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Development of Maternal Fetal Blood Anatomy and Circulation Simulation Media to Strengthen Clinical Reasoning of Midwifery Students

Fathunikmah[1], Ani Laila[2], Findy Hindratni[3]
[1,2,3] *Poltekkes Kemenkes Riau, Indonesia*
Corresponding Author: fathunikmah@pkr.ac.id

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ABSTRACT

The development of maternal-fetal blood anatomy learning and circulatory simulation media is important to strengthen the clinical reasoning skills of midwifery students, especially in understanding complex physiological concepts that are difficult to explain through conventional learning methods. This study aims to analyze the development and use of anatomical imentmage media, three-dimensional cardiac simulation models, and YouTube-based educational videos in improving conceptual understanding and clinical reasoning among midwifery students. This study uses a qualitative approach with a phenomenological design involving 10-20 participants who were deliberately selected. Data were collected through in-depth interviews, limited observations, and documentation during learning activities using simulation media. The results of the study show that the simulation media developed improves students' understanding of mother-fetal blood circulation and cardiac anatomy in a more comprehensive, interactive, and contextual manner. The use of visual and audio-visual media also strengthens clinical reasoning skills by encouraging analytical and systematic thinking patterns. In addition, students report an increase in learning motivation, engagement, and interest in independent learning because the media is easier to understand and more interesting than conventional lecture methods. This study concludes that the development of technology-based simulation media contributes significantly to strengthening clinical reasoning and improving the quality of learning in midwifery education.

Key Word
Mother-Fetal Circulation, Simulation Media, Clinical Reasoning, Midwifery Students, Midwifery Education.

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INTRODUCTION

The development of teaching and learning activities in teaching and learning activities in health sciences, especially in the field of midwifery, requires an improvement in the quality of learning that is able to support students' clinical reasoning skills. Clinical reasoning is a core competency in midwifery practice because it is directly related to students' ability to analyze

the condition of the mother and fetus and make appropriate clinical decisions (Firoozehchian et al., 2022). However, research has shown that health students still have difficulty understanding complex physiological concepts, such as fetal-maternal anatomy and blood circulation, which are dynamic and multidimensional (Masserdotti et al., 2024). This condition shows that there is an urgent need to develop more innovative and interactive learning media.

Globally, the use of technology in health education, especially digital-based simulations, is increasingly developing as a solution to improve the quality of clinical learning (Putu Wendi Yunianti & Kusumawardani, 2025). Simulation-based education (SBE) has been shown to be effective in improving concept understanding, clinical skills, and patient safety through learning experiences that resemble real conditions (Saken Dzhumatovich & Salimrouhi, 2025). In addition, recent research suggests that the use of high-tech simulations can significantly improve students' clinical reasoning skills, especially in the context of nursing and midwifery education (Dicheva et al., 2023). This shows that the integration of simulation technology in health education is a need that cannot be ignored.

In the context of obstetrics, understanding the anatomy and blood circulation of the fetus has a high level of complexity because it involves unique interactions between the mother's and fetal systems, such as the presence of physiological shunts and hemodynamic changes during pregnancy. This complexity is often difficult to understand through conventional learning methods that are still theoretical and static. In fact, misunderstandings in this concept can have an impact on misinterpreting clinical conditions, potentially increasing the risk of pregnancy complications and fetal developmental disorders (Scher, 2024).

A number of previous studies have developed simulation-based learning media and visual technologies, such as augmented reality and virtual reality, to improve students' understanding in the health field. Interactive digital media can help midwifery students understand anatomical changes during pregnancy more comprehensively. In addition, recent research shows that augmented reality-based simulations can improve the understanding of midwifery concepts, although they are still limited to certain aspects and have not been fully integrated with the reinforcement of clinical reasoning.

