

Multimedia Development Based on The *Assemblr* EDU Application in Human Reproductive System Material for Grade XI High School Students

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ABSTRACT

Based on an analysis of potential and problems involving 90 students in class XII in 3 top high schools in Blitar city/regency in 2023, the specific learning styles were 31,1% kinesthetic, 7,8% auditory, and 58,9% audiovisual. Data states that 64.4% of students find the material on the human reproductive system difficult to understand. Based on interviews with 3 biology teachers, it was revealed that preparing differentiated learning media is time-consuming. Teachers still predominantly use PPT-based media. The design of the multimedia, based on the *Assemblr* EDU application, is informed by data indicating that 93.3% of students favor multimedia-based learning. The objective of this Research and Development (R&D) is to develop and assess the feasibility of a multimedia platform based on the *Assemblr* EDU application as a teaching medium for material on the human reproductive system for grade XI high school students. This study research utilizes the R&D method, the research design following Sugiyono's development model, limited to 7 stages with a quantitative descriptive approach. The feasibility test, validated by material, language, and media experts, yielded scores of 92.5%, 90.6%, and 89.23%, respectively, all falling within the "Very Feasible" criteria. Additionally, the feasibility test, conducted through limited trials with teachers and students, yielded scores of 87.3% and 93.2% under the "Very Feasible" criterion. Thus, the developed *Assemblr* EDU application-based multimedia material on the human reproductive system for grade XI High School Students is considered suitable for learning activities.

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Keywords: Multimedia, *Assemblr* EDU, Human Reproductive System

Introduction

The core of current curriculum development in Indonesia is the educational principle of fully focusing on student-centered learning, as articulated in the “Merdeka Belajar” (Freedom to Learn) policy. This framework allows students to select subjects that align with their personal interests and aptitudes, fostering a supportive learning environment free from the rigid burden of standardized grading. Schools have the authority to develop curricula tailored to their specific characteristics and institutional needs. Under this policy, educational institutions are granted the autonomy to develop [\(Cholilah et al., 2023\)](#).

The Merdeka Curriculum mandates that schools design unique teaching units while emphasizing the teacher’s role in implementing differentiated learning. However, educational institutions still struggle to create instructional strategies that fully meet the diverse needs of their students [\(Gusteti & Neviyarni, 2022\)](#). Consequently, there is an urgent need to develop teaching media that account for the different abilities and uniqueness of each individual, ensuring optimal learning outcomes for students with varying abilities.

At the secondary level, biology is one of the key scientific disciplines used to cultivate students’ potential. As a science, biology encompasses a broad range of subjects, deeply integrated with everyday life. Biology encompasses more than just theory; it also involves more than rote memorization and requires an understanding of real-world concepts through discovery-based processes. Therefore, instructional delivery of subject matter must actively engage students in identifying and solving problems through scientific methods [\(Syahdiani et al., 2017\)](#).

Based on interviews with biology teachers at 3 leading high schools in Blitar city/regency (Ministry of Education and Culture, 2022), region – SMAN 1 Kota Blitar, SMAN 4 Kota Blitar dan SMAN 1 Talun, it was revealed that the human reproductive system is still perceived as a taboo topic by many students. Variations in student backgrounds and characteristics significantly influence their classroom responses. Teachers noted a gender-based disparity in Engagement: female students often appear hesitant or shy when discussing the material, whereas male students tend to be more enthusiastic. In practice, educators must exercise extreme caution and sensitivity when delivering this particular subject matter.

The significant difficulty students face in understanding the material is evidenced by a needs assessment questionnaire conducted with 90 Grade XII high school students. The results indicated that 64.4% of students find the human reproductive system a challenging topic in biology. Specifically, the menstrual cycle sub-topic is identified as particularly difficult. In practice, female students often struggle and feel confused when interpreting fertility calendars, while many male students find the material hard to grasp as they do not personally experience menstruation. This gap highlights that the current understanding of the material remains sub-optimal.

In practice, the implementation of learning activities is inseparable from the use of media and teaching materials. The media plays a crucial role in achieving educational objectives and desired outcomes. Various media types exist to assist teachers in delivering instructional content, generally categorized as text, images, audio, video, and audiovisual formats. Multimedia, as an integration of these various forms, can effectively convey knowledge, skills, and attitudes. It stimulates students’ emotions, attention, and engagement, allowing the learning process to occur naturally, in a directed and controlled manner [\(Kartikasari, 2016\)](#).

