The effect of physical activity in team-based project learning on collaboration skills

La influencia de la actividad física en el aprendizaje por proyectos en equipo sobre las habilidades de colaboración

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Abstract

Introduction: Learning that emphasizes physical activity contributes to a person's ability to interact positively with others. One of the learning that emphasizes group-based physical activity is Team-based Entrepreneurship Project (TBEP) learning.
Objective: This study aims to determine (a) the effect of TBEP learning on collaboration skills, and (b) the effect of TBEP learning on collaboration skills based on gender.
Methodology: This study is a pre-experimental study with a One Group Pretest-Post-test design. The research sample consisted of 92 students. The data collection technique used was observation. The data analysis technique used quantitative descriptive analysis.
Results: The results of the data analysis obtained a significance value of 0.000. The collaboration skills of female students increased by 0.62 (moderate), and in male students increased by 0.19 (low).
Discussion: The TBEP model is effective in improving students' collaboration skills because TBEP learning invites students to be active directly. Female students have stronger characteristics in maintaining cooperation with group members in solving problems.
Conclusion: In general, the TBEP learning model can improve student collaboration. Based on gender, the improvement of female students' collaboration skills is better than male students.

Keywords

Collaboration; entrepreneurship; gender; physical activities; team-based project.

Resumen

Introducción: El aprendizaje que enfatiza la actividad física contribuye a la capacidad de una persona para interactuar positivamente con los demás. Una de las actividades de aprendizaje que enfatiza la actividad física en grupo es el aprendizaje del Proyecto de Emprendimiento Basado en Equipo (TBEP).
Objetivo: Este estudio tiene como objetivo determinar (a) el efecto del aprendizaje TBEP en las habilidades de colaboración, y (b) el efecto del aprendizaje TBEP en las habilidades de colaboración en función del género.
Metodología: Esta investigación es una investigación preexperimental con un diseño Pretest-Post-test de un grupo. La muestra de investigación estuvo constituida por 92 estudiantes. La técnica de recolección de datos utilizada es la observación. La técnica de análisis de datos utiliza análisis descriptivo cuantitativo.
Resultados: Los resultados del análisis de datos obtuvieron un valor de significancia de 0,000. Las habilidades de colaboración de las estudiantes mujeres aumentaron en 0,62 (moderadas) y las de los estudiantes hombres aumentaron en 0,19 (bajas).
Discusión: El modelo TBEP es eficaz para mejorar las habilidades de colaboración de los estudiantes porque el aprendizaje TBEP invita a los estudiantes a ser activos directamente. Las estudiantes mujeres tienen características más fuertes a la hora de mantener la cooperación con los miembros del grupo en la solución de problemas.
Conclusión: En general, el modelo de aprendizaje TBEP puede mejorar la colaboración estudiantil. En función del género, la mejora de las habilidades de colaboración de las estudiantes es mejor que la de los estudiantes.

Palabras clave

Actividades físicas; colaboración; emprendimiento; género; proyecto en equipo.

Introduction

Collaboration skills are one of the key competencies needed to succeed in academic and other professional fields (García Pérez et al., 2021; Lamb et al., 2017; Salamanca et al., 2020; Thornhill Miller et al., 2023). Sari et al. (2017) argue that collaboration skills are the ability to participate in every activity to build relationships with others, respect relationships and teamwork to achieve the same goal. Collaboration skills are mandatory for students as life skills because they can help students develop the importance of social and personal dimensions (Dewi et al., 2020). Therefore, collaboration skills are something that students need to master. Collaboration skills include working together, communicating effectively, resolving conflicts, and building productive relationships. Along with the increasing focus on collaboration skills, various methods to improve collaborative abilities have been explored, including student physical activity.

Physical activity can be defined as any body movement that uses muscles and requires more energy (Trimuliana, et al., 2022). Physical activity can be in the form of structured sports or other physical activities related to the movement of body parts, which have benefits for physical and mental health (Irab et al., 2024; Tassitano, et al., 2020). Some examples of learning that emphasize physical activity include a) physical-based educational games, which use physical movement to teach academic concepts. For example, games that require students to solve puzzles or answer questions while moving can increase engagement and understanding of the material; b) physical activity during learning sessions, which is integrating short periods of physical activity, such as stretching or breathing exercises, during learning sessions to increase student concentration and energy; c) collaborative projects with physical components, which is designing team-based projects that involve physical elements, such as making models of molecular design projects, constructing multilevel filtration devices, making models of earth rocks, or making entrepreneurial projects; d) mobile learning techniques, which are implementing learning techniques that combine movement with the learning process, such as group-based learning where students move from one group to another to complete tasks related to the subject matter; and e) flexible classroom settings, which is designing classrooms that support physical activity, such as tables that can be moved or areas designed for group activities. This helps students interact physically and socially while learning.

