordance with the needs and objectives of the research. This allows researchers to identify and correct deficiencies from the beginning to the end of development, so that the final result is more effective, relevant and optimal in supporting learning. With this approach, the resulting product can be more assured of success in its use.

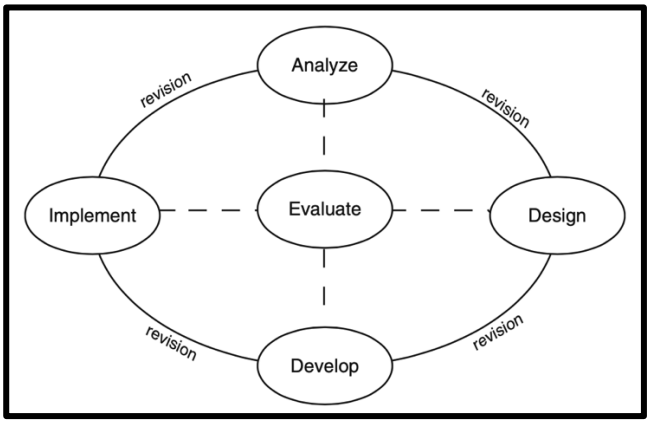


Figure 1. ADDIE Development Model
Source: Branch (2009)

Research Subject

The subjects in this study involved students from three grade levels at Madrasah Aliyah Unggulan Techno Scientist Malang, namely grades X, XI, and XII. In detail, class X consists of 18 students, class XI involves 21 students, and class XII as many as 8 students. The total number of student subjects is 47 people. The selection of subjects aims to get representation from various levels of education in testing the effectiveness of the developed learning media. In addition, this study involved two expert validators to ensure the validity of the products produced. The first expert validator is the Biology teacher of Madrasah Aliyah Unggulan Techno Scientist Malang who acts as a material expert. The second validator is a Malang State University lecturer who is an expert in the field of learning media development. Validation from these two experts aims to ensure that the product is in accordance with pedagogical and technical aspects.

Research Phase

This research was conducted systematically by following five stages, namely Analysis, Design, Development, Implementation, and Evaluation. The following is an explanation of each stage:

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

Analysis

The needs analysis stage aims to understand the learning needs in the Biology class of Madrasah Aliyah. The steps taken at this stage include:

a. Interview with Biology Teacher: Conducted to identify students' difficulties in understanding Biology materials as well as evaluate the shortcomings of the learning media currently used.
b. Learning Process Observation: Observations were conducted in the classroom to map the learning methods often used, student enthusiasm, and potential integration of 3D-based technologies such as Sketchfab.
c. Material and Media Suitability Analysis: The analysis was conducted to ensure that the selected materials are in line with the curriculum needs and are capable of being implemented in the form of Sketchfab-based interactive media.

Design

At this stage, the learning media design is organized to ensure its efficiency and effectiveness. This stage includes:

a. Selection of Learning Materials: The materials selected focus on complex topics in Biology that require in-depth visualization, such as cell anatomy or human organ systems.
b. 3D Model Creation: Relevant 3D objects were created using Sketchfab software to bring the visual experience to life.
c. Design of Navigation Features: Navigation features are designed to be easy for students to use, including interactive prompts, model animations, and text or audio explanations that help understand concepts.

Development

The development stage is the technical implementation of the previously developed design. Activities at this stage include:

a. 3D Model Creation: Interactive models were created and tested using the Sketchfab platform to ensure functionality as well as visual aesthetics.
b. Initial Function Testing: Testing is done to identify bugs or errors in the media, such as malfunctioning navigation or improper placement of elements.
c. Revision Based on Feedback: Revisions were made based on the results of the initial function testing as well as feedback from teachers and students at the initial trial stage.

Implementation

Implementation was carried out in two stages of testing to measure the effectiveness of the media, namely:

a. Small Group Trial: The media was tested on a subset of students from each class to see initial responses related to ease of use, visual design, and media appeal.
b. Large Group Trial: The media was tested on all students in classes X, XI, and XII. This trial was conducted to obtain more representative data regarding the effectiveness of the media in improving student understanding.

Evaluation

The evaluation stage aims to assess the quality of the media based on the results of the trial

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

and input from various parties. The evaluation was conducted using the following methods:

a. Expert Validation: Validation was conducted by material experts (Biology teachers) to assess the suitability of the material to the curriculum, and by media experts to assess the quality of the media design.
b. Pretest and Posttest: Used to measure the improvement of students' understanding before and after using the learning media.
c. Teacher and Student Satisfaction Questionnaire: Questionnaires were given to evaluate user satisfaction with the Sketchfab-based interactive learning media, covering aspects of design, ease of use, and learning effectiveness.

With this stage, the research is expected to be able to produce interactive learning media that is not only interesting but also effective in improving students' understanding of Biology material.