Based on an initial study conducted in 2023 via *Google Forms* involving 90 Grade XII students across three leading high schools in the Blitar region, 97.8% of students preferred learning processes that incorporate instructional media, with 76.7% specifically favoring digital media. Student learning styles were identified as follows: 58.9% audiovisual, 31.1% kinesthetic, and 7.8% auditory. These findings are further supported by data showing that 93.3% of students enjoy multimedia-based learning, though only 72.2% had previously

experienced it in the classroom. Given this analysis, developing multimedia that aligns with differentiated learning styles is essential for biology education at the high school level.

The implementation of multimedia as a support for biology learning and as an alternative to support differentiated learning is expected to address the demands of the Merdeka Curriculum and meet the diverse learning needs of students. Based on the identified challenges, multimedia, including text, images, and audiovisuals, is expected to foster student interest and enhance understanding. One *platform* that supports this is an education-specific application, *Assemblr EDU*.

By providing *Augmented Reality* (AR) technology and 3D animations, *Assemblr EDU* fosters creativity and allows for the presentation of highly engaging learning materials. Furthermore, the application has significant potential to support the formation of the “Pancasila Student Profile,” specifically by focusing on the values of cooperation, creativity, critical thinking, and independence as envisioned by the Merdeka Curriculum.

Previous *research and development* by [Kumalasari et al. \(2023\)](#) demonstrated that the implementation of multimedia *mobile learning* achieved a high media validation score of 57 (very valid category) and a good implementation rating. The percentage of feasibility test results was 62% (very feasible category). Furthermore, *research and development* in interactive multimedia by [Kevin et al. \(2024\)](#) achieved a 94.8% success rate, with the category “Very Good” in terms of design and functionality.

The results of AR media development by [Surani & Fricticarani \(2023\)](#) showed that using the *Assemblr EDU* application can significantly increase interest in learning science. Similarly, research and development by [Oktaviana & Jasril \(2023\)](#) found the AR *Assemblr EDU* media to be both valid and practical for use in learning electronic circuits instruction. At the same time, [Hikmah et al. \(2023\)](#) reported a “Very Feasible” rating (averaging 86%) for 3D multimedia using the same platform.

Building upon these findings, this study aims to implement the *Assemblr EDU* application to support multimedia design as an instructional medium for human reproductive system material for Grade XI high school students, in accordance with the demands of the Merdeka Curriculum. The quality of the developed media is analyzed based on expert validation results and readability tests conducted with teachers and students.

Therefore, this study aims to implement the *Assemblr EDU* application to support multimedia design as a teaching medium in biology learning on the human reproductive system for grade XI high school students, in accordance with the demands of the Merdeka Curriculum. The quality analysis is based on: Validation results by experts and readability tests for teachers and students.

After product refinement, the results of this research are published in BIOEDUKASI: Jurnal Pendidikan Biologi, Universitas Sebelas Maret, with the title: “*Multimedia Development Based on the Assemblr EDU Application in Human Reproductive System Material for Grade XI High School Students.*” This publication serves as a form of scientific dissemination, ensuring that the development results are accessible and beneficial to practitioners and academics within the field of Biology Education.

Methods

This multimedia development is a procedural-research using a quantitative descriptive approach that involves analyzing numerical data with statistical and formulaic certainty. A procedural model is a descriptive framework outlining the necessary stages or processes that must be followed to produce/achieve a specific result. This study employs a *Research and Development* (R&D) approach, which utilizes surveys or experiments to produce a specific product, followed by effectiveness testing ([Arifin, 2020](#)).

The *research and development* design refers to the model proposed by [Sugiyono \(2017\)](#). Given the researcher’s practical limitations, the scope of this research was limited to 7 stages, concluding at the product revision stage following limited trials. The subjects for this limited trial were three biology teachers and five students, using quantitative descriptive data analysis

techniques. *Purposive sampling*, based on XI grade student participants of SMAN 1 Kota Blitar during the 2023/2024 academic year, who had already learned and previously completed the human reproductive system module.

Data collection focused on a readability test administered via a questionnaire. This instrument was administered to both the teachers and students to evaluate the feasibility and usability of the developed multimedia application based on *Assemblr EDU*. Quantitative descriptive techniques were then applied to analyze the collected data.

