Students' perceptions on learning, motivation, and performance through project-based learning: undergraduate students' case

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Abstrak. *Project-based learning* merupakan salah satu pendekatan yang dapat memfasilitasi terwujudnya pembelajaran autentik. Pembelajaran autentik berbasis pengalaman yang dilaksanakan untuk mempersiapkan para mahasiswa sebagai calon pendidik dapat mengembangkan kompetensi mengajar yang dibutuhkan. Peran *project-based learning* dalam mendukung pengalaman belajar mahasiswa tersebut perlu dievaluasi melalui suatu asesmen. Oleh karena itu, dilaksanakan penelitian yang bertujuan untuk mengukur perspektif mahasiswa terhadap implementasi *project-based learning* melalui suatu survei ini. Mahasiswa peserta mata kuliah strategi pembelajaran matematika pada fakultas keguruan dan ilmu pendidikan di salah satu universitas berpartisipasi sebagai responden survei tersebut. Respon terhadap kuesioner pada survei diberikan berdasarkan pengalaman yang diperoleh mahasiswa dalam tugas proyek pembuatan video simulasi strategi pembelajaran. Data penelitian yang terkumpul kemudian dianalisis secara deskriptif. Hasil analisis data menunjukkan bahwa *project-based learning* berdampak positif terhadap pengalaman belajar, motivasi, dan kinerja mahasiswa. Dengan demikian, implementasi *project-based learning* dapat dipelajari dan dikembangkan secara lebih mendalam dalam penelitian-penelitian atau pembelajaran-pembelajaran selanjutnya.

Kata kunci: analisis pembelajaran, motivasi belajar, evaluasi kinerja, *project-based learning*

Abstract. Project-based learning is an approach that is able to facilitate authentic learning. Authentic learning as an experiential process that prepares future educators can help the development of necessary teaching skills. Assessment of project-based learning is required to evaluate how it successfully promotes students' learning. Therefore, this research was conducted to assess students' perspectives on the implementation of project-based learning through a survey. Undergraduate students who enrolled in a mathematics learning strategy course at a faculty of teaching training and education of a university participated in the survey. Student samples responded to the questionnaire based on their experiences producing the learning strategy simulation video as the project assignment. The collected research data were then analyzed descriptively. Data analysis results suggested that project-based learning positively impacted students' learning, motivation, and performance. As a result, future research and learning can investigate and implement project-based learning in greater depth.

Keywords: learning analysis, learning motivation, performance evaluation, project-based learning

Introduction

Undergraduate mathematics education students required an advanced understanding of mathematics learning strategies to support their preparation as future educators. A well-rounded understanding can be obtained by using a specific approach to authentic learning. Project-based learning is a suitable approach that accommodates students' authentic learning. Student-centered learning can be practiced through students' interactions with authentic issues by implementing project-based learning (Al-Balushi & Al-Aamri, 2014). Project-based

learning as an instructional approach provides a framework as well as mindset for teaching skills and teaching content. Project-based learning can be distinguished from other approaches by the word project itself that is related to production and complexity concepts (Lenz et al., 2015). Project-based learning that was initially introduced by John Dewey involves a product or performance creation and authentic tasks (Warin et al., 2016). Project-based learning is one of the primary approaches that is implemented to realize active learning, which is in line with the Merdeka Belajar Kampus Merdeka policy (Yudhawasthi & Christiani, 2022). Merdeka Belajar Kampus Merdeka, that is released by Indonesia's Ministry of Education and Culture, facilitates students' knowledge acquisition to face global competition (Baharuddin, 2021; Fatmawati, 2021). Therefore, project-based learning was selected as one of the implemented approaches in the mathematics learning strategy course.

Gibbes & Carson (2014) who conducted Activity Theory analysis to investigate students' reflections of project-based learning in a university proposed that project-based learning is implemented in numerous higher education disciplines. Thus, the outcomes of the implemented project-based learning must be assessed. They may be assessed from the perspective of the students. An exploration on students' perspective is acceptable since students directly gain the advantage (Chu et al., 2017). Measurement of students' perceptions toward project-based learning quality may be performed through the evaluation. Research was conducted by Trisnowati & Ismawati (2018) to study students' perspectives on their learning readiness, interest, and profile in project-based learning. An assessment of how students perceive their learning, motivation, and performance is required as well. Students' perceptions of their learning, motivation, and performance could represent the effectiveness of a learning.

There have been researchers who have studied how important experience-based learning is. Project-based learning has the potential to develop experiential learning (Miranda et al., 2020). According to Yardley et al. (2012), experiential project-based learning helps students construct knowledge and make sense of real-life situations. (Syakur et al., 2020) revealed that project-based learning could promote students' learning motivation and achievement through the application of problems in certain courses to real-life situations. On the other hand, O'Leary et al., (2019) suggested that experiential learning improves the quality of the learning process through a stronger construction of knowledge in a robust learning process.