Learning that emphasizes physical activity can psychologically improve mental well-being and reduce stress, contributing to a person's ability to interact positively with others. Physical activities that involve teamwork, such as team sports or group games, can improve children's social skills and attitudes (Li & Shao, 2022; Rahman et al., 2024). Physical activity often creates an environment where individuals must coordinate and work together to achieve common goals, developing skills relevant to effective collaboration. In addition, learning that emphasizes physical activity can strengthen relationships between team members, build trust, and facilitate better communication. This is important because effective collaboration often depends on strong relationships and clear communication between team members.

One learning model that emphasizes physical activity is team-based entrepreneurship project learning (TBEP). A team-based Entrepreneurship Project is a group-based learning model that emphasizes the creation of entrepreneurial projects. The TBEP learning model aims to focus students on real problems and enable them to develop skills and knowledge through complex and meaningful project activities. Entrepreneurial projects developed by students are entrepreneurial projects based on environmental problems that are linked to lecture material. In TBEP learning, students are invited to analyze environmental problems and find alternative solutions to solve these problems. For example, overcoming pollution due to unconditioned coconut water waste disposal, post-harvest banana stem waste processing, and so on. The solutions designed by students are then made into entrepreneurial projects in groups. Through this project, students are expected to develop several skills needed in the 21st century. Trimuliana, et al., (2022) stated that learning involving physical activity can optimize various potentials students possess, especially in terms of motor development. In addition, learning involving physical activity can develop students' social and psychological skills (Maugeri et al., 2020; Opstoel et al., 2020).

Based on the description above, it is essential to explore further how 1) the influence of learning involving group-based physical activity (TBEP) on students' overall collaboration skills; 2) the influence of learning involving group-based physical activity (TBEP) on students' collaboration skills based on gender.

Method

Participants

The sample in this study was 92 students consisting of 9 male students and 83 female students who took the green chemistry-based entrepreneurship course at Walisongo State Islamic University Semarang, Indonesia. The age of the sample students ranged between 20 and 21 years.

Procedure

This study is a pre-experimental research with a one-group pretest-postest Design to measure students' collaboration skills after group-based physical activity learning.

Data collection

The data collection tool used in this study is an observation sheet instrument developed based on a review of relevant literature. In addition, the observation sheet has been tested for validity and reliability. The instruments used have been validated by 5 lecturers with expertise in learning models and learning evaluation. The validation result are presented in Table 1.

Table 1. Validation Result

	Item																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ne	7	6	6	6	6	6	7	7	7	6	6	6	7	7	7	7	6	7	6	7
I-CVI	1	0,86	0,86	0,86	0,86	0,86	1	1	1	0,86	0,86	0,86	1	1	1	1	0,86	1	0,86	1
Desc	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V

V=valid

The observation sheet is compiled based on collaboration skill indicators, which consist of 5 questions related to student collaboration skill indicators. The outline of the five questions is a) skills in showing an attitude of wanting to be a helpful person in a group, b) skills in accepting tasks and responsibilities in working together, c) skills in appreciating opinions, actions, and behaviours of each group member, d) skills in working together and participating in groups, and e) skills in participating in problem-solving. In each question, four options describe students' collaboration skills. The four options are excellent, good, moderate, and bad. Student collaboration skill data are analyzed based on collaboration skill indicators. Collaboration skill indicators are several sub-indicators. Collaboration skill indicators are presented in Table 2.

Table 2. Collaboration Skills Indicators and Sub-Indicators

Collaboration Skills Indicator	Collaboration Skills Sub-Indicators
a. skills in showing an attitude of wanting to be a useful person in a group	- Always provide information to the group. - Motivate group members in doing project work. - Carry out the group leader's orders with enthusiasm. - Always be present in carrying out-group project tasks.
b. skills in accepting tasks and responsibilities in working together	- Do not complain about the tasks given by the group leader. - Do the tasks given by the group well and thoroughly. - Discuss with the group leader if you do not understand the tasks given. - Work according to the targets given by the group.
c. skills in appreciating the opinions, actions and behaviour of each group member	- Do not interrupt when the leader/member of another group is expressing their opinion. - Do not force your own opinion to be accepted by the group. - Do not bully group members who are not doing the right thing. - Be friendly to group members.
d. skills in cooperation and participation in groups	- Participate in completing group project work. - Work according to the job description shared by the group. - Do not interfere with the work of group mates. - Participate in every activity carried out by the group.
e. skills to participate in problem-solving	- Participate/actively provide ideas/concepts in solving problems in groups. - Deliver ideas/concepts logically, coherently, and systematically. - Do not force ideas/concepts to be accepted by the group. - Participate in decision-making.

