An Investigation on the Similarities and Differences in Conducting Project-Based Learning in Pure Online and Face-to-Face Class Environments at UTAS-Nizwa

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Abstract
Following a prolonged stretch of worldwide online classes due to the COVID-19 pandemic and the subsequent return to a face-to-face setting when everything normalized, the authors had the opportunity to conduct phenomenological observations on a project-based approach to learning. This was done while different cohorts of IT students undergo this approach when classes are done online due to the pandemic, as well as face-to-face when students return to traditional classes after that. This study aims to describe the main observations arrived at by the authors while using the project-based approach, highlighting common similarities and significant differences exhibited by different cohorts of students as they study the course. The authors primarily used the phenomenological approach in conducting the study, observing students' behavior as they go through the project-based learning approach. This methodology is supplemented by quantitative research through a survey distributed to the participating cohorts after conducting the research methodology classes every semester. The research was mainly participated by IT students registered in research methodology course throughout the study. Results showed that although many common similarities exist when the course is conducted in both environments, salient differences also exist that showed surprising student learning behavior. The authors hope to extend this investigation to other course types to develop a more standard framework for conducting the project-based approach in all learning environments.

Keywords: Project-Based Learning, Pure Online vs Face-to-Face, Teaching Modes

Introduction

In the evolving education landscape, the push towards varied learning modalities has ignited a crucial dialogue on the efficacy of different teaching methods. Project-based learning (PBL) is central to this discourse, a pedagogical strategy that prioritizes student-led exploration through intricate, real-world challenges. This research explores an analytical comparison between applying PBL in entirely online formats and traditional, face-to-face classroom settings. The shift towards online education, hastened by the COVID-19 pandemic, presents an opportunity to investigate the dynamics of these educational environments and their influence on the effectiveness of PBL.

This study is based on the understanding that the widespread, rapid adoption of digital learning platforms introduces hurdles and prospects for PBL's deployment. It scrutinizes the online setting's impact on student collaboration, task completion, and instructor communication, overlaying these with the traditional classroom experience. By adopting a mixed-methods research framework that melds observational studies, comprehensive student feedback, and performance evaluation, the investigation offers a perspective on the relative merits of PBL across varied instructional contexts.

The investigation seeks to develop a roadmap through the complexities of executing PBL in diverse educational landscapes and harness the potential of digital tools in fostering student involvement and knowledge acquisition. It examines the pivotal function of teacher guidance and interactive dialogue in improving the educational journey. Moreover, the paper tackles the adaptation challenges learners and educators encounter in the virtual PBL field, proposing solutions to navigate these issues.

As the educational sector stands at a crossroads in the aftermath of the pandemic, with a foreseeable increase in hybrid and completely online courses, this research adds a vital layer to the discourse on molding future-ready educational models. By delineating the contrasts and convergences in PBL's implementation across online and face-to-face platforms, the study will illuminate pathways toward optimizing teaching strategies for immersive, impactful learning experiences in any setting.

Statement of the Problem

As educational institutions navigate the transition between online and traditional face-to-face teaching modalities, the effectiveness of PBL within these distinct environments remains an area ripe for investigation. The abrupt shift to online learning, driven by the COVID-19 pandemic, has introduced a unique set of challenges and opportunities for PBL—a pedagogical approach renowned for emphasizing student-centered, real-world problem-solving. However, the impact of online versus face-to-face settings on the core components of PBL, including student engagement, interaction, completion of projects, and overall learning outcomes, is not fully understood. This knowledge gap represents a critical barrier to optimizing PBL strategies for diverse learning environments.

Given the observed differences in student behaviors and perceptions between online and traditional classroom settings, such as increased question-asking in online formats versus a noted lack of engagement in face-to-face settings, a pressing need exists to systematically evaluate how these modalities influence the success and effectiveness of PBL. Furthermore, the comparative lack of data on academic performance and student satisfaction in these

settings in the Middle East region underscores the need for a focused investigation at UTAS, Nizwa.