Results and Discussion

This Following to perspective of [Indrawan et al. \(2020\)](#), the multimedia product based on the *Assemblr EDU* application developed in this research and development has met the criteria for instructional suitability in the learning process. as evidenced by its alignment with the required standards for material presentation, linguistic clarity, and visual design have met to the required solution criteria. Multimedia can provide a viable solution to address the challenges of the Merdeka Curriculum, particularly by simplifying the complex learning process for biological concepts and addressing real-world instructional problems, while also solving the main problems encountered in real life.

In the first stage of this research, a potential and problem analysis was conducted through structured interviews with 3 biology teachers, and a needs analysis assessment questionnaire was administered to 90 grade XII students at 3 schools: SMA Negeri 1 Kota Blitar, SMA Negeri 4 Kota Blitar, and SMA Negeri 1 Talun. Initial data collection was conducted in October 2023. The potential and problem analysis aimed to identify needs in the field related to the implementation of the learning process and the products to be developed. This analysis was critical for identifying field-specific needs in curriculum implementation and for determining the necessary product specifications.

Based on interviews with 3 biology teachers, they stated that students still consider the human reproductive system a taboo subject. In practice, teachers are very careful when explaining this sensitive topic. This sensitivity contributes to the learning gap, as evidenced by the questionnaire results, which showed that 64.4% of 90 students admitted that the material, specifically the human reproductive system material, is difficult to comprehend, requiring educators to exercise extreme caution during instruction.

To address these challenges, integrating Augmented Reality (AR) visualization and 3D animation of materials supports differentiation of student learning styles. Based on the results of the initial study, 97,8% of students preferred learning processes using learning media, and 76,7% preferred digital media.

The specifications of student learning styles are: 31,1% kinesthetic, 7,8% auditory, and 58,9% audiovisual. In an effort to meet the learning needs of the Merdeka Curriculum, multimedia helps students learn in ways that suit their individual interests and abilities. This is supported by data showing that 93.3% of students enjoy multimedia-based learning and that 72.2% have used multimedia in the learning process. By aligning with these individual interests and abilities, the developed multimedia facilitates a more personalized learning experience as mandated by the Merdeka Curriculum.

Based on the analysis and potential problems, the researchers developed a multimedia application using *Assemblr EDU* as an alternative learning medium to support teachers in delivering information more effectively to students. Utilizing multimedia content as an alternative tool to support differentiated learning is expected to address the demands of Merdeka Belajar, meeting the diverse learning needs of students, and making reproduction materials easier to understand and less of a taboo.

The Integration of Augmented Reality (AR) technology with 3D animation of instructional materials provides a more engaging way to visualize learning materials. This learning medium offers an immersive experience, allowing students to perceive biological objects as if they were seeing them directly. Such immersion enhances students'

understanding and fosters curiosity, enabling them to complete and master biology lessons on the human reproductive system with optimal conceptual clarity.

The advantages of the *Assemblr EDU* application include its attractive design, interactive menu features, and alignment with specific student characteristics. This multimedia platform enables both teachers and students to explore modules and watch instructional videos in accordance with the principles of independent learning, consistent with self-directed learning. Materials are accessible through web-based Virtual Learning Environments (VLEs) or mobile applications, and the high level of interactivity significantly boosts student engagement.

Furthermore, the application has great potential to support the development of the “Pancasila Student Profile,” particularly in fostering the values of cooperation, creativity, critical thinking, and independence. Ultimately, this integration fosters a more balanced and holistic learning experience for students. The developed multimedia design has been validated by three categories of expert validators, including material experts, media experts, and linguistics experts, to ensure its quality and feasibility.

Table 1. Results of the expert validation questionnaire on multimedia

Validator	Validator Individual Score			Total Score	Maximum Score	Percentage (%)	Criteria
	Expert 1	Expert 2	Expert 3				
Material Experts	35	39	37	111	120	92.5%	“Very Feasible”
Linguists	24	24	20	68	75	90.6%	“Very Feasible”
Media Experts	57	59	58	174	195	89.23%	“Very Feasible”

As illustrated in Table 1, validation by material experts yielded a score of 92.5%, which is categorized as “Very Feasible.” Similarly, evaluations by linguists and media experts resulted in scores of 90.6% and 89.23%, respectively, both meeting the “Very Feasible” criteria. These results indicate that the content, language, and technical aspects of the multimedia are highly suitable for educational use.

Following expert validation, a limited trial was conducted to evaluate the practicality of *Assemblr EDU*-based multimedia using a readability test. This trial involved three biology teachers and five students via Google Forms. The results are presented in Table 2.

