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Project-based learning innovation through animated learning videos to sharpen students' creativity and understanding

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ABSTRAK

Paradigma pembelajaran telah beralih dari Teacher-Centred Learning (TCL) menuju Student-Centred Learning (SCL), yang lebih menekankan pada partisipasi aktif mahasiswa untuk meningkatkan pemahaman, kreativitas, dan keterampilan mereka dalam menghadapi tantangan profesional. Salah satu metode yang mendukung pendekatan ini adalah Project-Based Learning (PjBL) yang dipadukan dengan Animated Learning Video (ALV). Metode ini diterapkan untuk membantu mahasiswa memahami mata kuliah biokimia yang sering dianggap sulit. Penelitian ini mengadopsi desain pre-eksperimental untuk mengukur peningkatan pemahaman mahasiswa melalui pre-test dan post-test setelah penerapan metode pembelajaran. Penelitian ini melibatkan dua kelas dengan total 64 mahasiswa menggunakan teknik total sampling. Hasil penelitian menunjukkan bahwa penerapan metode PjBL berbasis ALV efektif dalam meningkatkan pemahaman mahasiswa, terbukti dengan nilai rata-rata yang lebih tinggi dibandingkan dengan yang menggunakan metode konvensional, serta meningkatkan kepuasan mahasiswa dalam mempelajari biokimia. Namun, penerapan metode ini memerlukan pengulangan dan kolaborasi dengan metode lain untuk memperdalam daya ingat mahasiswa.

ABSTRACT

The learning paradigm has shifted from Teacher-Centred Learning (TCL) to Student-Centred Learning (SCL), emphasizing active students' participation to increase their understanding, creativity, and skills in facing professional challenges. One method that supports this approach is Project-Based Learning (PjBL) combined with Animated Learning Video (ALV). This method is applied to help students understand biochemistry courses, which are often considered challenging. This research adopted a pre-experimental design to measure the increase in students' understanding through pre-tests and post-tests after implementing the learning method. This research involved two classes with 64 students using total sampling techniques. The research results show that applying the ALV-based PjBL method is practical in increasing students' understanding, as evidenced by a higher average score compared to conventional methods and improving students' satisfaction in studying biochemistry. However, applying this method requires repetition and collaboration with other methods to deepen students' memory.

INTRODUCTION

The rapid development of technology has made a significant contribution to the world of education, which should go hand in hand to create more efficient, optimal, and innovative learning methods. Conventional learning methods such as lectures, which are included in the Teacher-Centred Learning (TCL) system, are the most widely applied learning methods. Still, unfortunately, there are not many student activities in this learning method because students only focus on listening to the teacher's presentation. As a result, students become passive, and learning becomes less than optimal for students with a visual learning style orientation (Sulandari, 2020). This condition ultimately causes an uneven understanding of students in the learning process who only understand theoretical knowledge so that students will be considered the same or called uniformity in the world of education and do not consider the potential and needs of each different student (Salay, 2019).

To optimise a higher quality learning process, the independent curriculum compiles a learning method centred on students, or student-centred learning (SCL). This method will give students more opportunities to develop personal characteristics in a more optimal learning process (Wahyudin et al., 2024). The advantages of the SCL method are that students will feel that learning will be their own because of broad opportunities to participate, students will be motivated in learning activities, a democratic environment will be built through dialogue and discussion between students in exchanging scientific information, and the delivery of information from previously unknown knowledge will increase these students' insight and knowledge (Farrow et al., 2024; Salay, 2019).

Although the SCL method focuses on students, the role of the teacher is still needed in its implementation. The teacher will act as a facilitator in learning, knowing the competencies that students must master, designing strategies, and creating a supportive learning atmosphere. Providing various learning experiences that help students, guiding students in solving problems, and determining and compiling a relevant assessment system as a measure of student learning achievement (Salay, 2019).