However, there is still a significant research gap. Most previous research has focused on improving technical skills or partial conceptual understanding, but not many have integrated the simulation media of fetal and maternal anatomy and blood circulation comprehensively with the development of students' clinical reasoning skills (Clayton, 2022). In addition, the use of

simulation media in the context of midwifery education in Indonesia is still limited and has not been studied empirically, especially in the context of adaptive and contextual technology-based learning (Aruani & Susanti, 2025).

Another gap lies in the lack of learning media that is able to visualize the interaction between the maternal and fetal systems simultaneously in a dynamic unit. In fact, research shows that interactive simulation-based visualizations can improve students' understanding of complex concepts and help clinical decision-making processes more accurately (Abdulmohdi & Mcvicar, 2023). This shows that the development of integrated simulation media is very important to answer the needs of modern midwifery learning.

Based on the identified research background and gaps, this study aims to develop a learning media of maternal-fetal anatomy and blood circulation using anatomy images and YouTube-based educational videos designed to strengthen the clinical reasoning skills of midwifery students. This research specifically focuses on the use of visual and audiovisual learning media that are able to present physiological processes more clearly, systematically, and contextually, thereby supporting the clinical analysis process of students in understanding pregnancy conditions comprehensively.

This research is expected to make a theoretical and practical contribution. Theoretically, it can enrich studies in the field of midwifery education, especially regarding the integration of visual and digital learning media in the development of clinical reasoning skills. Practically, the findings of this study can be the basis for the development of innovative learning media that are more effective, interactive, and easily accessible through the use of anatomical images and YouTube-based learning videos. Furthermore, the media developed is expected to be an alternative learning strategy to improve the quality of midwifery education and support the safety of clinical practice in the field.

RESEARCH METHODS

Research Design

This study uses a qualitative approach with a phenomenological study design that aims to gain an in-depth understanding of the experiences and perceptions of midwifery students in using anatomy and maternal-fetal blood circulation learning media to strengthen their clinical reasoning skills. The qualitative approach was chosen because it allows for the exploration of meanings, interpretations, and subjective experiences that cannot be quantitatively measured, especially in the context of complex and contextual health education (Alhazmi & Kaufmann, 2022). Phenomenological design is applied because it focuses on participants' direct experience with visual and

audiovisual learning media in understanding physiological processes during pregnancy and clinical decision-making (Bouzioti, 2023).

Learning Media Used in Research

The learning media used in this study include illustrations of cardiac anatomy and mother-fetal blood circulation, visual anatomy models, and YouTube-based educational videos that explain mother-fetal circulation interactively. This visual and audiovisual media is intended to help students better understand anatomical structures, physiological processes, and clinical concepts that are often difficult to understand through conventional learning methods. The integration of this media is expected to increase student engagement and strengthen clinical reasoning skills.

Population and Participants

This study involved participants who were selected using non-probability sampling techniques, especially purposive sampling. The participants consisted of midwifery students who had participated in learning related to pregnancy physiology. The number of participants is determined based on the principle of data saturation, which refers to the point when the data collected becomes repetitive and no new information appears. In qualitative health research, this generally ranges from 10-20 participants (Im et al., 2023).

Data Collection Techniques

Data collection was conducted through in-depth interviews using semi-structured interview guidelines. This technique was chosen because it provides flexibility for researchers to explore the participants' experiences more broadly while maintaining the focus of the research (Dahal et al., 2024). The interview instrument was developed based on a theoretical framework of clinical reasoning and visual-audiovisual learning approaches adapted from previous research and conceptually validated by experts in obstetrics and health education.

The research procedure begins with the preparation stage, including a literature review, instrument development, and the preparation of learning media in the form of anatomical images and YouTube educational videos. The implementation stage involves recruiting participants, explaining the research objectives, utilizing learning media during learning activities, and conducting in-depth interviews. All interview data is documented through audio recordings and word-for-word transcriptions. In addition to interviews, supporting data was obtained through limited observation of student responses and involvement during the use of learning media to strengthen the validity of the data through methodological triangulation.