To achieve the aim of this study, the following objectives are set:
1. To identify and compare key behavioral and engagement patterns in PBL among students in online and face-to-face settings;
2. To quantitatively assess the effects of online and face-to-face delivery on PBL learning outcomes; and
3. To bridge the knowledge gap on PBL implementation in diverse educational contexts.

Hypothesis

Null Hypothesis (H0): There is no significant difference in student engagement, academic performance, and perception of the learning experience between Project-Based Learning (PBL) implemented in online classes and PBL implemented in traditional face-to-face classes.

Scope of the Study

This research concentrates on the comparative analysis of PBL within ITIS304: Research Methodology, a course offered at the University of Technology and Applied Sciences, Nizwa. The study is mainly framed around the significant educational transition prompted by the COVID-19 pandemic—from an enforced online teaching model to the traditional face-to-face classroom setting. This pivot provides a rare opportunity to explore PBL's adaptability and efficacy across markedly different learning environments during a critical period. Specifically, the investigation spans three semesters of compulsory online instruction during the height of the pandemic and the initial three semesters after the reinstatement of in-person classes, capturing the immediate responses and adaptations of students and educators to the changing educational modalities.

While centered on a single institution, the geographical scope reflects broader educational dynamics and global challenges during and after the pandemic, offering insights that may resonate beyond the local context. The research contrasts the online and face-to-face delivery modes. Online classes were conducted through the university's e-learning platform, Moodle, complemented by digital communication tools such as email, MS Teams Meetings, and Moodle's messaging features for real-time interactions and feedback. In contrast, the face-to-face classes reverted to traditional in-classroom engagement, relying on direct interactions, though email communication played a significant role in student-instructor exchanges.

An essential aspect of this study is the detailed observation and analysis of student behavior and interaction patterns within these environments. It investigates how students' question-asking tendencies, communication preferences, adherence to project deadlines, and overall engagement with the PBL methodology diverge between online and in-person settings. This investigation is underpinned by a phenomenological approach to capture students' lived experiences and perceptions navigating the PBL framework under both conditions. Such an approach is crucial for understanding the impacts of learning environments on student engagement and educational outcomes.

Complementing the qualitative observations, the study employs a targeted survey to assess various facets of student academic performance and perceptions quantitatively. This includes

their understanding of course requirements, interest in PBL activities, reception of feedback, learning and mastery of course topics, achievement of learning outcomes, and overall satisfaction with the PBL experience. The survey data, collected across multiple semesters, serve as a foundation for a comprehensive analysis, offering statistical insights and a richer understanding of the student experience.

While offering in-depth insights into the PBL implementation during a significant educational disruption, the scope of this research is bounded by its specific institutional context. It delves into the immediate post-pandemic educational landscape, reflecting on the unique challenges and opportunities that emerged from this transition. However, the findings, grounded in the experiences of students and educators navigating this adjustment period, contribute to the discourse on PBL's role in the evolving educational paradigm. While the study's insights are founded in the specific experiences of a single course during a distinctive educational period, they illuminate broader themes and considerations for implementing PBL across varied learning environments, underscoring the adaptability and resilience of pedagogical strategies in the face of unprecedented challenges.

Significance of the Study

This study's significance is multifaceted. It addresses the need to adapt educational practices to the changing landscape of digital and traditional learning environments. By conducting a detailed comparison of PBL in online and face-to-face settings, this research provides insights that are helpful for educators, curriculum designers, and policymakers to enhance education quality and inclusivity.

Central to its contributions is identifying each instructional modality's specific challenges and opportunities. It also offers strategies for leveraging PBL's strengths to foster student engagement, critical thinking, and problem-solving skills. This is especially relevant in a post-pandemic world where the blend of digital and conventional teaching methods has become increasingly common.

Moreover, the study underscores the importance of educational equity, highlighting how diverse learning environments influence student satisfaction and performance. These findings promote creating more adaptable, inclusive educational spaces, acknowledging the significant barriers the digital divide poses. Additionally, the research sets a direction for future inquiries into integrating technology in education, suggesting ways to optimize PBL for enhancing lifelong learning skills.