Several studies have also shown how students' motivation for studying impacts their performance. Froiland & Worrell (2016) examined students' intrinsic motivation and academic performance relationship to reveal that students' learning motivation and learning performance are significantly and positively associated. A study that was performed by (Law et al., 2019) also revealed learning motivation impacts on learning performance. Project-based learning has a positive effect on students' intrinsic learning motivation through the improvement of interest, autonomy, competence, and pressure (Zhang, 2021).

Several researches have also identified the effects of project-based learning on students' performance. Chen & Yang (2019) reviewed the improvement of teachers' direct instruction on primary, secondary, and tertiary students' academic achievement by implementing project-based learning. The results indicated that project-based learning contributed more to students' academic achievement than direct instruction. Project-based learning successfully engaged students through authentic project work and product development. Moreover, Boubouka &

Papanikolaou (2013) found that project-based learning positively affected students' perceived learning performance.

Nonetheless, there are unresearched project-based learning impacts that need to be investigated. The earlier studies looked into the perceived effects of project-based learning on students' learning, motivation, and performance in separated investigations. Accordingly, this research proposed a comprehensive evaluation of the impacts of project-based learning implementation on these three aspects. The evaluation was conducted based on mathematics education study program undergraduate students' discernments. The majority of prior research has concentrated on the implementation of earlier stage students' learning or other majors and courses, such as studies by Mosier et al. (2016), Beier et al. (2019), Choi et al. (2019), Tsybulsky & Muchnik-Rozanov (2019), Barus & Simanjuntak (2020), and Almulla (2020). Therefore, it is imperative to enrich researches on the approach's implementation and evaluation on the occasionally investigated population in this field.

Ngereja et al. (2020) suggested three measurement criteria to evaluate the performance of students' learning project-based learning. Learning, motivation, and performance are the measurement criteria that have significantly aided the effectiveness of learning. The learning criterion focused on measuring learning outcomes, including achieved knowledge and competencies. The motivation criterion evaluated conditions that support students' learning. The performance criterion assessed the long-term benefit of knowledge gained. Puspitarini & Hanif (2019) stated that learning is undertaken to acquire knowledge, acquire specific competencies, and form attitudes of students. Moreover, students' learning motivation, which could lead them to get along with the learning process, will support their learning activities.

Hence, the identification of whether project-based learning successfully promotes students' learning needs to be conducted. A summative assessment was conducted to identify how the implementation of project-based learning affect students' learning in the mathematics learning strategy course. The evaluation is expected to reveal how the implemented approach facilitates students to experience an authentic learning. It leads to the objective of this research which is aimed to evaluate the perceived impacts of project-based learning on students' learning experience, students' learning motivation, and students' learning performance from students' perspective.

Research Methods

This research was performed in a mathematics learning strategy course to reveal how project-based learning in the course impacts students' learning, motivation, and performance. This course was rolled out in the 2022/2023 academic year for mathematics education study program students. Undergraduate students who were enrolled in this course could learn about learning models and approaches as mathematics learning strategies. A learning simulation video production project was assigned in the second term of the semester to practice these learning strategies in small groups. Each group that was consisted of 2 or 3 students simulated different learning strategies in a 10-minute video.

The produced video demonstrated the implementation of an assigned learning strategy. One of the group members played the teacher role in the simulation class, while the rest played

as students. Several members of other groups supported them by playing the students' roles in the video recording. They simulated and recorded learning activities based on the model or approach. The learning simulation recordings are then processed in video editing and uploaded on a video sharing website, as shown in Figure 1. The published videos, which are digitally available at https://bit.ly/MLS_01_PjBL_videos, can be used as learning aids.
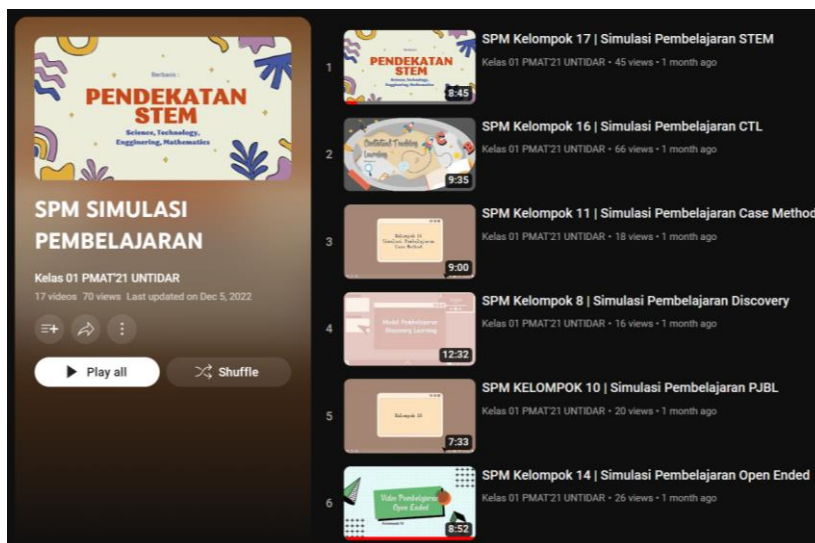