Table 2. Results of the teacher and student readability test (limited trial) questionnaire for multimedia

Validator	Respondents Individual Score					Total Score	Maximum Score	Percentage (%)	Criteria
	Teacher 1	Teacher 2	Teacher 3						
Biology Teachers (3)	46	40	45			131	150	87.3%	“Very Feasible”
Students (5)	50	45	49	43	46	233	250	93.2%	“Very Feasible”

Based on the results of the multimedia readability assessment in Table 2, the biology teachers gave a feasibility rating of 87.3%, while the students gave a higher final score of 93.2%. Both groups respectively categorized the media as “Very Feasible,” suggesting that the *Assemblr EDU*-based multimedia is not only easy to use but also highly effective in helping students visualize the human reproductive system of for use as an innovative biology learning medium and provided an even supporting the Merdeka Curriculum and confirming the application’s status as an Innovative biology learning medium. This evidence demonstrates

that the *Assemblr EDU*-based multimedia materials on the human reproductive system are highly suitable for classroom implementation.

The high levels of acceptance from both teachers and students indicate that the *Assemblr EDU* application-based multimedia on the human reproductive system is suitable as a learning medium. These findings suggest that the *Assemblr EDU*-based multimedia is not only technically functional but also user-friendly and effective in clarifying the complex concepts of the human reproductive system. The high student score specifically reflects the positive engagement and interest sparked by the application's 3D and AR features.

Multimedia based on the *Assemblr EDU* application in human reproductive system material for grade XI high school students, which has been developed, can be accessed at the following link:

https://drive.google.com/file/d/1wmTIOQtIQ3Cf_5Hy_ol7Z4jcHFVl5wyu/view?usp=drivesdk. The initial product design plan can be seen in Table 3 below.

Table 3. Initial design draft for multimedia usage instructions

Appearance	Information
	<u>Cover Design</u> Includes the title, subject, and grade identity, application branding, author credentials, material, and images relevant to the human reproductive system.
	<u>Application User Guide</u> This page provides instructions for downloading the <i>Assemblr EDU</i> application, a specific class-joining code, and a QR code/barcode for video tutorials on scanning images in the application.
	<u>Displays a visual</u> Overview of the human reproductive system topics covered within the multimedia platform.



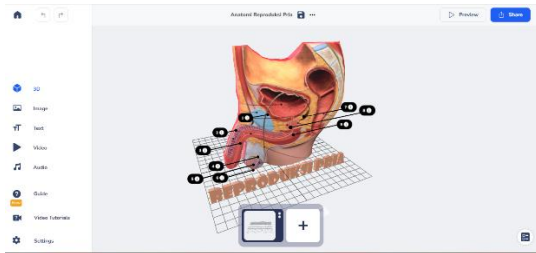
Sub-topic Cover Page

Serves as an introductory page containing the opening of each specific sub-topic title within the material.



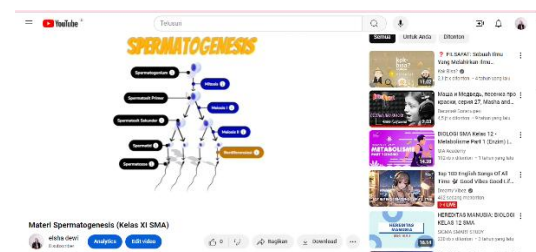
Marker/Barcode Page

Contains a 3D image markers/barcodes integrated with the *Assemblr EDU* app and a link to *YouTube* videos.



3D Augmented Reality Display

This image is an interactive AR-based visual display designed to support material on the understanding of the human reproductive system.



Video Material on the Human Reproductive System

Video instructional content has been developed and is accessible via an integrated *YouTube* link and presented on the *YouTube* page.

However, each type of learning media certainly has its own characteristics, encompassing both advantages and disadvantages. The advantages and disadvantages of the *Assemblr EDU* application-based multimedia for the human reproductive system are outlined below.

Product Advantages

1. **Immersive Conceptual Visualization via AR Technology:** The *Assemblr EDU* application transforms abstract concepts of the human reproductive system into contextual 3D objects and AR animations. This facilitates the visualization of complex biological processes – such as gametogenesis and the menstrual cycle – which are often difficult to comprehend through conventional media. This aligns with [Kevin et al. \(2024\)](#), who found that AR-based media significantly increases student interest and information retention, achieving a 94.8% feasibility rate.
2. **Strategic Integration with the “Merdeka Belajar” Framework:** This multimedia is designed to support differentiated learning and strengthen the Pancasila Student

Profile (critical thinking, collaboration, and independence). The application encourages self-paced learning, which is essential for the successful implementation of the Merdeka Curriculum ([Cholilah et al., 2023](#); [Gusteti & Neviyarni, 2022](#)).