Research Instruments

The research instruments used in this study consisted of interview guidelines, observation sheets, documentation, anatomical simulation models, anatomical illustrations, mother-fetal blood circulation diagrams, and YouTube-based educational videos. Semi-structured interview guidelines were developed to explore students' experiences, perceptions, comprehension, and clinical reasoning abilities after using learning media. Observation sheets are used to record student engagement, participation, and responses during learning activities. Documentation techniques are also used to support data validity through photographs, field notes, and learning notes.

In addition, this study uses several visual and audiovisual learning media as research instruments to support students' understanding of mother-fetal circulation and cardiac anatomy.

Figure 1.
Three-Dimensional Cardiac Anatomy Simulation Model

This image shows a three-dimensional cardiac anatomy simulation model used in this study as a learning medium to assist midwifery students in understanding the anatomical structure of the heart and blood circulation pathways visually and interactively during the learning process.

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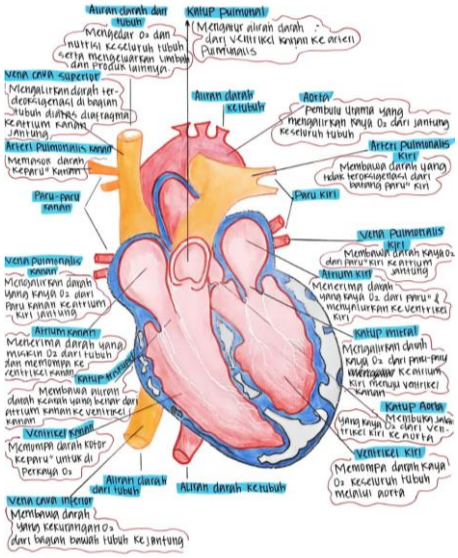

Figure 2.
Anatomy and Blood Circulation Illustration of the Human Heart

This image presents an illustration of the anatomy and blood circulation of the human heart used in this study to explain systemic and pulmonary blood circulation processes, as well as to support students' conceptual understanding of cardiac physiology.

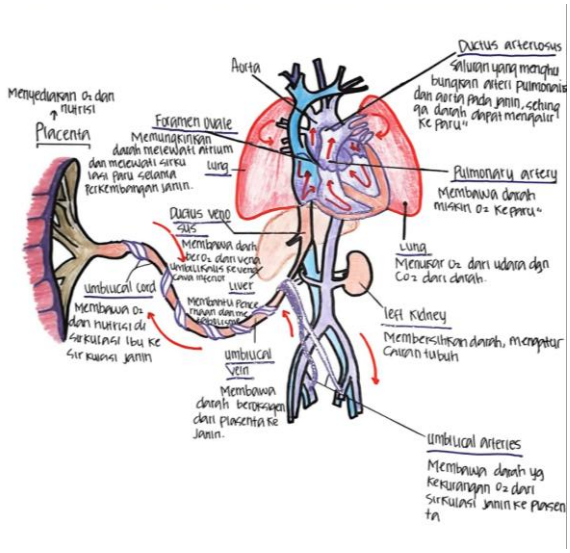

Figure 3.
Mother-Fetal Blood Circulation Diagram

This image shows a mother-fetal blood circulation diagram used in this study to explain the mechanisms of fetal circulation, placental circulation, and physiological adaptation during pregnancy as part of a simulation-based learning medium.

In addition to visual learning media, this study also uses YouTube-based educational videos that explain mother-fetal circulation interactively to support

independent learning and strengthen students' clinical reasoning skills. The educational videos used in this study can be accessed through the following link: https://youtu.be/RTNoucHTtOs?si=Jhx77ho2dLrnGS2Q

The integration of visual and audiovisual instruments is expected to increase student engagement, enhance conceptual understanding, and strengthen clinical reasoning skills in midwifery education.

Data Analysis

Data analysis is carried out using thematic analysis techniques that aim to identify, analyze, and interpret patterns of meaning in qualitative data (Braun & Clarke, 2021). The analysis process is carried out in several stages, including data reduction, open coding, categorization, and identification of key themes relevant to the research objectives. The analysis was carried out inducively using a reflective approach to better understand the context of the participants' experiences.