RESEARCH INSTRUMENTS

The instruments used in this research are designed to collect data comprehensively, including interviews, validation, testing, and evaluation of Sketchfab-based learning media. The following are the details of each instrument:

Teacher Interview Instrument

The interview instrument was used to explore learning needs and obtain initial input on materials relevant to interactive media. Interviews were conducted with a guide in the form of a list of questions that included:

Table 1. Interview Instrument Grid

Aspects Measured	Indicator	Question	Item Number	Answer Type
Obstacles in learning	- Students' difficulty in understanding abstract material	1. What Biology materials are often considered difficult by students?	1	Narrative
	- Limitations of existing learning media	2. What learning media is currently used, and is it adequate?	2	Narrative
	- Constraints on students using technology media	3. What are the main obstacles for students in utilizing technology-based media?	3	Narrative
Learning media needs	- Ideal media types	4. What kind of media do you think will help students understand the material better?	4	Narrative
	- Important features in learning media	5. What features do you think are important in learning media for Biology students?	5	Narrative
Assessment of the prototype	- Suitability of the material to the curriculum	6. Is the material in this media in accordance with the basic competencies of the Biology curriculum?	6	Narrative
	- Clarity of material presentation	7. Is the material in the media presented in an interesting and	7	Narrative

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

		easy-to-understand way?		
	- Media impact on student learning outcomes	8. How does this media affect students' understanding of the material?	8	Narrative
	- Potential for further media development	9. What are your suggestions for further development of this media?	9	Narrative

Material Expert Validation Instrument

The material expert validation instrument was designed to evaluate the suitability of media content with the Biology curriculum. Validation was conducted by an experienced Biology teacher with assessment aspects including:

Table 2: Material Expert Validation Instrument

Assessed Aspect	Indicator	Statement/Task	Item Number	Answer Scale
Material Suitability	- Materials in accordance with the curriculum	1. The material presented is relevant to the applicable basic competencies.	1	Likert 1-4
	- The material is appropriate for the student's ability level	2. The material in the media is in accordance with the ability level of students (class X, XI, XII).	2	Likert 1-4
Clarity of Material	- The material is presented coherently	3. The presentation of the material is systematic and logical.	3	Likert 1-4
	- The language used is simple and easy to understand	4. The language in the media is appropriate for students' abilities.	4	Likert 1-4
Completeness of Material	- All related topics are covered in detail	5. Materials cover all important aspects of the topic being taught.	5	Likert 1-4
	- No concept error	6. No errors were found in the explanation of material concepts.	6	Likert 1-4
Material Benefits	- Material supports learning outcomes	7. Materials in the media help students achieve targeted learning competencies.	7	Likert 1-4
	- Materials improve student understanding	8. Presentation of material can improve students' understanding of the topic taught.	8	Likert 1-4

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

Media Expert Validation Instrument

Media expert validation was conducted by a lecturer who is experienced in the field of learning media development. The aim was to assess the technical and design aspects of the media. The assessed aspects include:

Table 3: Media Expert Validation Instrument

Assessed Aspect	Indicator	Statement/Task	Item Number	Answer Scale
Visual Design	- Attractive and appropriate display	1. The media display is attractive and appropriate to the learning context.	1	Likert 1-4
	- Proportional layout of visual elements	2. The layout of text, images, and other elements is proportional and comfortable to look at.	2	Likert 1-4
	- Color selection supports learning	3. The color combination in the media supports readability and visual appeal.	3	Likert 1-4
Media Interactivity	- Media has interactive features	4. The media allows students to interact directly with the content presented.	4	Likert 1-4
	- Interaction improves understanding	5. Interactive features in the media help students understand the material better.	5	Likert 1-4
Ease of Navigation	- Instructions for use are clear	6. The media usage guide is clear and easy to understand.	6	Likert 1-4
	- Navigation between sections is simple and effective	7. Navigation between sections in the media is easy to follow.	7	Likert 1-4
Media Function	- Media can be accessed without constraints	8. The media functions properly without technical glitches.	8	Likert 1-4
	- Media can be used on different devices	9. Media is compatible with various devices (laptops, tablets, etc.).	9	Likert 1-4
Appropriateness to Learning Objectives	- Media supports learning objectives	10. This media is in accordance with the expected Biology learning objectives.	10	Likert 1-4
Visual and Audio Effects	- Audio is clear and relevant	11. Audio in the media supports the delivery of material and is easy to understand.	11	Likert 1-4
	- Comfortable visual transitions	12. Animations or visual transitions are not distracting and support the learning flow.	12	Likert 1-4

Pretest and Posttest Instruments

Pretest and posttest are used to measure the level of student understanding of the material before and after using the learning media. The test questions are prepared based on the learning indicators on the selected material. The items for the preparation of this instrument include:

Table 4. Pretest and Posttest Instruments

Basic Competencies	Indicator	Question Item	Item Number	Answer Type

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

Understand cell structure	- Students can identify the parts of the cell	1. Name the main parts of a plant cell and their functions!	1	Short fill-in-the-blank
	- Students can distinguish cell organelles	2. What is the difference between chloroplasts and mitochondria?	2	Short fill-in-the-blank
Understand the human organ system	- Students understand the human respiratory system	3. Describe the flow of human breathing from the nose to the lungs!	3	Essay
	- Students understand the concept of gas exchange	4. What happens to the alveolus during breathing?	4	Short fill-in-the-blank

Student Test Instrument

This instrument is used at the implementation stage to measure student responses to learning media in small and large groups. The following is the student trial instrument:

Table 5. Student Trial Instrument

Aspects Measured	Indicator	Statement	Item Number	Answer Scale
Media Effectiveness	The material helps with understanding	This media helps me understand difficult material.	1	Likert 1-4
	Media supports learning achievement	This media helps me achieve the learning objectives.	2	Likert 1-4
Media Appeal	Attractive visual display	The media display is attractive and in accordance with the material.	3	Likert 1-4
	Interactive experience	It provides an interactive learning experience.	4	Likert 1-4
Ease of Media Use	Easy to understand navigation	The media is easy to use and navigate.	5	Likert 1-4
	Media is not confusing	I don't feel confused when using this media.	6	Likert 1-4
Learning Motivation	Increase learning motivation	This media increases my motivation to learn.	7	Likert 1-4
	Media encourages further exploration	This media makes me want to learn more.	8	Likert 1-4

Teacher and Student Satisfaction Questionnaire Instrument

This questionnaire aims to evaluate the level of teacher and student satisfaction with the developed learning media. The aspects assessed include:

Table 6: Teacher and Student Satisfaction Questionnaire Instrument

Aspects Measured	Indicator	Statement/Task	Item Number	Answer Scale
Ease of Media Use	- Easy to use media	1. This learning media is easy to use with no technical barriers.	1	Likert 1-4
	- Navigation in the	2. Navigation in the media is	2	Likert 1-4

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

	media is simple and clear	easy to understand and follow.		
	- The user guide helps to understand the media	3. The guidelines for using this media are clear and easy to follow.	3	Likert 1-4
Media Effectiveness	- Media supports the achievement of learning objectives	4. This media helps students achieve targeted learning competencies.	4	Likert 1-4
	- Media clarifies difficult concepts	5. This media helps explain Biology concepts that are difficult to understand.	5	Likert 1-4
	- Media improves student learning outcomes	6. The use of this media helps students improve learning outcomes.	6	Likert 1-4
Visual Media Design	- Attractive and relevant display	7. The visual display in this media is interesting and relevant to the material.	7	Likert 1-4
	- The color combination is pleasing to the eye	8. The color combination in this media is comfortable to look at and supports learning.	8	Likert 1-4
	- Animation/visual effects support learning	9. Animations and visual effects in the media help in understanding the material.	9	Likert 1-4
Media Interactivity	- Media enables active student interaction	10. This media provides opportunities for students to actively interact with the material.	10	Likert 1-4
	- Interactivity increases learning motivation	11. Interactivity in the media makes learning more interesting.	11	Likert 1-4
Benefits of Media in Learning	- Media helps improve understanding of the material	12. This media helps students understand Biology material better.	12	Likert 1-4
	- Media expands the learning experience	13. This media provides a different and interesting learning experience.	13	Likert 1-4
Overall Satisfaction	- Teachers/students are satisfied with the media used	14. I am satisfied with this learning media overall.	14	Likert 1-4

Likert Scale

All instruments that produce quantitative data, such as expert validation, satisfaction questionnaires, and student trials, use a Likert scale. (Sugiyono, 2017). This scale has four levels of answers, namely:

Table 7. Likert Scale

No.	Score	Description
1	4	Strongly Agree
2	3	Agree
3	2	Disagree
4	1	Strongly Disagree

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

DATA ANALYSIS TECHNIQUE

Data analysis in this study was conducted to measure the effectiveness, quality, and level of satisfaction with Sketchfab-based learning media. (Akbar, 2013). The following is an explanation of the analysis method used:

Expert Validation Analysis

Expert validation analysis is carried out to assess the feasibility of media based on input from material experts and media experts. The formula used to analyze the validation results is as follows:

Formula:

$$R = \frac{\sum X}{N}$$

Description:
$\boldsymbol{R}$: Average validation score
$\sum \boldsymbol{X}$: Number of scores given by the expert
$\boldsymbol{N}$: Number of statement items

Pretest and Posttest Analysis

This analysis aims to determine the increase in student understanding after using learning media. The formula used is as follows:

Formula:

$$\text{Increase} = \frac{\text{Posttest} - \text{Pretest}}{\text{Pretest}} \times 100\%$$

Description:
Posttest: Average posttest score
Pretest: Average pretest score

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

Satisfaction Questionnaire Analysis

Satisfaction questionnaires are used to evaluate teacher and student perceptions of learning media. The formula used to analyze the questionnaire data is:

Formula:

$$R = \frac{\sum X}{N}$$

Description:
$\boldsymbol{R}$: Average validation score
$\sum \boldsymbol{X}$: Number of scores given by the expert
$\boldsymbol{N}$: Number of statement items

Satisfaction Percentage Analysis

The percentage of satisfaction is used to describe the level of satisfaction quantitatively. The formula used to calculate the percentage of satisfaction is:

Formula:

$$P = \frac{\text{Actual Score}}{\text{Maximum Score}} \times 100\%$$

Description:
$\boldsymbol{P}$: Satisfaction percentage
$\boldsymbol{Skor\ Aktual}$: Number of scores obtained from respondents
$\boldsymbol{Skor\ Maksimal}$: Maximum number of scores that can be obtained

Media Validity Criteria

Sketchfab-based learning media is validated based on indicators that have been compiled previously. The following is a table of Validity criteria according to Akbar (2013):

Table 8. Media Validity Criteria

No.	Percentage	Category
1	80% - 100%	Very valid (suitable for use without revision)
2	60% - 79%	Valid (suitable for use with minor revisions)
3	40% - 59%	Fairly valid (needs major revision)
4	<40%	Invalid (not suitable for use)

RESULTS AND DISCUSSION

RESULTS

Media Development Results

The Sketchfab-based learning media developed is designed to support interactive learning of Biology in Madrasah Aliyah. The following are the main characteristics of the media that have been produced:

1. Material Content

This media presents complex Biology material in the form of interactive 3D visualization. Some of the main topics that are the focus of development include:

a. Cell Structure: The 3D model displays various cell organelles such as the nucleus, mitochondria, and endoplasmic reticulum. Each organelle comes with a description of its function that appears when clicked by the user.



Figure 2. 3D Model of Cell Structure

b. Human Organ System: Features models of organs such as the heart, lungs, kidneys and brain. Models can be rotated to show in-depth anatomical details.

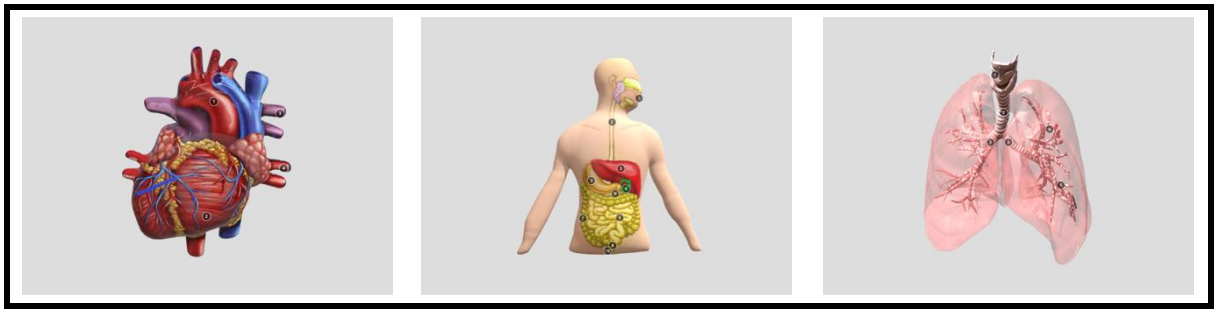


Figure 3. 3D Model of Human Organ Structure

2. Navigation

The navigation features in this media are designed to make it easier for users, especially students, to explore the 3D model. Navigation features include:

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

a. Model Rotation: Students can rotate the model to view it from different angles.

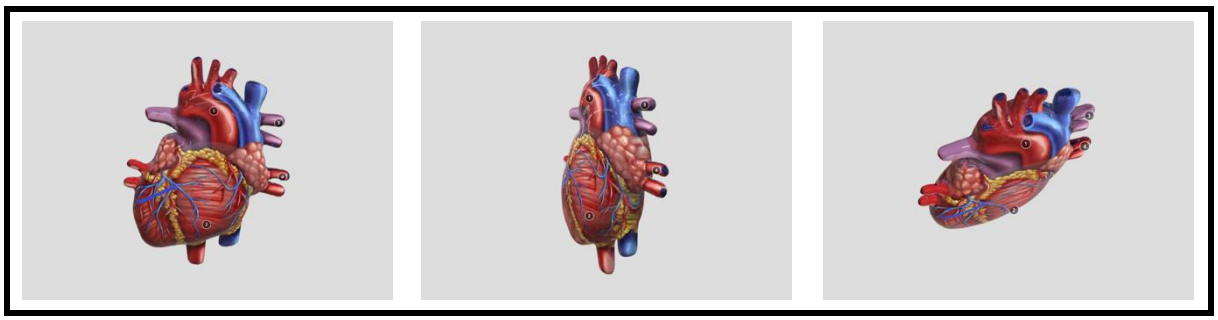


Figure 4. 3D Model Rotation Feature

b. Zoom In and Zoom Out: Allows users to zoom in and out on model details as needed.