Data analysis

Data analysis in this study is quantitative descriptive analysis. Quantitative descriptive statistical techniques are used to constructively describe, summarize or show data on students' collaboration skills. The stages carried out in data analysis are calculating the frequency distribution of initial collaboration skill values, calculating the frequency distribution of final collaboration skill values, conducting prerequisite tests (data normality and homogeneity tests), conducting hypothesis tests, and conducting improvement tests (N-gain).

Results

The influence of TBEP learning on students' collaboration skills

Data on students' collaboration skills were obtained based on observations of student performance before and after lectures. The results of descriptive analysis and frequency distribution of initial and final collaboration skills observation data are presented in Tables 3 and 4, respectively.

Table 3. Descriptive Analysis of Students' Collaboration Skills

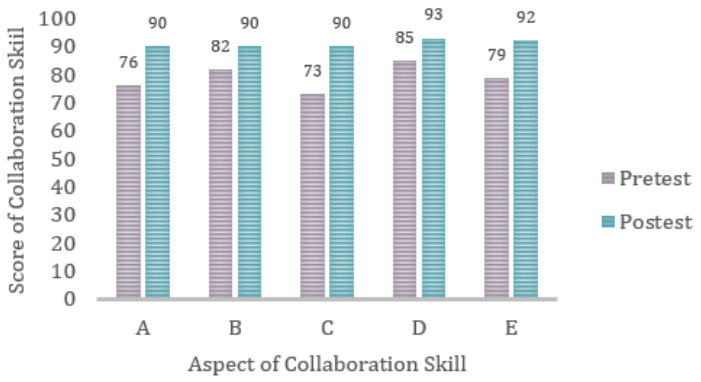
	N	Min	Max	Mean
Pretest	92	25	100	78,70
Posttest	92	45	100	90,92
Valid N	92			

Table 4. Frequency distribution of observation data on collaboration skills

Interval	Collaboration Skills			
	Before TBEP learning		After TBEP learning	
	Frequency	%	Frequency	%
81 – 100	27	29.35	71	77.17
61 – 80	61	66,30	17	18.48
41 – 60	3	3.26	4	4.35
20 – 40	1	1.09	0	0.00
Total	92	100	92	100

Changes in students' collaboration skills in each aspect before and after TBEP learning are presented in Figure 1.

Figure 1. Improving Collaboration Skills in Each Aspect



Description of aspects:
(A) skills in showing attitudes to be a useful person in a group,
(B) skills in accepting tasks and responsibilities,
(C) skills in appreciating the opinions, actions, and behavior of each group member,
(D) skills in working together in a group and
(E) skills in participating in problem-solving.

The improvement of collaboration skills in each aspect is presented in Table 5.

Table 5. Improvement of Collaboration Skills in Each Aspect

	Collaboration Skills Aspects				
	(A)	(B)	(C)	(D)	(E)
Pretest	76	82	73	85	79
Posttest	90	90	90	93	92
N-gain	0,58	0,44	0,63	0,53	0,62

The initial and final observation data show that the data is not generally distributed, as presented in Table 6. The results of the data homogeneity test, as presented in Table 7, show that the groups have the same variance (homogeneous).

Table 6. Data Normality Test Results

Test	N	Z	Sig.	Information
Pretest- Posttest	92	1,480	0,025	Not Normality

Table 7. Homogeneity Test Results

Group	F	df1	df2	sig	information
G1	1,978	1	182	0,161	Homogeneous

Referring to the data normality test results, the data analysis was done using non-parametric analysis. The non-parametric test used was the Wilcoxon test. The results of the Wilcoxon test, as shown in Table 8, show that the p-value < 0.005, namely 0.000 < 0.005. This means that H0 is rejected, and Ha is accepted. Based on the results of the Wilcoxon test, it can be concluded that learning involving group-based physical activities significantly influences students' collaboration skills.