The use of technology as a learning medium has been significantly developed today. Every student can get unlimited knowledge through technology. By utilising technology in the learning process, students can develop creativity and improve their understanding of learning achievements (Lailan, 2024). The Project-Based Learning (PjBL) method can integrate technology into the SCL approach. The PjBL method is one of the SCL methods that encourages students to develop their knowledge and skills through a deep and structured search or exploration process to produce a carefully designed project or product (Prianto et al., 2016).

In the Project-Based Learning (PjBL) method, students are encouraged to independently design and implement projects through teamwork. This approach does not emphasise memorising theories or formulas but analytical skills and critical thinking in processing information to solve problems through projects. In addition, the application of the constructivism principle in PjBL allows for the integration of various disciplines. Offline learning and online learning with the PjBL approach can encourage students to be active in critical thinking, solving problems, collaborating, and reflecting, all of which play an essential role in developing creativity. This method is considered more pragmatic because the focus is more on the learning process than just mastering the material's content (Guerra-Macías & Tobón, 2025; Sumarni, 2015; Yu, 2024).

The implementation stages of the Project-Based Learning (PjBL) method begin with formulating essential basic questions. These questions are the foundation for developing critical thinking skills in finding solutions realised through project design. After the project is designed, the next stage is to carry out project activities and monitor its progress. When the project completes, the process continues with the assessment stage of the project results and overall evaluation (Hapsari, 2019; Juniawan & Wikanta, 2023). The process of searching for information or exploration carried out by students in the PjBL method stage is one of the critical approaches in learning biochemistry courses. Biochemistry is a compulsory course in the Pharmacy Study Program taken by students in semester 3, which is part of forming core competencies in the Pharmacy Study Program. The knowledge gained by students in this course is the foundation for studying courses in the following semester, such as pharmacology and pharmacotherapy. The

material learned includes biochemical processes in the human body, including the metabolism of carbohydrates, lipids, proteins, hormones, and vitamins; and clinical biochemical studies related to metabolic disorders that trigger certain diseases. With a large amount of material discussing metabolic processes in detail, which involves various biochemical components of the body, students often have difficulty understanding metabolic reactions, hormones, and vitamins (Kurniawati & Jailani, 2020). Therefore, an effective learning model is needed to increase students' interest, creativity, and ability to solve problems, which can, in turn, improve their understanding of the teaching material.

Technology in the PjBL method can be implemented effectively in biochemistry courses by creating learning media in animated videos. This approach aims to deepen students' theoretical understanding of biochemistry material and allows them to produce valuable products in the following learning process. In addition, learning using visual and audio media can improve students' focus and concentration because it involves two senses -hearing and sight, so students can visually imagine the process that occurs and understand its complexity (Wikandari et al., 2021).

Research conducted by Kurniawati & Jailani (2020) on students of the Biology Education Study Program at FKIP University stated that as many as 50% wanted a learning method for biochemistry courses using video assistance. Learning methods accompanied by animated images and videos can help students be more focused and directed in understanding the materials. This method can also optimise the learning process and enable the development of teaching materials with easy-to-understand language and a material flow that is arranged according to the needs of biochemistry students. Using animated videos in the learning process can provide positive benefits, namely helping students understand broad courses, supporting teachers in delivering material more effectively, increasing the success of students' understanding, and encouraging more effective student learning methods for the material being studied (Aprilian et al., 2023).

Based on this background, the research team needed to research the application of PjBL method innovation through Animated Learning Video media in Biochemistry Courses in the Pharmacy Study Program, Faculty of Medicine and Health Sciences, University of Jambi. This research was motivated by the efforts of researchers to find the proper and optimal learning method to provide maximum understanding to students. The application of this method is expected to improve students' knowledge, creativity, critical thinking skills, communication skills, collaboration skills, problem-solving skills, and skills in applying technology to support the learning process to be more interesting while motivating them to be more active and involved in the interactive biochemistry learning process.