3. **Personalized Learning Based on Diverse Styles:** The product specifically accommodates the dominant learning styles identified in this study: audiovisual (58.9%) and kinesthetic (31.1%). By integrating video, audio, and interactive 3D object manipulation, it provides a concrete learning experience that can improve conceptual understanding by up to 40% compared to static media ([Nugroho et al., 2021](#)).
4. **Multi-Platform Flexibility and Accessibility:** The application is highly accessible on mobile devices and PCs, enabling a hybrid learning experience both in and out of the classroom. This flexibility increases student engagement and allows for exploration beyond face-to-face instructional hours ([Surani & Fricticarani, 2023](#)).

Product Disadvantages (Weaknesses)

1. **Dependence on Network Infrastructure and Device Specifications:** As a cloud-based AR platform, the application requires a stable internet connection and modern hardware to render 3D assets effectively (approximately 187 MB). This technological reliance aligns with the findings of [Kumalasari et al. \(2023\)](#), who identified that the digital infrastructure gap remains a major barrier to the adoption of mobile learning in various regions.
2. **Limited Accommodation for Purely Auditory Learners:** While the multimedia includes audio elements, its primary architecture is dominated by visual and kinesthetic stimuli. Consequently, students with a purely auditory learning style (7.8%) may require additional verbal instruction or supplementary auditory materials from the educator to achieve optimal understanding.
3. **Challenges in Educator Digital Literacy:** The successful implementation of this tool depends heavily on the teacher's proficiency with AR technology. As noted by [Cholilah et al. \(2023\)](#), many educators remain accustomed to conventional media such as PowerPoint; therefore, a lack of digital readiness can hinder the effective delivery of materials.
4. **Technical and Scaling Limitations:** Validation tests revealed inconsistencies in the 3D model zoom feature across different device resolutions, potentially affecting the visual experience. Additionally, during the development phase, technical deficits, such as inconsistent scientific typography in the oogenesis section, were identified and addressed during final product refinement.

Based on the results of research data processing, data analysis and the development of a multimedia product based on the *Assemblr EDU* application for the human reproductive system, effectively addresses the needs of eleventh-grade high school students, it can be concluded that the product was designed in accordance with students' and teachers' while supporting the implementation of the Merdeka Curriculum.

The developed multimedia product meets the criteria for a differentiated, technology-integrated learning solution from pedagogical, technological, and curricular perspectives. Expert validation results indicate that the product is categorized as "Very Feasible," with scores of 92.5% from material experts, 90.6% from linguists, and 89.23% from media experts. Furthermore, readability tests demonstrate high feasibility, yielding scores of 87.3% from biology teachers and 93.2% from students. The product's primary strengths lie in its high interactivity, clear concept visualization through AR integration, support for differentiated learning, and strong alignment with national curriculum standards. While minor challenges/weaknesses related to device accessibility and teacher digital readiness were identified, these were proactively addressed during the revision phase. Consequently, the *Assemblr EDU*-based multimedia is highly suitable for enhancing biology learning on the human reproductive system for eleventh-grade students.

Conclusion

The development of multimedia content for the human reproductive system using the *Assemblr EDU* application has been completed, following a 7-stage R&D process. Based on expert validations and limited field trials, the media has been proven “Very Feasible” for grade XI high school students, with an average validation score exceeding 85% across all parameters. This multimedia serves as an effective tool for differentiated learning, helping students visualize complex biological processes through 3D and AR technology while addressing the taboos often associated with reproductive health education.

According to experts and a student readability rating of 93.2%, this media effectively supports the Merdeka Curriculum’s goals of differentiated learning. While it faces challenges with internet dependence and teacher digital literacy, its ability to visualize abstract biological processes through AR technology represents a significant advancement over conventional teaching methods.

For future developments in AR-based instructional media, it is recommended to:

1. Expand Testing Scope: Proceed to the operational testing stage to evaluate educational effectiveness on a broader scale.
2. Optimize 3D Functionality: Enhance the detail and interactivity of 3D models, particularly by optimizing zoom performance across diverse device resolutions.
3. Refine UI/UX Design: Improve overall graphic design quality, including color contrast, layout ergonomics, and intuitive navigation systems

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