Figure 5. Zoom in and Zoom Out Feature of 3D Model

c. Simple Interface: The navigation menu uses intuitive icons so that students can easily access the various features without specialized training.

3. Visual Design

Media design considers aesthetically appealing elements without losing focus on the learning content. Some characteristics of visual design are:

a. High Graphic Quality: 3D models are designed with high resolution so that visual details are clearly visible, enhancing students' learning experience.

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

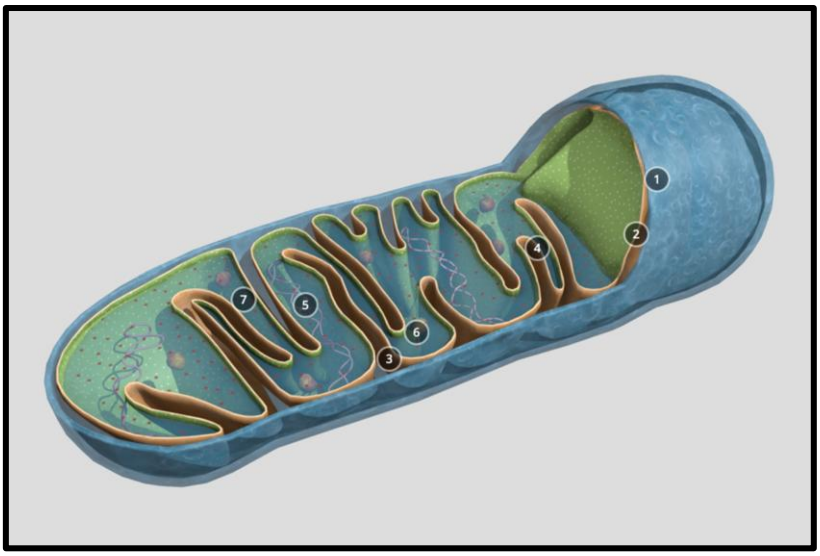


Figure 6. Image Quality of 3D Model

b. Clear Typography: Text descriptions use easy-to-read fonts to ensure students have no trouble understanding the material.

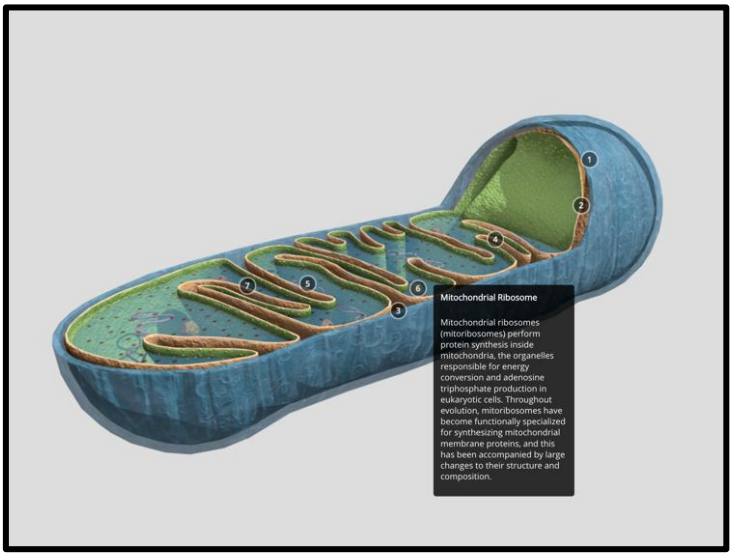


Figure 6. Typography Feature on 3D Model

4. Compatibility

This media can be accessed through various devices, providing flexibility for students to learn anytime and anywhere. Compatibility specifications include:

a. Platform: Accessible via browser on laptops, tablets, and smartphones.
b. Operating System: Supports popular operating systems such as Windows, MacOS, Android, and iOS.
c. Performance on Low Devices: Although the media has been optimized, there are still performance challenges on low-spec devices, especially in loading large 3D models.

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

Media Validation

1. Material Expert Validation

The results of the validation by the Material Expert showed that the Sketchfab-based learning media met the criteria for material feasibility. The best aspect is the relevance of the material to the basic competencies, while input is given to simplify the language in some parts to make it easier for students to understand.

Table 9. Material Expert Validation Results

Assessed Aspect	Score
Relevance of material to KD	4.00
Ability level suitability	3.50
Systematic presentation	3.50
Supports learning	4.00
Average	3.75

2. Media Expert Validation

The results of validation by media experts showed that this media has an attractive visual design, easy-to-understand navigation, and good compatibility. However, media experts provided input to optimize media performance on devices with low specifications. The average media expert validation score was 3.64 out of a scale of 4.

Table 10. Media Expert Validation

Assessed Aspect	Score
Attractive visual display	4.00
Easy to follow navigation	3.50
Device compatibility	3.50
Average	3.64

Media Trial Results

1. Small Group Trial

In the small group trial, 9 students from classes X, XI, and XII were involved. The questionnaire results showed that students gave an average score of 3.70 for the media effectiveness aspect, 3.60 for visual appeal, and 3.65 for ease of use. Students stated that the media navigation was simple and the material presented helped them understand abstract Biology concepts.