METHOD

This study is a pre-experimental study by analysing the level of students' understanding obtained from the pre-test and post-test scores at the end of each learning process. This study used a total sampling method, where there were two classes with a total of 64 students involved in this study, namely class A (n = 33) and class B (n = 31). Each class received a different topic for PjBL materials. Class A received a PjBL material topic about hormones, while class B received a PjBL topic about vitamins. To compare the increase in the PjBL method using ALV media, a control group was given related material but used a conventional learning method, namely lectures. When class A explained PjBL with hormone materials, class A became the treatment group. In contrast, class B, as the control group, received materials related to hormones through lectures, and when class B explained PjBL associated with vitamins as the treatment group, class A received material related to vitamins through lectures as the control group.

In implementing the PjBL method, there are systematic steps in implementing activities, namely the briefing stage, planning, scheduling, implementation, assessment, and evaluation (Wajdi, 2017). The six stages of activity implemented in this research are described in Figure 1.

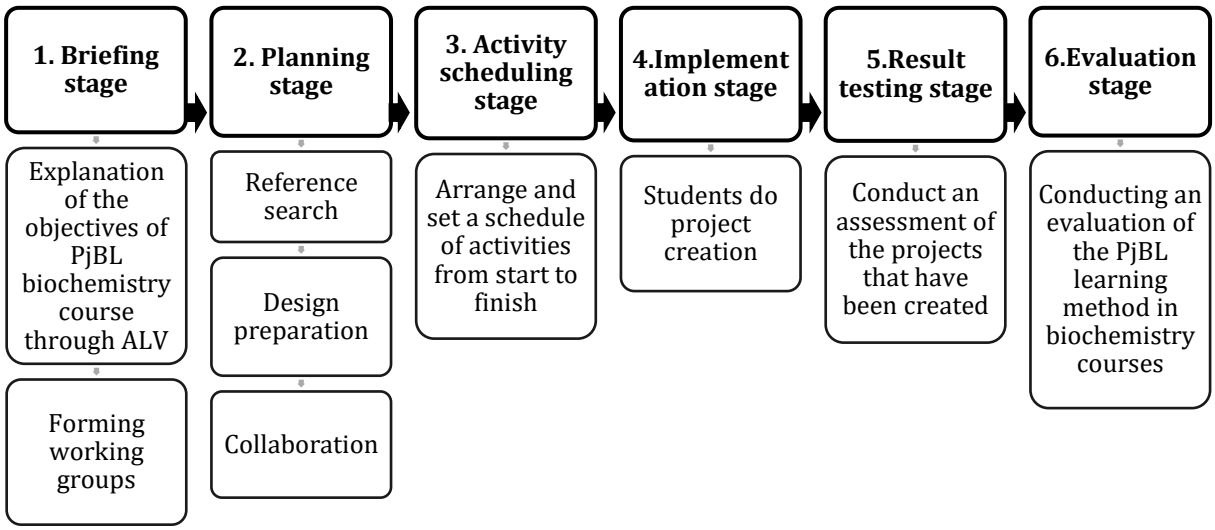

Figure 1. Stages of PjBL implementation activities in biochemistry courses

RESULTS

The results of this study indicate that both the PjBL method and the conventional one have a significant p-value ($p < 0.05$). However, the average value obtained is different in each class. In the class that implemented the PjBL method, the average post-test score was 63.39, higher than the control class with the conventional method, which obtained an average post-test score of 46.45 (see Table 1). This finding is in line with Puspitasari et al. (2024)'s research, which also found that the PjBL learning method has a positive effect on learning outcomes compared to the conventional method (Puspitasari et al., 2024).