To increase the credibility of the data, this study uses member checking techniques and peer briefing. In addition, the analysis process is supported by qualitative data analysis software such as NVivo or ATLAS.ti to facilitate data processing and systematic data interpretation. Through this approach, this study is expected to provide a comprehensive understanding of the effectiveness of simulation media in supporting the development of clinical reasoning skills among midwifery students.

RESULTS AND DISCUSSION

The findings of this study reveal that the use of anatomical image media, illustrations of mother-fetal blood circulation, cardiac anatomy models, and YouTube-based educational videos contribute positively to strengthening the clinical reasoning skills of midwifery students. The results were obtained from in-depth interviews, limited observations, and Focus Group Discussions (FGD) conducted during the implementation of learning activities using the developed media. The analysis identified several key themes related to conceptual understanding, clinical reasoning development, learning engagement, and media effectiveness perception.

Gambar 1.
Documentation of Learning Activities

Increased Understanding of Mother-Fetal Anatomy and Blood Circulation

Most participants stated that anatomical illustrations and visual simulation media helped them understand the structure of the heart, fetal circulation pathways, and the relationship between maternal and fetal blood circulation more comprehensively. The students explained that the previous conventional lecture method made it difficult to visualize physiological processes dynamically, especially regarding oxygenated and deoxygenated blood flow in the fetal circulation.

Participants reported that the combination of anatomical images and audiovisual explanations allowed them to connect theoretical concepts with visual representations more effectively. The observational findings also showed that students were more active in identifying anatomical structures and explaining circulation pathways during the learning session. One of the participants stated:

"*Before, I only memorized theories from textbooks, but after using anatomy images and YouTube videos, I was able to clearly understand how blood flows between mother and fetus*." (P03 Participant, FGD Session, March 3, 2026).

Another participant explained:

"*Visual media makes complex concepts easier to understand because we can directly observe the process of blood circulation step by step*." (Participant P07, Interview, March 04, 2026).

The results of the observation showed that students showed better accuracy in explaining structures such as the ductus arteriosus, foramen ovale, umbilical artery, and umbilical vein after participating in simulation-based learning activities.

Strengthening Clinical Reasoning Skills

The findings show that the learning media developed strengthens students' clinical reasoning abilities by encouraging analytical and systematic thinking patterns. Participants explained that visual and audiovisual simulations allowed them to better analyze the physiological changes that occur during pregnancy and fetal circulation.

Students report that they become better able to interpret clinical conditions and relate theoretical concepts to possible obstetric complications. During the FGD session, some participants showed improved ability to explain clinical cases related to oxygen supply disorders, placental circulation problems, and fetal hemodynamic changes. One of the participants stated:

"*The media helped me think more systematically when analyzing pregnancy cases because I could visualize the circulatory process more clearly*." (P11 Participant, FGD Session, March 5, 2026).

Another participant added:

"*When discussing cases of fetal disorders, I can better understand why circulation problems can affect the delivery of oxygen to the fetus*." (Participant P05, Interview, March 06, 2026).

The results of the observations also showed that students became more confident in answering case-based questions and showed more logical reasoning during group discussions after exposure to simulation media.

Increased Learning Motivation and Student Engagement

The use of visual and audiovisual media significantly increases student engagement and motivation during the learning process. Most participants described the learning sessions as more interactive, fun, and less monotonous compared to conventional lecture-based teaching.

Students revealed that YouTube-based educational videos caught their attention because they presented moving visualizations and simplified explanations of complex physiological processes. In addition, anatomical drawings encourage active participation during class discussions and collaborative learning activities. One of the participants stated:

"*The learning process became more interesting because we not only listened to the explanations, but we were able to visually observe the anatomy and circulation directly*." (Participant P02, Interview, March 07, 2026).