Table 11. Small Group Trial Results

Aspects	Score
Effectiveness	3.70
Visual Appeal	3.60
Ease of Use	3.65

2. Big Group Trial

In the large group trial, all students in grades X, XI, and XII were involved. The questionnaire results showed that:

a. Grade X: The average student satisfaction was 3.61, with the highest score on visual appeal.
b. Grade XI: The average student satisfaction was 3.59, with the highest score on ease of navigation.
c. Class XII: The average student satisfaction is 3.67, indicating high learning motivation.

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

Table 12. Large Group Trial

Class	Effectiveness	Visual Appeal	Ease of Use	Average Satisfaction
Class X	3.60	3.70	3.55	3.61
Class XI	3.65	3.55	3.60	3.59
Class XII	3.70	3.60	3.70	3.67

These results show that Sketchfab-based learning media is very well received by students at all grade levels.

Pretest and Posttest Results

The pretest and posttest results showed an increase in student understanding in all classes after using Sketchfab-based learning media.

Table 13. Pretest and Posttest Results

Class	Pretest	Posttest	Increase (%)
Class X	3.10	3.70	19.35
Class XI	3.00	3.60	20.00
Class XII	3.20	3.80	18.75

These results show that the media is effective in improving students' understanding of Biology material.

Satisfaction Questionnaire Results

1. Teacher Satisfaction

Teachers gave an average score of 3.57 out of a scale of 4 on all aspects, mainly stating that this media is very helpful in explaining complex material. The teacher also suggested that the media navigation be simplified.

Table 14. Teacher Satisfaction Questionnaire Results

Aspects	Average Score
Ease of Use	3.50
Media Effectiveness	3.70
Visual Design	3.50
Overall Average	3.57

2. Student Satisfaction

The average student satisfaction is as follows:

a. Media Effectiveness: 3.70, indicating that the media really helps students understand the material.
b. Visual Appeal: 3.65, indicating that the media visuals are attractive and relevant.
c. Ease of Use: 3.63, with students stating that the media navigation is easy to use.

Table 15. Student Satisfaction Questionnaire Results

Aspects	Class X	Class XI	Class XII	Overall Average
Media Effectiveness	3.60	3.65	3.70	3.65
Visual Appeal	3.70	3.55	3.60	3.62
Ease of Use	3.55	3.60	3.70	3.62

DISCUSSION

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

The results of this study show that Sketchfab-based learning media has a significant positive impact on students' understanding and motivation to learn. The use of three-dimensional (3D) visual-based technology provided by Sketchfab allows students to understand complex and abstract Biology concepts more easily. Material and media expert validation showed that this media has met the eligibility criteria, both in terms of content and design. Material experts assessed that the content presented was in accordance with the curriculum and was able to explain Biology concepts appropriately. This validation is supported by previous studies showing that the use of 3D technology-based media can improve the quality of learning materials by making it easier to convey difficult concepts (Sarker et al., 2019). Meanwhile, media experts gave a positive assessment of the interactivity, interface design, and ease of navigation aspects of this learning media, in line with the results of a study by W. Ahmed et al. (2022) who stated that attractive visual and interface design can increase student engagement in the learning process.

The measurement results through pretest and posttest also showed a significant increase in student understanding in all classes that were the subject of the study. The average increase in understanding of 19.03% reflects the effectiveness of the media in helping students master the material taught. This finding supports the argument put forward by Ahmed & Odewumi (2020) that visual-based learning has the potential to improve the understanding of abstract and complex concepts through the incorporation of text and visual animation. In addition, El Hammoumi et al. (2022) also showed that 3D representation-based learning media can increase student understanding by 22%, especially for material that requires spatial explanation. With Sketchfab-based media, students can explore Biology concepts interactively and independently, as reported by Arifin et al. (2021)that interactive technology can strengthen students' independent learning.

In addition, the results of the student satisfaction questionnaire showed a very positive response to this learning media. Most students stated that this media is interesting, interactive and easy to use with a percentage of 18%. They feel more motivated to learn because this media presents a different learning experience from conventional learning. This is in line with the findings by Negoescu & Mitrulescu (2023) who stated that technological innovation in learning increases student motivation. Teachers also gave similar responses. They appreciate the ability of this media to explain concepts that are considered difficult, such as the mechanism of photosynthesis or the life cycle of organisms and can increase participation in learning by 25%. Study by Ha & Im (2020) showed that interactive visual technology helps teachers reduce difficulties in explaining abstract topics. Teachers also considered that this media can increase student participation in the teaching and learning process, as confirmed by Balalle (2024)that interactive technology can increase participation in learning.