Table 1. Results of data analysis on students' level of understanding in vitamin learning

Evaluation	*Mean*		*p-value*
	Pre test	*Post test*	
Treatment (N=31)	41.16	63.39	<0.001*
Control (N = 33)	36.00	46.45	0.002*

Description: p-value <0.05 is declared significant (*)

The results of the dependent t-test conducted on both learning methods, as seen in Table 2, show significance with a p-value <0.05. However, the class with the PjBL method obtained a higher average post-test score, which was 66.39, compared to the control class using the conventional method, with a post-test score of 60.18. This shows that the PjBL method is more effective in improving students' understanding than the traditional method. In conventional methods, learning vitamins and hormones significantly increases understanding because this can be influenced by the lecturer's communication skills related to effective material delivery, thereby encouraging active students' participation. This active learning experience also plays an essential role in stimulating changes in neural connections that support the learning process in the brain (Uden et al., 2023). In this study, the PjBL method was applied for the first time with the Student-Centred Learning (SCL) approach using animated learning videos. However, due to its new nature, this method still requires further evaluation and refinement to maximize the effectiveness of the learning process.

Table 2. Results of data analysis on students' level of understanding in hormone learning

Evaluation	*Mean*		*p-value*
	Pre test	*Post test*	
Treatment (N=33)	40.97	66.39	<0.001*
Control (N = 31)	40.18	60.18	<0.001*

Description: p-value <0.05 is considered significant (*)

At the evaluation stage, to witness students' satisfaction with the PjBL method, a questionnaire was given in the form of a Google form consisting of 9 questions adapted from the questionnaire by Fitriani & Sarkity (2023). The results of a survey of students' satisfaction with the PjBL method in the biochemistry course that the study conducted on 3rd-semester students, as seen in Figure 2, measured the parameters of increasing interest, motivation, creativity, critical thinking skills, and communication skills in learning. The results show that 98.4% of students agreed that applying the PjBL method with animated video project assignments could increase their interest in participating in biochemistry learning. However, 1.6% of students disagreed, which was caused by the video duration being too short or the video display being less interesting, making the material tedious and challenging to understand.

As many as 96.9% of students stated that implementing the PjBL method through animated video project assignments effectively motivated them to learn better, and only 3.1% disagreed. This study's results align with previous studies on PjBL in the Science Education Study Program, which showed that this method increased student motivation to 97% who were satisfied with PjBL-based learning and strengthened their commitment to the learning process. This method also encourages students to integrate theory with its application in the real world (Quinapallo-Quintana & Baldeón-Zambrano, 2024). In this study, 3.1% of students' disagreements were generally caused by students needing more time to adapt to the collaborative learning environment. The less-than-optimal adaptation process made some students less active, which, in the end, could hinder the understanding of other students. In this situation, video project coordination is often only managed by students who are more dominant or understand the task well.

This study shows that implementing the PjBL method using Video Animated Learning (ALV) media successfully increases students' creativity and critical thinking skills, as seen from the quality of the videos they produce to explain biochemistry lecture materials. This study also shows that PjBL positively impacts students' creativity, critical thinking skills, and collaboration. As many as 100% of students agree that implementing PjBL with animated video project assignments increases their creativity, while 96.9% agree that this method also improves their critical thinking skills. The same results were also shown when applying PjBL to critical and creative abilities in physics learning (Ananda et al., 2021) Developing critical thinking skills will encourage increased student understanding of the material (Song et al., 2025). Only 3.1% disagreed. Two out of 64 students disagreed because making videos and understanding the materials took longer.

The application of the PjBL method aims to contribute to the development of the world of educational science by collaborating with the use of technology to improve students' understanding. In addition, the method uses five elements of the scientific approach: observing, asking, trying, reasoning, and communicating (Gaffar et al., 2023). In this PjBL study, a survey of students regarding the assignment of animated video projects showed that 95.3% of the students agreed that the method could improve communication skills. By implementing the PjBL method, students can develop their communication skills, both in writing and orally, in conveying arguments (Purwianingsih et al., 2023). As many as 4.7% (3 out of 64) students who disagreed stated that PjBL with animated video projects did not improve their communication skills because they did not take advantage of the opportunity and time to consult with the lecturer regarding obstacles and lack of understanding of the materials to be discussed. The main objective of this PjBL method is to increase teaching effectiveness through various learning activities and encourage good communication skills, individually and in groups, for the project's success (Bangun et al., 2022).