Figure 1. Publication of learning simulation video project results on a video sharing website

A survey was conducted at the end of the semester to collect students' perspectives towards the project-based learning assignment data. A questionnaire as the survey instrument was adapted from the instrument that was developed by Ngereja et al. (2020). The questionnaire was consisted of three criteria, i.e., project-based learning impacts on learning, motivation, and performance. Project-based learning impacts on these three criteria were measured using ten statements as measurement scales. Each measurement scale used 5-point Likert scale, i.e., strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1). The measurement scales of each criterion are shown in Table 1.

Table 1. Students' perception on project-based learning measurement criteria and scales

Measurement Criteria	Measurement Scales
A. Learning	1. The learning simulation video production project assignment helped me to gain an in-depth understanding of one or several concepts of the video topic
	2. The learning simulation video production project assignment provided an opportunity to relate better to the concepts of the video topic
	3. The learning simulation video production project assignment helped me to develop my technology, organizing, and innovation skills
	4. The learning simulation video production project assignment provided an authentic experience

Measurement Criteria	Measurement Scales
B. Motivation	5. Knowing the learning simulation video production project assignment percentage weight of the final score has motivated me to put in extra effort in working on the project
	6. Knowing that the the learning simulation video production project results will be used as learning aids in the Mathematics Learning Strategy course has motivated me to put in extra effort in working on the project
	7. I enjoyed working with my learning simulation video production project assignment fellow team members very much
C. Performance	8. I will be able to manage my future projects better through learning simulation video production project assignment
	9. I believe that the learning simulation video my team has produced will be an excellent learning aid
	10. I evaluate my team efforts in collaborating, communicating, and sharing knowledge within the team as outstanding

The survey was distributed to mathematics education students who were enrolled in the mathematics learning strategy course. Responses that have been collected from 82 survey participants through an online survey were processed for data analysis. The data processing was done for the data analysis following the data collection from students who had completed the course. The data sample were analyzed descriptively to uncover the contribution of each criterion to students' learning experience. Cronbach's alpha was used to test the measurement scales' internal consistency reliability. The reliability test result indicated that the scale had good internal consistency with the calculated Cronbach's alpha was 0.8496 which was greater than 0.8. Furthermore, the validity of the measurement was tested using face validity to show that the survey able to measure the claimed measurement and using content validity by expert opinion. Experts' decisions indicated that the measurement scales were intelligible and could cover the criteria that were intended to be measured.

Results and Discussion

There were 82 student samples who participated as respondents of the survey. The data descriptive analysis projected a significant learning outcome experienced by students. Most of students strongly agreed that the project aided them to gain a comprehensive understanding of concepts as well as an authentic experience. Besides, students mostly agreed to other eight measures of the three criteria. The collected responses for each measurement scale are shown in Table 2.

Table 2. Results of the project performance survey

Measure	n	Participants				
		SA	A	N	D	SD
1	82	54	27	1	0	0
2	82	40	41	1	0	0
3	82	40	40	2	0	0
4	82	44	37	1	0	0
5	82	34	47	1	0	0
6	82	33	46	2	1	0
7	82	29	47	6	0	0
8	82	24	55	3	0	0
9	82	37	39	6	0	0
10	82	30	46	6	0	0

n: total number of participants; SA: strongly agree; A: agree; N: neutral; D: disagree; SD: strongly disagree

A descriptive interpretation of the weighted mean was composed based on the interval that was proposed by Pimentel (2019). Table 3 shows the description interpretation of the weighted mean that summarized the collected data.

Table 3. The descriptive interpretation of the measurement

Likert Scale	Interval	Description
1	1.00-1.79	Strongly disagree
2	1.80-2.59	Disagree
3	2.60-3.39	Neutral
4	3.40-4.19	Agree
5	4.20-5.00	Strongly agree

The mean students' perceptions on of projects-based learning of each criterion data was also calculated based on the responses. The mean as a descriptive summary of the collected data are shown in Table 4.

