Perception, skills, and Attitude Towards Project-Based Learning: Understanding Its Impact on Knowledge Acquisition

Anil Kumar*

Assistant Professor, Department of Anatomy and Neurobiology, College of Medicine and Health Science (CoMHS), National University of Science and Technology (NUST), Sohar, Al Tareef, 391, P. O. Box: 321, Sultanate of Oman, Sultanate of Oman
*Corresponding Author

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ABSTRACT
Project-based learning (PjBL) has been shown to enhance learning and develop skills through active engagement with educational materials. At the National University of Oman, second-year medical students participated in a PjBL exercise. This study assesses Project-Based Learning (PjBL) in an anatomy course, focusing on its effects on critical thinking, communication skills, and overall competencies. Students were grouped into teams of four to five and tasked with creating a project based on the clinical topics assigned to them. The assessment, performed at the conclusion of the session, sought to ascertain whether Project-based Learning (PjBL) enhanced learning efficacy by offering an authentic learning experience. Relevant learning requirements, derived from current literature, were assessed by a questionnaire survey utilizing 13 measuring scales based on a 5-point Likert scale. The findings demonstrated that the integration of Project-Based Learning (PjBL) enhances student learning, motivation, and performance in both the short and long term. The study indicated that PjBL facilitates the formation of authentic experiences, hence enhancing the cultivation of practical competences. The development of transferable skills such as teamwork, effective communication, and time management was also qualitatively assessed, with results indicating that students successfully acquired these skills. PjBL highlights the necessity for measurable assessment tools and evaluates collaborative revision resources and adult students' perceptions, emphasizing the importance of these elements in enhancing student performance and learning outcomes.

Keywords: Project-Based Learning, Collaborative learning, Student evaluation; Student learning, Teaching and learning strategies, Transferrable skills

INTRODUCTION

Project-Based Learning (PjBL) is an instructional approach that emphasises the development of learners' skills and enhances the value of their learning experience. These talents encompass project management, effective communication and collaboration, analytical and creative thinking, problem-solving abilities, negotiating expertise, and conflict resolution capabilities [1]. PjBL enhanced students' cognitive abilities in critical thinking and effective communication, facilitating a deeper comprehension of the subject. PjBL is a method of integrating student-centred learning by having students engage with real-world problems and difficulties [2]. According to Yardley et al. (2012), experiential PjBL aids students in constructing knowledge and understanding real-life situations [3]. Syakur et al. (2020) found that PjBL enhances students' motivation and achievement by applying course-related problems to real-life contexts [4]. Ngereja et al. (2020) identified three criteria for evaluating student performance in PjBL: learning outcomes, motivation, and performance. The learning criterion measures achieved knowledge and competencies, the motivation criterion assesses conditions supporting student learning, and the performance criterion evaluates the long-term benefits of acquired knowledge [5]. Puspitarini& Hanif (2019) emphasized that learning aims to acquire knowledge, specific competencies, and form student attitudes. Additionally, students' learning motivation, which helps them engage with the learning process, supports their overall learning activities [6].

According to Sultan and Javaid (2018), the use of PjBL demonstrated a positive attitude and helped the students improve a variety of life skills, including teamwork, social and communication skills, and problem-solving abilities [7]. Blumenfeld et al. (1991) assert that "PjBL is a comprehensive perspective

that is centred on teaching by involving students in investigation." PjBL is a comprehensive process that entails the design, strategizing, implementation, analysis of outcomes, and enhancement of existing systems. PJBL is a teaching method that actively involves both educators and learners, in contrast to traditional methods. PJBL distinguishes itself by allowing students to engage in organised, guided inquiry, which involves questioning, making mistakes, and pursing solutions [8]. Within this framework, students ask and refine questions, debate concepts, make predictions, design plans and/or experiments, gather and analyse data, draw conclusions, present their ideas and findings to others, ask new questions, and create artefacts in an effort to solve nontrivial problems." However, the same justifications for "learning by doing" were emphasised in every iteration of PjBL [9].
This study assesses PjBL in an anatomy course, focusing on its effects on critical thinking, communication skills, and overall competencies. It highlights the necessity for measurable assessment tools and evaluates collaborative revision resources and adult students' perceptions, emphasizing the importance of these elements in enhancing student performance and learning outcomes.