Implementing the PjBL innovation also impacts the parameters of increasing collaboration skills, problem-solving skills, technology, and understanding of biochemical materials, as shown in Figure 3. In increasing collaboration, 100% of students agreed that implementing PjBL with video projects improves their collaboration skills. These results are the same as research conducted by Rahmadhani and Ardi (2024), which found that the PjBL method influences aspects of students' collaboration skills (Rahmadhani & Ardi, 2024).

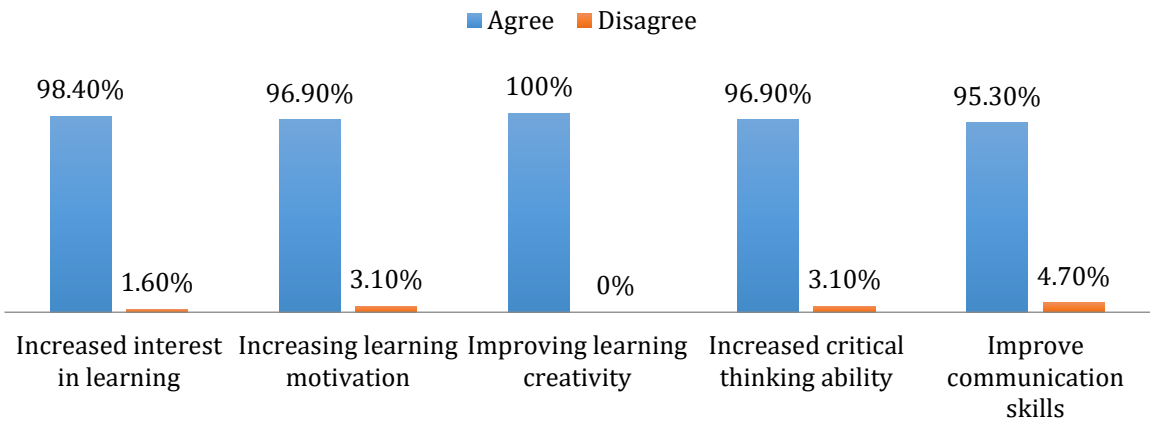

Figure 2. Results of the evaluation of the implementation of PjBL innovation on interest, motivation, creativity, critical thinking, and communication

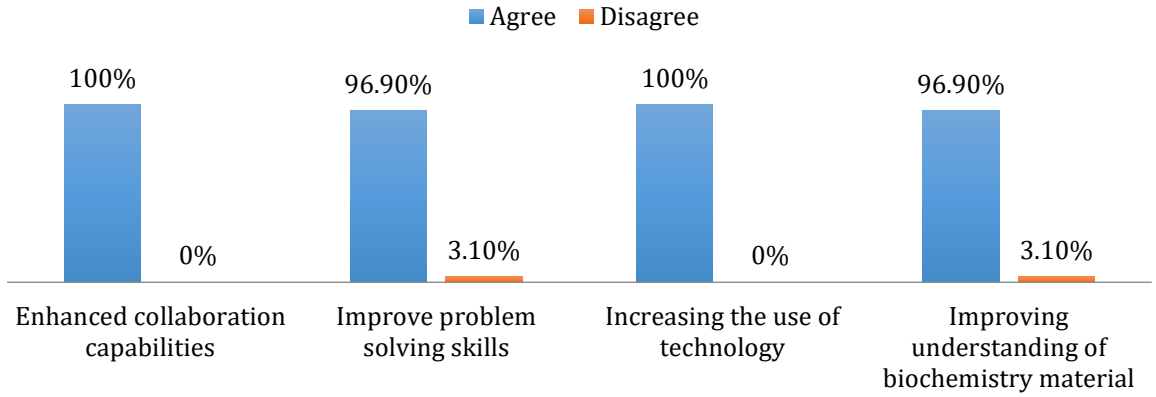

Figure 3. Results of the evaluation of the implementation of PjBL innovation on collaboration, problem-solving, technology, and understanding