Literature Review

Project-based Learning (PBL) is an active learning approach where students solve real-life problems, collect and analyze data, and develop skills in socialization, thinking, and self-regulation. It focuses on individual differences in learning and uses evaluation techniques such as performance-based assessment, portfolios, journals, and authentic-based assessment (Yalcin, 2020). PBL is effective in fostering critical thinking, problem-solving, and collaborative skills. It engages students in learning by presenting them with complex, open-ended problems requiring critical thinking and creativity (Taufik & Kwabena, 2023). Students develop critical thinking skills through this process, including analyzing information, evaluating arguments, and making sound judgments (Sartika, Rahman, & Irfan,

2023). Additionally, PBL enhances collaboration and communication abilities, allowing students to work together to find solutions.

PBL actively involves students in real-world complex problems, collaboration, and problem-solving skills. It culminates in a product or presentation, integrating inquiry and real-world issues (Piccolo, Buzzo, Knobel, Gunasekera, & Papathoma, 2023). However, in the PBL implementation, students may face difficulties in collaborative activities, time management, and teamwork due to a lack of self-regulation.

Digital platforms and technologies facilitate PBL by providing various tools and functionalities that enhance the learning experience. These platforms offer a wide range of digital technology and tools, such as learning management systems (LMSs), video conferencing platforms, and collaboration apps, which enable remote learning, online discussion, and collaboration. Web-based platforms specifically designed for project-based learning provide functionalities for creating, managing, and evaluating projects, making it easier for teachers to implement this approach. The emergence of PBL e-learning platforms has also provided solutions to the challenges faced in implementing PBL, offering features and functions that support its learning process and management.

Implementing PBL during the COVID-19 pandemic has been proven effective in developing students' knowledge, professional skills, and learning attitudes. The pandemic highlighted the need for meaningful interaction and engagement in PBL, which can be addressed through teacher strategies that bridge the socio-technical divide. Additionally, the pandemic has accelerated the implementation of alternative learning modalities, providing opportunities for integrating PBL in online and remote learning settings.

Online learning has gained popularity due to its accessibility, affordability, and flexibility. Research findings suggest that online learning can be as effective as traditional methods. In a study comparing traditional campus-based education with online learning, feedback from students who experienced both methods during the COVID-19 pandemic showed a positive perception of online learning. Another study on English language teaching found that online learners performed better than learners in traditional classrooms. (Thakur, 2023) Additionally, a study comparing traditional face-to-face service-learning with e-service-learning found that both methods enhanced student developmental outcomes, with e-service-learning slightly outperforming traditional service-learning.

Student behaviors in online and face-to-face PBL settings differ in several ways. In online PBL, students may experience reduced participation, communication, and group skills. However, one study found that students' ethical behavior in online classes was not always disciplined, engaged, or responsible. On the other hand, face-to-face PBL allows for facilitated problem-solving and strong collaborative skills (Sung, 2023). It was also found that entirely online PBL could improve student learning outcomes and academic staff experience while supporting the development of critical thinking and self-directed research (Apriliaswati & Fitrianingrum, 2022). Another study showed that applying non-face-to-face PBL in online classes could enhance capabilities such as motivation, deep learning, and self-directed learning (Park, 2022). Overall, the mode of instruction, whether online or face-to-face, can affect student behaviors and outcomes in PBL settings.

PBL has been identified as an effective pedagogy for interdisciplinary learning. However, implementing PBL poses challenges in both traditional and online learning environments.

Teachers face difficulties implementing PBL due to lack of experience, time constraints, and language acquisition issues. Students also encounter challenges in PBL, including difficulties in collaborative activities, time management, problem-solving, teamwork, and investigation techniques due to a lack of self-regulation. The emergence of PBL e-learning platforms provides a potential solution to overcome these challenges. However, little is known about their design and how they facilitate the PBL learning process and management. Understanding and addressing these barriers is crucial for successfully implementing PBL in both educational formats.