METHODOLOGY

Participants

The research was carried out on second-year MD medical students at the College of Medicine and Health Sciences, National University, Oman. The sample consisted of 160 students who engaged in diverse PjBLactivities as part of their Anatomy-III course in the 2023–2024 academic year. This course, provided by the Anatomy and Neurobiology department, specifically concentrated on the anatomical structures and functions of the head and neck regions. The entire class was divided into thirty-two groups, and the students worked together in teams of five to independently prepare their projects. They were given a three-week timeframe to create and design the project.

Research Procedure

According to Rosenfeld [10], the procedures of project-based learning are as follows: (1) Formulating the project questions; (2) selecting the primary questions or project identification; (3) reviewing and researching relevant materials; (4) formulating an appropriate strategy for resolving the issue (5) Formulate the project proposition. (6) Execute and generate the assignment document (7) Conduct an analysis of the data and formulate a conclusion. (8) Finalise the report; and (9) provide the project upon completion [11]. The quality of the final output is indicative of the extent to which each student has acquired knowledge of the subject matter, as demonstrated by their involvement in project creation and presentation [12]. Each student's performance is assessed individually. Thus, this study assesses and contemplates the distinct phases of the PjBL model, which encompass the following stages:
Stage 1 - Introduction and Briefing: Teachers provide students with a comprehensive overview of the project's preparation and design. Students receive instructions, guidelines, and rubrics via email.
Stage 2 - Topic Distribution: The teacher develops pertinent clinical research topics. The 32 student groups are assigned project topics through a lottery system.
Stage 3 - inquiry and Write: Students conduct inquiry and investigate the subject matter of their project.
Stage 4 - Project Design: Students collaborate in groups to conduct research on the subject matter and develop PowerPoint presentations.
Stage 5 - Presentation: The class is presented with the products by the students.
Stage 6 - Evaluation and Reflection: Rubrics, teacher feedback, and self-evaluation or reflection are employed by both teachers and students to evaluate learning and performance.

Instrument

A Likert scale questionnaire was used as the data collection instrument, distributed to students online through Google Forms. The questionnaire addressed the domains of Perception, Skills and attitude of medical students towards the PjBL.

Data analysis and statistics

Responses from 160 students, gathered via an online survey, were descriptively analysed to determine the impact of each criterion on their learning experience. Feedback was obtained through a grading and Likert scale questionnaire, developed with input from faculty members and medical education experts. The questionnaire data was evaluated and summarized using MS Excel and IBM SPSS statistical software version 20.0. Data analysis included calculating frequencies, %ages, means, and standard deviations. The reliability coefficient was calculated using the Cronbach alpha equation to ensure the stability of the factors.

Ethical approval

Participants were informed about the investigation's nature and assured that their responses would remain anonymous and impartial. Consent was obtained from all students after explaining the study's proposal. Ethical approval was granted by the institutional ethical committee.

RESULT AND DISCUSSION

Participants' profile

In medical education nowadays, we use teacher-centered strategies such didactic lectures and tutorials. Transitioning to student-centric methodologies like case-based, project-based, problem-based, student seminars, and role-playing is crucial. This teaching approach change takes time. We examined student-centered, interactive project-based learning. Out of the 160 Medical students who participated in the research, 84.2% were women, while 15.8% were men. The participants' age was as follows: 18–20 years:91.7%, 20–22 years: 8%, and more than 22years was 0.3%.

Validity and Reliability of The Scale

The initial version of the scale was shared with experts in curricula and teaching methods, as well as faculty members involved in the PjBL initiative, to gather their suggestions for modifications. Some experts recommended deleting, adding, and adjusting certain items, while others suggested rewording items to be more specific and easier to measure. To evaluate the scale's internal consistency, the Cronbach Alpha was calculated among three faculty members using the Cooper equation [13], as shown in figure 1.