The relationship between implementing PjBL and improving students' problem-solving skills shows that 96.9% of students agreed, while 3.1% disagreed. This disagreement is caused by students' lack of initiative and activeness in consulting with the lecturer, which results in 3.1% (2 out of 64) of students disagreeing or strongly disagreeing with this aspect. Improving students' problem-solving skills is one of the advantages of implementing the PjBL learning method, which increases curiosity about new knowledge, enhances problem-solving and critical thinking skills, and improves communication skills (Serin, 2019).

Implementing PjBL is expected to increase students' understanding of biochemistry courses. The majority, 96.9% of students, agreed that their understanding had increased, although 3.1% (2 out of 64) still disagreed that PjBL with animated video media was effective in increasing understanding. This is because animated learning videos have several shortcomings, such as sound quality, unclear explanations, and the need for additional material in the form of lectures from lecturers to deepen understanding.

DISCUSSION

The innovation of the PjBL method aims to improve various critical aspects of the learning process, such as creativity, critical thinking skills, self-confidence, independence, communication, collaboration, and responsibility. This method has several advantages, such as increasing learning motivation, encouraging student collaboration and cooperation, and developing creativity. In addition, PjBL is effective in expanding knowledge and understanding, improving communication skills through collaborative activities, and improving problem-solving skills, management, and

coordination of learning resources. Overall, PjBL creates a fun learning environment through the results of student creativity (Maor et al., 2023; Wainwright, 2018).

Based on the results of a meta-analysis of various studies, the PjBL method has proven effective in stimulating students' ability to apply knowledge in solving problems relevant to real life. PjBL is implemented by forming small groups that encourage collaboration, increase participation, and foster interest and motivation to learn. This method provides space for students to actively explore the subject matter, supported by a specific time allocation designed to allow for optimal conceptual deepening. This project-based learning process improves students' understanding and enriches their learning experience by applying theoretical principles to actual practice (Zhang & Ma, 2023).

The biochemistry course is the science of the chemical constituents of living cells and the reactions and processes experienced by these constituents, including cell biology, molecular biology, and molecular genetics (Murray et al., 2017). Hormones and vitamins are essential substances that work on responses in the body. Having a specific and detailed mechanism process sometimes makes it difficult for students to understand comprehensively related to the materials; based on this, the materials on hormones and vitamins was raised to be used as project-based learning (PjBL) material. This PjBL method positively impacts increasing students' knowledge, creativity, and innovation in technological development.

Research shows various advantages of applying the PjBL method with animated video projects in biochemistry courses. The study's results revealed a high student agreement with this method, positively impacting interest. The increase in students' interest resulting from applying the PjBL method aligns with the PjBL research conducted by Gaffar et al. (2023), which shows that increasing student interest also impacts creativity, critical thinking skills, and collaboration skills (Gaffar et al., 2023).

The diversity of students' characteristics and different learning approaches require adjustments to apply the PjBL method optimally. However, PjBL is designed to develop students' critical and creative thinking skills in finding innovative solutions. In addition to producing projects based on deep understanding, this method also contributes to forming students' personalities. PjBL encourages openness, strengthens collaboration, and helps students explore their potential and increase self-confidence. With this approach, PjBL becomes an effective learning system that prepares students to face real-world challenges through high-level thinking skills and productive collaboration (Manikutty et al., 2022).