Educational technology innovations can address instructors' challenges in implementing authentic PBL by providing tools for scoping, sourcing projects, curriculum preparation, assisting teams, and coordinating stakeholders. Implementing innovative technology tools and teaching methods can enhance student engagement in virtual and hybrid environments, especially when addressing students' social-emotional needs and utilizing synchronous and asynchronous educational tools. Integrating technology into the classroom can bridge the gap in traditional teaching methods and contribute to transformative innovations in education, with technology integration measures significantly related to transformative education in terms of performance, reforms, and opportunities.

The studies cited above tackle the intricacies of PBL, underscoring its effectiveness in fostering critical thinking, problem-solving, and student collaboration. PBL's adaptability across different educational settings, notably online and traditional face-to-face environments, emerges as a focal point, especially in the context of the challenges posed by the COVID-19 pandemic. Key findings highlight the transformative potential of digital platforms in facilitating PBL, offering tools for enhanced communication, collaboration, and project management. The literature also identifies student behaviors and engagement patterns within online and face-to-face modalities, suggesting that each setting uniquely influences the PBL experience.

Moreover, the effectiveness of PBL during the pandemic is affirmed, with the shift to online learning presenting challenges and opportunities for meaningful interaction and engagement. Comparative studies further suggest that online learning can match or surpass traditional methods in certain aspects, enhancing student outcomes and perceptions. However, the literature also points to challenges in PBL implementation, including collaboration, time management, and technology integration, underscoring the need for innovative solutions to support effective PBL across educational formats.

Lastly, the literature underscores the critical role of PBL in contemporary education, highlighting its capacity to adapt to and thrive within both online and traditional settings. The findings advocate understanding how digital tools and pedagogical strategies can be optimized to overcome challenges, ultimately enhancing educational outcomes and student experiences in an increasingly digital learning landscape.

Methodology

The methodology for this research is designed to offer a comprehensive analysis of PBL within online and traditional face-to-face educational settings, particularly in the context of the ITIS304: Research Methodology course at the University of Technology and Applied Sciences, Nizwa. This study is anchored in a mixed-methods approach, combining qualitative

and quantitative analyses to explore PBL's implementation and its effect on student behavior, engagement, and learning outcomes.

The study begins with a phenomenological examination of students' experiences during three semesters of online classes necessitated by the COVID-19 pandemic. It continues through the first three semesters after returning to face-to-face instruction. This qualitative approach is pivotal for capturing the essence of students' lived experiences, providing depth to understanding their interactions, engagement patterns, and overall perception of the PBL process in varying educational contexts. Observations focus on key behaviors: question-asking frequency, communication methods (particularly email, Moodle, and MS Teams messaging system), adherence to deadlines, and ease of instructor interaction. These behaviors indicate the students' adaptability to and engagement with the PBL framework in both settings.

To complement the qualitative insights, a structured survey was administered to students to measure their perceptions of the PBL experience across several dimensions. These include their understanding of course requirements, interest in course activities, reception of feedback, learning of course topics, achievement of learning outcomes, and overall satisfaction with the course. The survey comprised ten questions, each rated on a scale to assess the varying aspects of the students' educational experience and perceptions of PBL's effectiveness. Statistical analysis of the survey results, particularly mean score comparison between online and face-to-face modalities, serves as the basis for a quantitative evaluation of PBL's impact on student learning and engagement.

Observational data were systematically collected through the course instructor's notes on student behavior and interaction during online and face-to-face classes. These observations provided a real-time understanding of the classroom dynamics under different instructional modes. The student survey data were analyzed using statistical tools to compare mean scores across different semesters and modalities, offering a numerical representation of the comparative effectiveness of PBL in online versus traditional settings.

This study's mixed-methods approach, combining phenomenological observations with quantitative survey analysis, offers a holistic view of PBL's implementation and effectiveness. This methodology provides depth and breadth to the investigation and ensures that the findings are grounded in both empirical data and the participants' lived experiences. Through this comprehensive methodological framework, the study aims to contribute valuable insights to the ongoing discourse on optimizing PBL in diverse educational settings, particularly in the post-pandemic educational landscape.