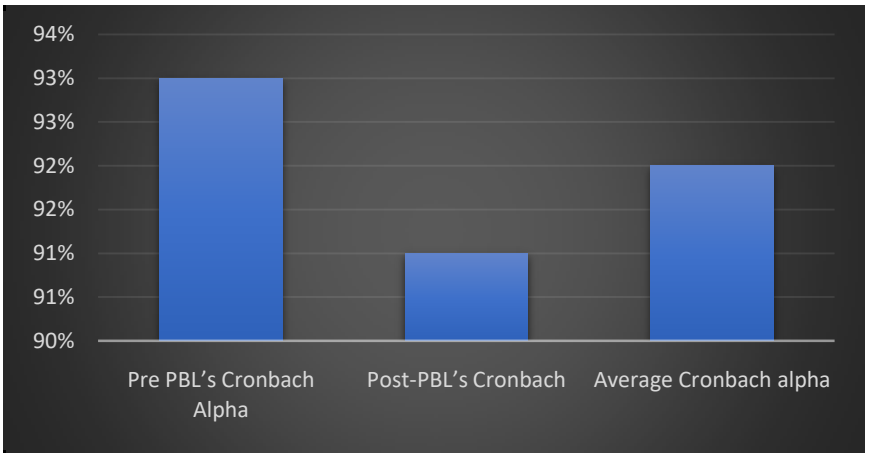

Figure 1: Calculating the Cronbach alpha

Figure 1 showed an average Cronbach alpha of 92%, indicating that the scale had strong internal consistency and was appropriate for the current research. The final version of the scale included twelve standards, confirmed for accuracy, reliability, and effectiveness in measuring the achievement of PjBL standards in this study.

Table 2 presents the results of the pre- and post-application for each criterion in the rubric. The statistical significance of each questionnaire item was determined using a non-parametric statistical analysis, as illustrated in Table 2. The hypothesis, which addresses about the role of the PjBL initiative in meeting the standards for implementing the PjBL strategy, indicates that "There were statistically significant differences between the pre- and post-assessment means in the rubric of criteria for practicing PjBL, favoring the post-assessment.

Table 2: Results of pre-and post-application of the rubric of project-based learning criteria.

No.	Criteria	Pre-Test	Post-test
1	Alignment of student projects with learning outcomes	1.4	3.2
2	Project planning	2.6	3.9
3	Training course professors in project-based learning strategies	2.4	3.9
4	Training students in project-based learning	1.8	4.2
5	Educational supervision: follow-up and support	2.2	4.4

6	Productivity	1.5	3.1
7	Independence	2.7	4.6
8	Originality	2.7	4.3
9	Monitoring students' skills gained during project work	2.1	4.4
10	Diversity in project design	2.1	3.3
11	Project presentations	2.5	3.3
12	Project evaluation mechanisms	3.3	4.8
13	**Total: out of 60**	**27.3**	**47.4**

"The T-test was used to calculate the significance of differences between the pre- and post-mean scores in the PjBL practice criteria rubric. The subsequent table presents the average score differences, standard deviation, and the computed T-value at the 0.05 significant level.

Table 3: Shows results of the "T" test for the average differences between the pre- and post-assessment in the rubric of PjBL standards

Application	**Average score**	**standard deviation**	**Calculated T**	**Significance level**
Pre	27.2	3.382	39.492	Significant at
Post	47.1	6.852		(0.05) level

The preceding table 3 demonstrates that the "T" value for the discrepancies between the mean levels of post-assessment in the rubric of project-based learning standards attained 39.492, which is significant at the 0.05 level. This indicates variations in the standards of PjBL practices that favor post-implementation, underscoring the influence of teaching through a PjBL method, thereby validating the hypothesis.
The other hypothesis is that "students could acquire various skills when engaging in project-based learning." This hypothesis was tested by computing the mean evaluations of students for questionnaire items about students' skill acquisition, as shown in table 2.

Significance of the Study
The findings presentation commences with a preliminary examination of the sample respondents' reactions to the PjBL approach, classified by agreement and disagreement utilising a four-point Likert scale: Strongly disagree, disagree, agree, and strongly agreetable 4. This is succeeded by a re-evaluation of the findings, analysing the responses about students' positive and negative perceptions of the PjBL methodology.

Table 4: Perceptions of students towards skills and attitudes in the Project-Based Learning system (n=160)

Questions	**Strongly disagree**	**Disagree**	**Agree**	**Strongly Agree**
Enabled me to enhance my problem-solving skills	0	4	106	50
Fostered my ability to collaborate effectively in a team	0	10	110	40
Assisted me in planning my own work efficiently	0	24	110	26
Boosted my motivation towards learning	0	14	106	40
Stimulated my creativity	0	9	106	45
Improved my written communication skills	0	45	80	35
Enhanced my oral presentation skills	0	45	85	30
Clarified the necessary knowledge for success	0	25	90	45
Encouraged a positive outlook on achieving my goals	0	14	106	40
Inspired me to consider new life opportunities	0	20	100	40

The strong consensus in these responses suggests that students predominantly support the implementation of the PjBL methodology in their coursework. The positively framed statements suggest

that "agree" and "strongly agree" replies reflect favourable sentiments, but "disagree" and "strongly disagree" responses denote unfavourable opinions concerning the PjBL methodology.
Figure 2 indicates that students view the PjBL methodology positively, especially in areas such as problem-solving skills, teamwork, and individual work planning. However, skills related to written and oral communication show less improvement. In terms of attitudes, students express strong approval, highlighting increased motivation, creativity, positivity, and a willingness to seek new opportunities.