Table 8. Summary of Wilcoxon Test Results

		N	p	α
Posttest-Pretest	Negative Ranks	13	0,000	0,05
	Positive Ranks	67		
	Ties	12		
	Total	92		

The effectiveness of TBEP learning on collaboration skills is determined by determining the N-gain score. The N-gain score can be obtained using the equation (Hake, 1999):

$$N_{gain} = \frac{Skor\ Postest - Skor\ Pretest}{100 - Skor\ Pretest}$$

The results of the N-gain test are presented in Table 9. The results of the N-gain test obtained a score of 0.42. This means that learning involving group-based physical activity (TBEP) can improve collaboration skills with a moderate category.

Table 9. N-gain Test Results

	Min	Max	Ave	N-gain	Category
Pretest	25	100	78,70	0,42	Medium
Posttest	45	100	90,92		

The influence of TBEP learning on students' collaboration skills based on gender.

The results of descriptive analysis and frequency distribution of observation data on students' collaboration skills based on initial and final gender are presented in Tables 10 and 11, respectively.

Table 10. Descriptive Analysis of Collaboration Skills by Gender

	Female			Male		
	Min	Max	Mean	Min	Max	Mean
Pretest	25	100	78,92	55	90	76,67
Posttest	45	100	91,99	55	100	81,11

Table 11. Frequency Distribution of Students' Collaboration Skills Based on Gender

Interval	Collaboration Skills							
	Male Students				Female Students			
	Before		After		Before		After	
	Freq	%	Freq	%	Freq	%	Freq	%
81 – 100	2	22,22	4	44,44	25	30,12	67	80,72
61 – 80	6	66,67	3	33,33	55	66,27	14	16,87
41 – 60	1	11,11	2	22,22	2	2,41	2	2,41
20 – 40	0	0	0	0	1	1,20	0	0
Total	9	100	9	100	83	100	83	100

The results of the normality and homogeneity tests of student collaboration skills data before and after TBEP learning are presented in Tables 12 and 13.

Table 12. Results of Data Normality Tests Based on Gender

Group	Test	N	Z	Sig.	Information
GF	Pretest- Posttest	83	1,412	0,037	Not Normality
GM	Pretest- Posttest	9	0,559	0,913	Normality

Table 13. Results of Data Homogeneity Test by Gender

Group	F	df1	df2	Sig	Information
GF	0,099	1	164	0,753	Homogeneous
GM	6,473	1	16	0,022	Not Homogeneous

Referring to the results of the GF data normality test, the data analysis in this study was carried out using non-parametric analysis. In this study, the non-parametric test used was the Wilcoxon test. The results of the Wilcoxon test, as in Table 14, show that the p-value < 0.005, namely 0.000 < 0.005. This means that H0 is rejected, and Ha is accepted. Based on the results of the Wilcoxon test, it can be concluded that learning involving group-based physical activity (TBEP) significantly influences female students' collaboration skills.

Table 14. Summary of Wilcoxon Test Results

		N	p	α	Information
Posttest-Pretest	Negative Ranks	10	0,000	0,05	There is a difference
	Positive Ranks	63			
	Ties	10			
	Total	83			

Referring to the results of the GM data normality test, the data analysis in this study was carried out using parametric analysis. In this study, the parametric test used was the t-test (paired sample t-test). The results of the t-test, as in Table 15, show that the p-value < 0.005, namely 0.000 < 0.005. This means that H0 is rejected, and Ha is accepted. Based on the results of the Wilcoxon test, it can be concluded that learning involving group-based physical activity (TBEP) does not significantly affect male students' collaboration skills.

Table 15. Summary of t-Test Results

	N	p	A	Information
Posttest-Pretest	9	0,569	0,05	No difference

The results of the N-gain test show that the collaboration skills of female students have increased higher than the increase in collaboration skills of male students. The increase in collaboration skills can be seen in Table 16.

Table 16. N-gain Test Results

Group	N	N-gain	Category
GF	83	0,62	Medium
GM	9	0,19	Low

Discussion

The first objective of this study was to determine the effect of learning involving group-based physical activity (TBEP) on students' overall collaboration skills. The study's results, as shown in Table 8, show that TBEP learning positively affects students' collaboration skills. Students' collaboration skills after TBEP learning have increased compared to before learning. The cooperative model significantly contributes to improving cooperative teamwork skills (García-Taibo et al., 2024). The increase in students' collaboration skills is because TBEP learning requires students to collaborate in solving problems by creating entrepreneurial products. When making products, students are encouraged to exchange ideas with other students. Klang et al. (2021) stated that when students develop projects as a form of problem-solving solutions, students need to exchange ideas with other students to clarify thoughts related to the projects developed by involving cross-disciplinary knowledge. Creating products as solutions to problems can encourage peer interaction and collaboration. This increases students' conceptual knowledge and strengthens students' motivation and self-efficacy (Abdurrahman & Nurulsari, 2019). In addition, students who participate in learning involving physical activity can increase their enthusiasm for learning (Hall-lópez & Ochoa-martínez, 2023).