Another participant explained:

"*YouTube videos make me more enthusiastic about self-study at home because I can replay the explanation whenever needed*." (Participant P09, FGD Session, March 8, 2026).

Observational findings showed that students actively asked questions, participated in discussions, and engaged more intensively with peers during simulation-based learning sessions.

The Effectiveness of Visual and Audiovisual Learning Media

Participants generally found the developed learning media to be effective, accessible, and easier to understand than traditional learning methods. Students emphasize that the integration of anatomy illustrations and YouTube educational videos creates a more contextual learning experience.

Some participants highlighted that the media supports independent learning because educational videos can be accessed repeatedly outside the classroom. Students also appreciated the clarity of the visual explanations provided through anatomical illustrations and circulation diagrams. One of the participants stated:

"*The combination of images and videos is very helpful because some concepts are difficult to imagine through verbal explanations alone*." (Participant P14, interview, March 09, 2026).

Other participants commented:

"*This medium is easier to understand than PowerPoint slides because the process of circulation is explained visually and gradually*." (P06 Participant, FGD Session, March 8, 2026).

Differences from Previous Studies

The findings of this study differ from some previous studies that have mainly focused on high-tech simulation tools such as virtual reality or augmented reality in health education. In contrast, this study shows that relatively simple and accessible visual-audiovisual media, including anatomy illustrations and YouTube-based educational videos, are also effective in improving conceptual understanding and strengthening clinical reasoning among midwifery students.

Unlike previous studies that emphasized technical simulation skills, this study highlights the integration of conceptual visualization and reflective clinical analysis in the context of mother-fetal physiology learning. Furthermore, the findings suggest that low-cost educational media can still provide meaningful learning experiences if designed contextually and interactively.

Discussion

The findings of this study show that the use of anatomical image media, maternal-fetal blood circulation illustrations, cardiac anatomy models, and YouTube-based educational videos contribute positively to strengthening conceptual understanding, clinical reasoning skills, learning motivation, and

student involvement among midwifery students in learning maternal-fetal anatomy and physiology. These findings show that visual and audiovisual learning media function not only as instructional aids but also as pedagogical tools that make it easier for students to connect theoretical concepts with clinical contexts.

The first major findings reveal that visual learning media helps students understand the anatomical structure of the heart, fetal circulation pathways, and the relationship between maternal and fetal blood circulation more comprehensively. These findings are consistent with multimedia learning theory, which explains that learning becomes more effective when information is conveyed through a combination of verbal and visual representations because learners process information through multiple cognitive channels simultaneously. In this study, the use of anatomical illustrations and circulation diagrams reduced the abstraction of complex physiological concepts such as ductus arteriosus, foramen ovale, umbilical artery, and umbilical vein. As a result, students can visualize physiological processes more clearly compared to conventional lecture-based teaching.

Furthermore, the findings show that the simulation media developed strengthens students' clinical reasoning skills. Students become better able to interpret clinical conditions and relate theoretical knowledge to obstetric complications, including fetal circulation disorders, placental circulation disorders, and oxygen supply disorders. These findings support previous research emphasizing that simulation-based learning can improve analytical thinking, decision-making, and reflective reasoning in healthcare education. From a theoretical perspective, clinical reasoning develops when students actively integrate conceptual understanding with clinical interpretation rather than simply memorizing information. Therefore, the visual and audiovisual simulations applied in this study provide a meaningful opportunity for students to develop a systematic and evidence-based thinking pattern.

Another important finding is increased student motivation and engagement during the learning process. Participants described learning activities as more interactive, fun, and less monotonous than traditional teaching methods. YouTube-based educational videos capture students' attention because they present dynamic visualizations and simplified explanations of complex physiological mechanisms. These findings are in line with educational theory that emphasizes that motivation and engagement are important components that affect study perseverance, participation, and academic achievement. The ability to autonomously play back educational

videos also supports self-paced learning and strengthens students' understanding outside of classroom sessions.