However, although the results showed significant success, there are some inputs that need to be considered for future media development. One of the inputs was the need for language simplification in some parts of the material. This problem was also identified by Suwondo & Syaifullah (2021) who mentioned that simplifying language in learning media can increase student understanding by 12%. In addition, media compatibility with low-specification devices is also a challenge. Some students experienced technical problems, such as long loading times or 3D models that could not be loaded perfectly. This is in line with research by Salam et al. (2023)(2023), which showed that technical constraints can reduce the effectiveness of learning media by up to 15%. Therefore, developers are advised to optimize the media so that it can be accessed properly on various types of devices, including devices with minimal specifications. Study by Bercaru & Popescu (2024) also emphasizes the importance of software optimization to improve accessibility across multiple platforms.

These improvements are important to ensure that Sketchfab-based learning media can be widely used by all users, without being constrained by technical or language factors. Thus, this media is expected to continue to make a positive contribution in improving the quality of Biology learning in Madrasah Aliyah and other educational institutions. As an additional reference, Hare et al. (2024) mentioned that technology integration in education should be balanced with iterative testing to identify user needs and barriers. This ensures that learning media can achieve optimal quality standards and provide maximum benefits to its users.

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

CONCLUSION

The Sketchfab-based learning media developed was declared very feasible to use based on the validation of material experts with an average score of 3.75 and media experts with an average score of 3.64. This media is effective in improving students' understanding of Biology material, with an average increase in posttest scores of 19.03%, which shows a positive contribution to learning. Positive responses were also obtained from teachers with an average satisfaction score of 3.57, and from students with an average score of 3.62, especially in the aspects of visual appeal and ease of use. This media is equipped with simple navigation, attractive visual displays, and interactive quizzes that support independent learning, thus motivating students to learn. However, simplification of material language and optimization of performance on devices with low specifications need to be considered for further development. Overall, this media can be an innovative alternative in learning Biology to help students understand abstract material and increase learning motivation in the digital era.

REFERENCE

Abouhashem, A., Abdou, R. M., Bhadra, J., Santhosh, M., Ahmad, Z., & Al-Thani, N. J. (2021). A Distinctive Method of Online Interactive Learning in STEM Education. *Sustainability*, *13*(24), 13909. https://doi.org/10.3390/su132413909

Ahmed, M. A., & Odewumi, M. O. (2020). Impact of Visual Learning Devices on Secondary School Biology Students' Academic Performance in Ilorin, Nigeria. *Indonesian Journal of Science and Education*, *4*(2), 83. https://doi.org/10.31002/ijose.v4i2.2722

Ahmed, W., Parveen, Q., & Dahar, M. A. (2022). Analysis of User Interface Design and Technological Aspects of Learning Management System. *Global Educational Studies Review*, *VII*(IV), 40–48. https://doi.org/10.31703/gesr.2022(VII-IV).04

Akbar, S. (2013). *Instrumen Perangkat Pembelajaran* (A. Holid, Ed.; Cet. 2). Remaja Rosdakarya.

Arifin, Z., Tegeh, I. M., & Yuda Sukmana, A. I. W. I. (2021). Independent Learning through Interactive Multimedia Based on Problem Based Learning. *Jurnal Edutech Undiksha*, *9*(2), 244. https://doi.org/10.23887/jeu.v9i2.41292

Arslan, R., Kofoğlu, M., & Dargut, C. (2020). Development of Augmented Reality Application for Biology Education. *Turkish Journal of Science Education*, *17*(1), 62–72. https://doi.org/10.36681/tused.2020.13

Aslan, A., Avcı, S. G., & Gökçü, M. Ş. (2024). *Using 3-dimensional Models as Teaching Tools in Science Education for Elementary School Students*. https://doi.org/10.21203/rs.3.rs-3934766/v1

Atabek, O. (2019). CHALLENGES IN INTEGRATING TECHNOLOGY INTO EDUCATION. *Turkish Studies - Information Technologies and Applied Sciences*, *14*(ITAS Volume 14 Issue 1), 1–19. https://doi.org/10.7827/TurkishStudies.14810

Balalle, H. (2024). Exploring student engagement in technology-based education in relation to gamification, online/distance learning, and other factors: A systematic literature review. *Social Sciences & Humanities Open*, *9*, 100870. https://doi.org/10.1016/j.ssaho.2024.100870

Banihashem, S. K., Noroozi, O., van Ginkel, S., Macfadyen, L. P., & Biemans, H. J. A. (2022). A systematic review of the role of learning analytics in enhancing feedback practices in higher education. *Educational Research Review*, *37*, 100489. https://doi.org/10.1016/j.edurev.2022.100489

Bercaru, V., & Popescu, N. (2024). A Systematic Review of Accessibility Techniques for Online Platforms: Current Trends and Challenges. *Applied Sciences*, *14*(22), 10337. https://doi.org/10.3390/app142210337

Branch, R. M. (2009). *Instructional Design: The ADDIE Approach* (1st ed.). https://doi.org/https://doi.org/10.1007/978-0-387-09506-6