Students' collaboration skills increased by 0.42 with a moderate category. The results of this study are in line with research conducted by Safarini (2019); Saldo & Walag (2020); Yanti, et al. (2023) which states that project-based learning can improve collaboration skills. Collaboration skills are one of the skills needed so that students can play an active role in learning, respect each other, and solve problems to achieve common goals (Kropp et al., 2016; Le et al., 2018).

TBEP learning is learning that begins with analyzing problems in everyday life and then finding solutions to the problems found through physical activities of making products of economic value in groups. Thus, TBEP learning requires students to actively solve group problems by making economic value products (Prayitno et al., 2024). Rasyid & Khoirunnisa (2021) stated that the project-based learning model effectively improves students' skills in working on group assignments, expressing opinions, and being actively involved in solving problems. Learning that involves physical activity has an impact on responsibility, making substantive decisions together, and complementing each other in completing project results (Safarini, 2019).

The implementation of TBEP learning requires each group member to actively participate in group activities, respect other people's opinions, and not be self-centred. Kokotsaki, et al. (2016) stated that Project-based learning is a form of active learning centred on students, characterized by student autonomy, constructive investigation, goal setting, collaboration, communication, and reflection in real-world practice. The project-based learning model can foster students' abilities in discussing, communicating, expressing themselves, teamwork, and thinking effectively, and can increase students' creativity (Lou et al., 2017). Integrating physical activity into team-based project learning can positively impact student collaboration skills, this integration not only enhances communication and teamwork but also fosters a more engaging learning environment (Qutishat et al., 2021; Yulianti & Anjani, 2020).

Figure 1 shows that collaboration skills in each aspect have increased. The increase in each aspect, as presented in Table 5, shows that skill aspects (3) and (5) have increased significantly with scores of 0.63 and 0.62. This shows that TBEP learning can foster an attitude of mutual respect for the opinions, actions, and behaviour of each group member and can improve participation skills in problem-solving. Lai et al. (2017) states that collaboration skills can be identified based on student contributions in completing group work, respecting differences of opinion and a responsible attitude in completing tasks.

In this study, students were divided into small groups, so improving collaboration skills was not optimal. Mulhim & Eldokhny (2020) argue that dividing students into large groups is more effective in improving collaboration skills than small groups. The number of groups with more students is assumed to increase student interaction, motivation, and active participation, and provide greater feedback (Parks-Stamm et al., 2016).

The second objective of this study was to determine the effect of learning involving group-based physical activity (TBEP) on students' collaboration skills based on gender. The results of the study, as presented in Table 14, show differences in female students' collaboration skills. This means that the collaboration skills of female students have increased after learning involving physical activity (TBEP). Table

15 shows that the collaboration skills of male students before and after TBEP learning did not experience significant changes. In line with the study's results, Song et al. (2015) state that gender composition influences team performance, with all-female teams being the most productive.

The results of the N-gain analysis, as presented in Table 16, show that the increase in female students' collaboration skills is better than in male students' collaboration skills. Female students' collaboration skills increased by 0.62 in a moderate category, while male students' collaboration skills increased by 0.19 in a low category. The difference in the increase in collaboration skills in female and male students is caused by several things, one of which is the difference in the characteristics of women and men. The characteristics of women are more oriented towards establishing relationships and cooperation, while the characteristics of men are more towards domination and competition with each other. Women have stronger characteristics in maintaining good relationships with group members in solving problems (Andriani et al., 2015). Moreover, women can remember explicit memory tasks at a higher level than men (Andersson, 2001).

Students' creative thinking skills also influence collaboration skills. Bart et al. (2015); Ulger (2017) stated that women's creative thinking skills are higher than men's thinking skills. Through creative thinking, students can maximize their ability to collaborate with group members.

Conclusions

Based on the results of the study and discussion, it can be concluded that learning activities related to physical activity can improve student collaboration as a whole. Based on gender, the improvement of female students' collaboration skills after TBEP learning is better than that of male students. The limitation of this study is that this study divides students into small groups of less than four people. It is recommended that further researchers can apply TBEP learning with larger group divisions. In addition, using a similar learning model, researchers can conduct further research on the relationship between creative thinking and collaboration skills. Dividing students into large groups is more effective in improving collaboration skills compared to small groups (Mulhim & Eldokhny, 2020).

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