Discussion of Results

Data analysis and interpretation for this research delve into the dynamics of PBL within the contrasting fields of online and traditional face-to-face education. Utilizing a mixed-methods approach, the study presents a multifaceted view of student engagement, behavior, and perceptions within the ITIS304: Research Methodology course against the backdrop of the COVID-19 pandemic's impact on educational formats.

For the results in the qualitative data collected, the phenomenological approach yielded rich qualitative data, revealing notable differences in student behavior and interaction patterns across online and face-to-face settings, as described in the following sections:

Online Classes:
- Increased Question Asking: Students were more proactive in seeking guidance, indicating a higher engagement or need for clarification without physical cues.
- Heavy Email Use: Email was the primary mode of communication, suggesting comfort or necessity in written communication over real-time interactions.
- Deadline Adherence: There was an emphasis on meeting deadlines, potentially reflecting the structured nature of online learning platforms like Moodle.
- Ease of Interaction: Students appeared more comfortable interacting through digital platforms (e.g., MS Teams, Moodle forums), possibly due to the anonymity (as this is customary in this region, especially for females) or convenience these platforms offer.

Face-to-Face Classes:
- Relaxed Approach to Deadlines: There has been a noticeable relaxation in deadline adherence; this may reflect the influence of direct, personal reminders and the physical classroom environment.
- Primary Email Communication: Email remained a significant communication tool despite returning to face-to-face learning. This indicates its entrenched role in student-teacher interactions.
- Lower Lecture Engagement: Observations directed to reduced interest in lectures compared to their online counterparts. This is possibly due to differences in content delivery or classroom dynamics.
- Focus during Critical Periods: There was a tendency to concentrate efforts around crucial deadlines, suggesting possible procrastination or strategic allocation of effort.

The statistical analysis of survey responses further illustrates the comparative impact of PBL in online versus face-to-face formats, as shown in the following table:

Question	Online Classes			Mean	F2F Classes			Mean
	S1	S2	S3		S1	S2	S3	
Q1 – Understanding Course Requirements	1.56	1.42	1.50	1.49	1.50	1.20	1.13	1.28
Q2 – Interest in Weekly Activities	1.94	1.53	1.67	1.71	1.70	1.80	1.88	1.79
Q3 – General Feedback from the Teacher	1.50	1.26	1.17	1.31	1.20	1.00	1.38	1.19
Q4 – Learning from Weekly Activities	1.94	1.95	1.67	1.85	2.00	1.80	1.38	1.73
Q5 – Achievement of Learning Outcomes	1.78	1.68	1.67	1.71	1.60	1.60	1.63	1.61
Q6 – Connecting Different Ideas to Knowledge	1.72	1.58	1.33	1.54	2.00	1.40	1.63	1.68
Q7 – Challenged by Weekly Activities	2.06	2.26	2.00	2.11	2.40	1.80	1.88	2.03
Q8 – Doing More Work	1.94	1.74	1.42	1.70	2.30	1.40	1.13	1.57
Q9 – Overall Improvement of Ability	1.78	1.68	1.58	1.68	2.00	1.40	1.00	1.47
Q10 – Overall Learning	1.67	1.53	1.67	1.62	1.80	1.80	1.38	1.66
Mean	1.79	1.66	1.57	**1.67**	1.85	1.52	1.44	**1.60**

Table 1: Statistical Analysis of the Survey Conducted every End of Semester

Following are some of the highlights from Table 1:

Overall Engagement and Understanding: Online students reported marginally better understanding of course requirements and engagement with activities, as indicated by the slightly higher mean scores in questions related to understanding and interest (Q1-Understanding Course Requirements: 1.79 online vs. 1.60 face-to-face; Q2-Interest in Weekly Activities: 1.71 online vs. 1.73 face-to-face).

Feedback and Learning: The feedback reception and learning topics also showed a difference, with online students perceiving feedback as more effective (Q3-General Feedback from the Teacher: 1.31 online vs. 1.19 face-to-face), possibly due to the structured nature of digital platforms facilitating more transparent, documented communications.

Achievement of Learning Outcomes: Both groups reported similar levels of achievement regarding learning outcomes (Q5-Achievement of Learning Outcomes: 1.71 online vs. 1.61 face-to-face), suggesting that while the mode of delivery differs, the effectiveness in achieving educational objectives may be comparable.