In addition, participants considered the developed media to be effective, accessible, and easier to understand compared to traditional PowerPoint-based instructions. The integration of anatomical images and audiovisual explanations creates a more contextual learning environment that facilitates a gradual understanding of physiological processes. These findings support the Health Simulation Best Practice Standards, which emphasize that effective simulation-based learning must be designed according to learning objectives, contextual relevance, and learner needs. Unlike many previous studies that have focused primarily on advanced technologies such as virtual reality or augmented reality, this study shows that relatively simple and low-cost media can still provide meaningful educational outcomes when developed interactively and contextually.

The novelty of this study lies in its emphasis on combining conceptual visualization and reflective clinical analysis in the learning of maternal-fetal physiology. While previous research has often focused on technical simulation skills, this study highlights the role of accessible visual-audiovisual media in fostering conceptual understanding and clinical reasoning simultaneously. Therefore, this research contributes to the development of innovative learning strategies in midwifery education by showing that effective educational innovation does not always depend on expensive technology but rather on the suitability of instructional design and contextual implementation.

Several factors may explain the positive results observed in this study. First, the integration of visual and auditory elements facilitates cognitive processing and reduces cognitive load among students. Second, an interactive learning environment encourages active participation, collaborative discussion, and reflective thinking. Third, the flexibility of YouTube-based educational videos allows for repetitive self-learning, thereby strengthening conceptual retention. However, despite the positive findings, some limitations must be acknowledged.

The study involved a relatively limited number of participants, which may limit the generalization of the findings to a broader educational context. In addition, qualitative design provides in-depth insights into the student experience but does not quantitatively measure improvements in clinical reasoning performance. The effectiveness of learning media may also be influenced by factors such as students' digital literacy, internet accessibility, and lecturers' facilitation skills during simulation activities. Additionally, students'

individual learning preferences may have contributed to differences in learning outcomes.

Future studies are recommended to use mixed methods or experimental research designs involving larger participant populations and quantitative assessment instruments to measure clinical reasoning improvements more objectively. Comparative studies between visual-audiovisual simulation media and advanced technologies such as virtual simulations, augmented reality, or mannequin-based simulations are also recommended. In addition, future research may explore the long-term effects of simulation-based learning on clinical competence, decision-making ability, and patient care readiness among midwifery students.

Overall, the findings suggest that anatomical simulation media and mother-fetal circulation visualization can significantly improve conceptual understanding, clinical reasoning, motivation, and student engagement in midwifery education. These findings reinforce the importance of applying contextual, interactive, and visually-oriented learning approaches to support the development of higher-level thinking skills in health education.

CONCLUSIONS

This study concludes that the development of maternal-fetal blood anatomy and circulatory simulation media through anatomical illustrations, cardiac anatomy models, and YouTube-based educational videos contribute significantly to improving conceptual understanding, strengthening clinical reasoning skills, increasing learning motivation, and increasing student engagement among midwifery students. The findings show that visual and audiovisual learning media enable students to understand complex physiological processes more comprehensively, systematically, and contextually compared to conventional lecture-based methods. The integration of simulation-based learning also encourages analytical and reflective thinking patterns, allowing students to connect theoretical concepts to clinical conditions more effectively. In addition, the study highlights that accessible, low-cost educational media can still provide meaningful learning experiences and support the development of high-level thinking skills when designed interactively and contextually in midwifery education.

Despite the positive findings, the study was limited by a relatively small number of participants and the use of qualitative designs that did not quantitatively measure improvements in clinical reasoning ability. Therefore, future studies are recommended to involve a larger population of participants and apply mixed methods or experimental research designs to obtain more

comprehensive and measurable findings. Further research is also recommended to compare the effectiveness of visual-audiovisual simulation media with other advanced technologies such as virtual reality, augmented reality, or mannequin-based simulations in health education. In addition, educational institutions are encouraged to integrate innovative simulation-based media into the midwifery learning process to create a more interactive, student-centered, and clinically relevant educational environment that can better prepare students for professional clinical practice.

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