Table 4. Students' perceptions mean score on the project-based learning

Criteria		Project-based Learning Impacts	Mean	Description
A. Learning	1.	Gaining an in-depth understanding of the discussed concepts	4.65	Strongly agree
	2.	Relating better to the discussed concepts	4.48	Strongly agree
	3.	Developing technology, organizing, and innovation skills	4.46	Strongly agree
	4.	Having an authentic experience	4.52	Strongly agree
B. Motivation	5.	Putting in extra effort by knowing the percentage weight of the project score	4.40	Strongly agree
	6.	Putting in extra effort by knowing that the project result will be used as learning aids	4.35	Strongly agree
	7.	Enjoying working in the team	4.28	Strongly agree
C. Performance	8.	Having better project management ability	4.26	Strongly agree
	9.	Believing that the project result will be an excellent learning aid	4.38	Strongly agree
	10.	Having an outstanding team collaboration, communication, and knowledge sharing	4.29	Strongly agree

The descriptive interpretation of each weighted mean suggested that project-based learning in the mathematics learning strategy course excellently promoted students' learning. The improvement was indicated by students' in-depth understanding, their engagement to the concepts, their developed related skills, and authentic experiences they gained. The measurement showed that 93% of all students strongly agreed that the learning simulation video production project helped them to gain an in-depth understanding of the video topic concepts. The data also showed that 90% of students strongly agreed that they were more related to the learning strategy concepts that they simulated in the project. In addition, 89% of the students also strongly agreed that their technology, organizing, and innovation skills could be developed through the project assignment. The result also projected 91% of all students strongly agreed that an authentic experience was provided by the assignment.

Moreover, it could be summarized from the mean of each motivation measure criterion that students' motivation was greatly encouraged by the project-based learning. Students' motivation was investigated through their perception of their effort in completing the project and their enjoyment of the teamwork. The results showed that 88% and 87% of the students strongly agreed that the video production assignment motivated students to put in extra effort respectively by knowing the percentage weight of the final score and by knowing that the video will be used as learning aids. Besides, 86% of students also strongly agree that they enjoyed working on the project with their team.

Project-based learning had a positive impact on students' performance in the mathematics learning strategy course as well as the two previous categories. Students' performances in their project management abilities, producing project results, and teamwork

were positively impacted. 85% of all students strongly agreed that their video production experience could develop their project management ability that will be applied in the future projects. In addition, 88% of students strongly agreed that the produced videos will be excellently aid the learning activity. 86% of all students strongly agreed as well that their teams' have performed an outstanding collaboration, communication, and knowledge sharing.

The data analyzed showed that students' positive perspectives on the learning process through project-based learning in the course supported the learning simulation video production. The video production project was aimed to enhance students' experience through their engagement to the experiential learning. The survey conducted also revealed that project-based learning supported the students' understanding and engagement with the concepts. It is in accordance with Yardley et al. (2012), who proposed that project-based learning is experiential learning that is conducted in the light of context and situations that are relevant to students' future careers. Project-based learning successfully developed students' authentic experience as well as skills that are related to technology, organization, and innovation. The experiential learning also promotes students' knowledge construction. The enhancement showed a positive effect to the construction of students' knowledge (O'Leary et al., 2019). Implementing project-based learning also allowed for the creation of project-making curricula with an integrated learning effect. Therefore, students' learning effectiveness for their professional skills is able to be improved.

This research findings supported Zhang (2021) who argued that students' interest, autonomy, competence, and pressure improvement. Students perceived that the project score percentage weight pushed them to work harder. The data also indicated that students' interest was projected by the extra efforts they put in to serve learning aids that showed competence improvements. Students' appreciation for teamwork was able to improve their autonomous work within the team as well. Eventually, students' motivation will be promoted through the project-based learning implementation.

Students' motivation is related to their academic performance as stated by Froiland & Worrell (2016) and Law et al. (2019). Students perceived that they be able to improve their project management through the video making assignment. Their authentic video production activity has resulted in an outstanding learning aid by collaborating, communicating, and sharing knowledge excellently. These findings are in accordance with (Chen & Yang, 2019) who revealed that students were engaged more to the learning by developing the authentic product. The authentic product development promoted students' learning performance since the meaningful projects and real-world product development constructed their knowledge (Brundiers & Wiek, 2013; Krajcik & Shin, 2014).

Conclusion and Recommendation

The results suggested that students perceived positive impacts on learning, motivation, and performance in the implemented project-based learning. Project-based learning has successfully assisted students to gain an authentic learning experience through the project assignment. The meaningful learning also excellently promotes students understanding of the learning material concepts. The findings that showed a successful implementation project-based learning are supported by the following student's statement: "The project-based learning

assignment helped us as future educators gain a well-rounded understanding of how to prepare learning strategies that suit the learning objectives."

The research results justified that project-based learning has an outstanding effect on learning. Hence, other research will be established to prepare for improved project-based learning in the future. More advanced learning activities and project assignments will be planned according to the research findings. Furthermore, future studies will evaluate the project-based learning implementation in the same course or other courses to improve the learning experience. Other analysis method beside the students' perspective may be selected to study the implementation of project-based learning.

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