The PjBL method in this study improved students' creativity and critical thinking skills through Animated Learning Video (ALV). Creativity is an ability individuals possess to find and produce new things, new ideas, and valuable ways for themselves and society. Creative thinking is not about finding something new but how the individual can collaborate existing things into new constructs to produce different qualities (Sudarti, 2020). This creativity needs to be built in the student environment to train students' abilities in creativity. One of the efforts in building creative and critical thinking skills in students is by implementing learning methods through PjBL, which is also supported by research by Sari and Angreni (2018), which shows an increase in student creativity through the PjBL learning method (Sari & Angreni, 2018).

Through the PjBL method, students can improve their 4C skills, namely critical thinking, creativity, communication, and collaboration. These skills are built by providing a project so students can find solutions to problems independently (Ekaputra, 2024). Previous research conducted by Dias-Oliveira, et al. (2024) on business students through Multidisciplinary Project I (MPI) found that MPI students were better able to think critically, defend arguments, communicate effectively, and create productive teamwork (Dias-Oliveira et al., 2024).

The problems that become obstacles in implementing the PjBL method indicate the need for improvements in time management, increased collaboration skills, and further support from lecturers to ensure the smooth implementation of the PjBL project. This approach has great potential to improve the quality of learning if its shortcomings can be overcome with the proper steps. The successful implementation of this method requires a longer process and cannot be done in one go (Maros et al., 2023). In addition, research conducted by Wikandari et al. showed that learning methods that combine animated videos and flipped learning can significantly improve

students' understanding, compared to methods that only use PowerPoint and animated videos. Students can study the material repeatedly outside the class meeting schedule through flipped learning (Wikandari et al., 2021).

Some of these weaknesses are significant evaluation materials in the application of the PjBL method with future animation video projects so that it can produce more optimal and comprehensive project output. The purpose of the PjBL method is to provide opportunities for students to be able to explore, solve problems, make decisions, and design a project through this learning process, which will ultimately form and encourage interest, motivation, creativity, critical thinking skills, communication, collaboration, skills in solving problems, utilising technology and information, and increasing students' understanding of new knowledge (Muqtada et al., 2023).

Several techniques and strategies are used to improve the success of implementing the PjBL method. First, good time coordination ensures project work runs according to the planned stages. Second, provide learning orientation to ensure students understand the PjBL method that will be applied. Third, students should be responsible for designing, deciding, and developing their projects. Fourth, groups should be formed to encourage active student participation. Fifth, collaboration should be encouraged with various parties to produce better projects. Sixth, provide opportunities for students to utilize technology in project development. Seventh, assessments should be provided using multiple methods, both individual and group, and opportunities should be offered to students to give feedback on projects that have been implemented (Dewi, 2022).

This research supports innovation in learning methods, especially in applying Project-Based Learning (PjBL) combined with animated videos, and provides new insights into how these two approaches can improve students' understanding and creativity in biochemistry courses. In addition, this research contributes to developing project-based learning models focusing on using visual media to explain more complex materials. This method also presents innovation in the learning process by combining engaging and interactive technology, which can be applied to various disciplines. Thus, students are trained to work collaboratively in completing projects, which at the same time improves their abilities in groups, communication, and problem-solving.

CONCLUSION

Research on the Project-Based Learning (PjBL) method with animation projects shows a significant increase in students' knowledge of biochemistry courses, with a higher average score than conventional learning methods. In addition, this method also shows the level of student satisfaction, which is reflected in the diagram showing that most students agree that the implementation of PjBL can increase learning interest, motivation, creativity, critical thinking skills, communication, collaboration, problem-solving skills, and the ability to utilize technology and information, as well as improving understanding of biochemistry material. The limitation of this study was the limited duration of implementation, so further research is recommended to be carried out over a more extended time and combine the animation video method with other effective learning methods to improve memory of the material.

Author contributions

The authors made significant contributions to the study's conception and design. The authors was in charge of data analysis, interpretation, and discussion of results. The final manuscript was read and approved by the authors.

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Conflict of interest

The authors declare that there is no potential conflict of interest.

Data availability statement

All data are available from the authors.

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