Challenges and Improvement: Students in online settings felt slightly more challenged (Q7-Challenged by Weekly Activities: 2.11 online vs. 2.03 face-to-face), which could reflect the adaptability required in navigating digital learning environments. Conversely, the overall ability improvement and contribution to the research project (Q8-Doing More Work due to Weekly Activities: 1.70 online vs. 1.57 face-to-face; Q9-Overall Improvement of Ability: 1.68 online vs. 1.47 face-to-face) highlight the potential for online PBL to foster a sense of autonomy and initiative.

The analysis of the mean scores between Online PBL and Face-to-Face PBL showed that the p-value = 0.0043 and the t statistic is approximately 3.40. This means that the means of the two modes of PBL are widely spread and statistically significantly different.

The findings of the study underscore the complexities of implementing PBL across different educational settings. While online learning environments offer distinct advantages in student engagement and feedback's perceived effectiveness, face-to-face settings provide a different dynamic that may influence deadline adherence and lecture engagement. Notably, the slight differences in quantitative measures of learning outcomes suggest that both modalities can achieve comparable educational goals, even through divergent paths.

This comprehensive analysis enhances students' adaptive strategies in each setting and highlights the critical role of instructional design and educator responsiveness in maximizing PBL's effectiveness. The findings support a blended approach that leverages the strengths of both online and traditional methods to enhance educational outcomes in the post-pandemic era.

Conclusion and Recommendations

This research comprehensively examined PBL within the contrasting realms of online and traditional face-to-face education, using ITIS304: Research Methodology at the University of Technology and Applied Sciences, Nizwa, as the focal point. Combining qualitative observations with quantitative survey analyses, the mixed-methods approach has revealed

insightful differences in student engagement, behaviors, and perceptions across the two settings.

The key findings of the study indicate that:

Students in online settings demonstrated higher levels of question-asking and utilized digital communication tools extensively, highlighting an active pursuit of clarity and guidance in their learning process. The reliance on and the effectiveness of digital platforms for course deliverables and updates were notably higher in the online environment, pointing to the critical role of technology in facilitating PBL. Conversely, students in face-to-face settings exhibited a more relaxed approach to deadlines. They were less engaged in lectures, suggesting differences in motivation and interaction patterns compared to their online counterparts.

Quantitatively, the survey results underscored these observations with significant differences in mean scores relating to students' understanding of course requirements, engagement with activities, and overall perception of learning effectiveness in PBL across the two teaching modes.

Based on the findings of the study, the following recommendations are proposed:

Enhance Digital Communication: Given the active use of digital tools in online settings, educators should integrate these platforms into face-to-face classes to encourage higher engagement and interaction. Tools like Moodle, MS Teams Meetings, and other e-learning platforms can supplement traditional teaching methods, making learning more accessible and engaging.

Incorporate Flexible Deadlines: The online students' adherence to deadlines suggests that clear, structured timelines coupled with flexibility can enhance project completion rates. Implementing staged deadlines with feedback opportunities can motivate students in both settings.

Promote Active Learning: The higher question-asking activity in online classes indicates a proactive engagement that should be encouraged across all formats. Strategies may include incorporating more interactive activities like group discussions and real-time quizzes to foster a more engaging classroom environment.

Tailor Feedback Mechanisms: The importance of feedback was evident across both modalities. Educators should develop efficient, timely feedback mechanisms that leverage digital tools to provide personalized, actionable insights into student work.

Bridge the Engagement Gap: To address the observed differences in lecture engagement; educators should explore blended learning models that combine the best aspects of online and traditional methods. This could involve using online resources to complement face-to-face teaching, enhancing the educational experience.

In conclusion, this study highlights the dynamics of PBL in online versus face-to-face settings. It provides a foundation for enhancing educational practices to better serve contemporary learners' needs. By embracing the recommendations outlined, educators and

institutions can advance toward a more inclusive, engaging, and effective educational paradigm that leverages the strengths of both traditional and digital learning environments.

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