Dede, C. J., & Richards, J. (2020). *The 60-Year Curriculum* (C. J. Dede & J. Richards, Eds.). Routledge. https://doi.org/10.4324/9781003013617

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…

El Hammoumi, S., Zerhane, R., & Janati Idrissi, R. (2022). The impact of using interactive animation in biology education at Moroccan Universities and students' attitudes towards animation and ICT in general. *Social Sciences & Humanities Open*, *6*(1), 100293. https://doi.org/10.1016/j.ssaho.2022.100293

Ha, Y., & Im, H. (2020). The Role of an Interactive Visual Learning Tool and Its Personalizability in Online Learning: Flow Experience. *Online Learning*, *24*(1). https://doi.org/10.24059/olj.v24i1.1620

Hansen, A. K., Langdon, T. R., Mendrin, L. W., Peters, K., Ramos, J., & Lent, D. D. (2020). Exploring the Potential of 3D-printing in Biological Education: A Review of the Literature. *Integrative and Comparative Biology*, *60*(4), 896–905. https://doi.org/10.1093/icb/icaa100

Hare, R., Ferguson, S., & Tang, Y. (2024). Enhancing student experience and learning with iterative design in an intelligent educational game. *British Journal of Educational Technology*. https://doi.org/10.1111/bjet.13526

Jiang, S., Tatar, C., Huang, X., Sung, S. H., & Xie, C. (2022). Augmented Reality in Science Laboratories: Investigating High School Students' Navigation Patterns and Their Effects on Learning Performance. *Journal of Educational Computing Research*, *60*(3), 777–803. https://doi.org/10.1177/07356331211038764

Negoescu, A. G., & Mitrulescu, C. M. (2023). Using Technology to Increase Students' Motivation for Learning a Foreign Language. *International Conference KNOWLEDGE-BASED ORGANIZATION*, *29*(2), 210–214. https://doi.org/10.2478/kbo-2023-0059

Prasetya, L. A., Aufani, N. A., & Frima, A. R. (2025). Role of Environment and Information in Student's Decision to Choose Vocational Education. *SETYAKI : Jurnal Studi Keagamaan Islam*, *3*(1), 43–57. https://doi.org/10.59966/setyaki.v3i1.1629

Prasetya, L. A., Herwanto, H. W., & Yoto, Y. (2024). Development of Learning Modules for Electric Power Plant Machinery for Class XI Phase F of Electric Power Plant Engineering Expertise Program in Vocational Schools. *IJECA (International Journal of Education and Curriculum Application)*, *7*(3), 279. https://doi.org/10.31764/ijeca.v7i3.26218

Prasetya, L. A., Rofiudin, A., & Herwanto, H. W. (2025). Implementation of Internet of Things (IoT) in Education: A Systematic Literature Review. *Journal of Education and Computer Applications*, *2*(1), 1–45. https://doi.org/10.69693/jeca.v2i1.19

Prasetya, L. A., Widiyawati, I., Rofiudin, A., Haq, S. T. N., Hendranawan, R. S., Permataningtyas, A., & Ichwanto, M. A. (2025). The use of CLO3D application in vocational school fashion expertise program: Innovations, challenges and recommendations. *Journal of Research in Instructional*, *5*(1), 287–299. https://doi.org/10.30862/jri.v5i1.550

Salam, U., Wahdini, W., Surmiyati, S., Rezeki, Y. S., Riyanti, D., & Suthathothon, P. (2023). Teachers' challenges and strategies in using digital media in teaching English. *Journal of English Language Teaching Innovations and Materials (Jeltim)*, *5*(1), 49. https://doi.org/10.26418/jeltim.v5i1.63204

Sarker, M. N. I., Wu, M., Cao, Q., Alam, G. M., & Li, D. (2019). Leveraging Digital Technology for Better Learning and Education: A Systematic Literature Review. *International Journal of Information and Education Technology*, *9*(7), 453–461. https://doi.org/10.18178/ijiet.2019.9.7.1246

Sugiyono. (2017). *Metode Penelitian dan Pengembangan untuk Bidang Pendidikan, Manajemen, Sosial, Teknik : Research and Development / R&D / Prof. Dr. Sugiyono* (Cet. 3). Alfabeta.

Suwondo, S., & Syaifullah, S. (2021). Do Simplified Text Can Improve Students' Reading Comprehension in Narrative Text?: A Classroom Action Research Perspective. *Utamax : Journal of Ultimate Research and Trends in Education*, *1*(3), 125–129. https://doi.org/10.31849/utamax.v1i3.5945

Teplá, M., Teplý, P., & Šmejkal, P. (2022). Influence of 3D models and animations on students in natural subjects. *International Journal of STEM Education*, *9*(1), 65. https://doi.org/10.1186/s40594-022-00382-8

Copyright © 2025, *Luhur Adi Prasetya, et.al.*, DEVELOPMENT OF SKETCHFAB…