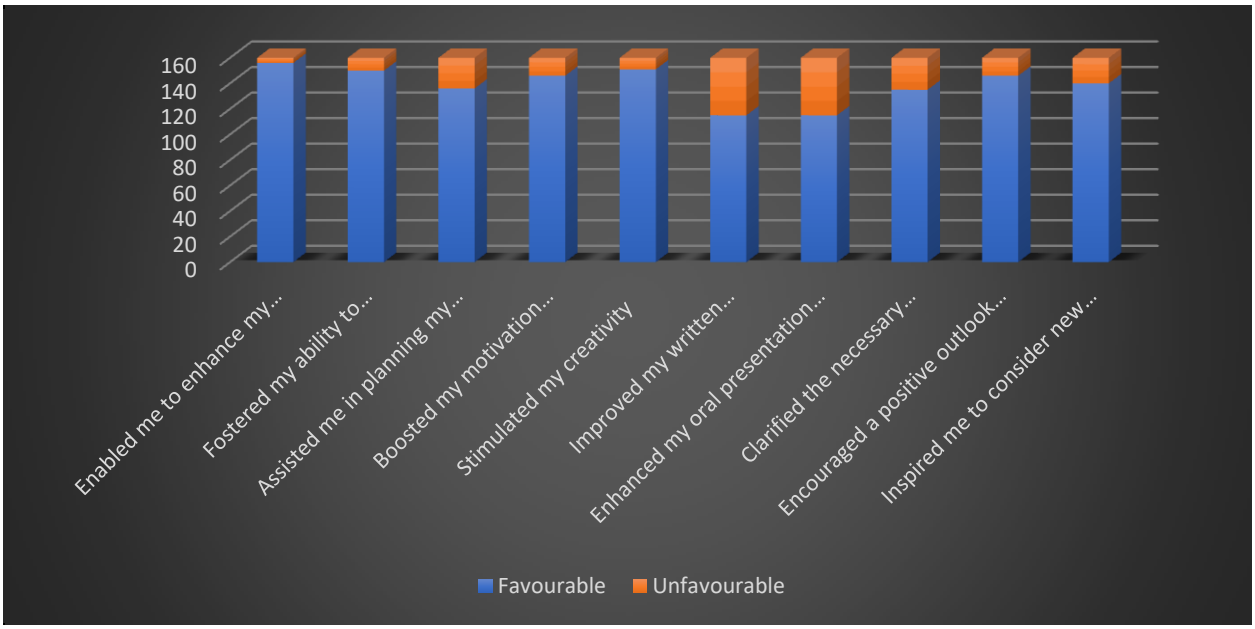

Figure 2: Shows the students view on the PjBL Session

The distribution of the sample subjects' responses in terms of agreement and disagreement regarding their perceptions of the effects of the PjBL methodology on skills and dispositions is illustrated in table 5.

Table 5: Shows the distribution of responses related to these skills.

Questionnaire for Skills	Strongly disagree (%)	Disagree (%)	Agree (%)	Strongly Agree (%)
Complex problem solving	0	3	71	26
Critical thinking	0	1	70	29
Creativity	0	5	64	31
Conflict management	0	11	64	25
Cooperation	0	2	77	21
Decision making	0	3	81	16
Mutual help	0	1	69	30
Negotiation	0	11	69	20
Listening to others	0	1	77	22

Critical thinking, teamwork, decision-making, listening to others, mutual aid, and complicated problem-solving are among the most highly regarded abilities. All the skills enhanced by the PjBL methodology which were assessed in this study deserved widely favourable opinions from the students. On the other hand, less students selected negotiation and conflict management as their least favourite talents. We understand "agree" and "strongly agree" replies to reflect students' positive ideas based on the style of the statements under examination, whereas "disagree" and "strongly disagree" responses reflect students' negative opinions.

CONCLUSION

Majority of students considered PjBL as an interesting technique for learning. Students' approach was very conclusive for this type of active learning method, and it should be encouraged in routine teaching learning process. PjBL enhances self-directed learning and fosters greater interest in the subject. Group projects improve teamwork skills, strengthen bonds between students, and enhance relationships with

teachers. Additionally, projects often develop students' research abilities. Further studies on larger scale are required to develop more understanding on this aspect.

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CONFLICTS OF INTEREST
Authors declare that no conflict of interest exists or owes to any organization/ Institute/ individuals in carrying out this work.

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