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Resilient Online Project-Based Learning Post-Covid: An NPS Evaluation

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RESILIENT ONLINE PROJECT-BASED LEARNING POST-COVID: AN NPS EVALUATION

Abstract: In the wake of the COVID-19 pandemic, educational institutions globally have adapted to new teaching methodologies to ensure resilient and effective learning environments. This study evaluates the transition to project-based learning (PBL) in online classrooms within the Thai education system, using the Net Promoter Score (NPS) methodology to assess student satisfaction. A survey was conducted among 95 undergraduate students, classifying respondents into Promoters (scores of 9-10), Passives (scores of 7-8), and Detractors (scores of 0-6). The results indicated that 65% of students were Promoters, expressing high satisfaction and a strong endorsement of the PBL approach. Meanwhile, 20% were Passives, and 15% were Detractors, showing varying levels of contentment. The overall NPS score of 50% reflects a highly resilient and favorable response to the PBL method in online classrooms. These findings suggest that PBL is an effective teaching strategy for maintaining student engagement and learning outcomes in a post-pandemic educational landscape. This study highlights the potential of PBL to enhance the resilience of online education, providing valuable insights for educators and policymakers aiming to adapt to future disruptions.

Keywords: Project-based learning, online education, COVID-19, student satisfaction, Net Promoter Score (NPS), educational resilience.

Introduction

The COVID-19 pandemic has brought unprecedented challenges to educational institutions worldwide, compelling a swift transition from traditional face-to-face teaching methods to various online learning platforms. This shift has sparked a significant interest in evaluating the effectiveness and resilience of these new teaching methodologies. Among these, Project-Based Learning (PBL) has emerged as a promising approach to engage students and maintain educational standards in an online environment.

Since the onset of the pandemic in early 2020, countries across the globe have enforced lockdowns and social distancing measures to curb the spread of the virus. Educational institutions, from primary schools to universities, were not exempt from these measures and had to pivot quickly to online learning to ensure continuity in education. In Thailand, as in many other nations, this transition was marked by a widespread adoption of digital tools such as Google Classroom, Zoom, and Microsoft Teams. The abrupt switch to online learning highlighted several challenges, particularly in maintaining student engagement and ensuring the quality of education. Traditional lecture-based teaching methods, which relied heavily on in-person interaction, proved less effective in a virtual setting. This shift necessitated the exploration of alternative pedagogical strategies that could better suit the online format and address the evolving needs of students.

Changing Dynamics of Student Engagement

The new generation of students, often referred to as digital natives, has distinct learning preferences compared to previous generations. These students, who have grown up in an era dominated by digital technology and instant information access, tend to find traditional lectures monotonous and disengaging. Studies have shown that these students prefer interactive and gamified learning experiences, which offer a more dynamic and engaging way to absorb information.

Moreover, the prolonged periods of passive listening required in traditional lectures do not align well with the shorter attention spans and the need for interactivity prevalent among today's students. As a result, educational strategies that promote active learning and student-centered approaches have gained traction.

Project-Based Learning (PBL), which emphasizes hands-on projects and real-world problem solving, has been identified as an effective method to cater to these preferences.

Project-Based Learning: A Student-Centered Approach

Project-Based Learning (PBL) is a pedagogical approach that involves students actively exploring real-world problems and challenges, thereby fostering a deeper understanding of the subject matter. PBL shifts the focus from teacher-led instruction to student-centered learning, where students take ownership of their learning process. This method not only enhances engagement but also develops critical thinking, collaboration, and problem-solving skills.

In online education, PBL offers flexibility, allowing students to work on projects at their own pace and schedule. Additionally, the collaborative nature of PBL can be effectively facilitated through various digital platforms, promoting interaction and teamwork among students even in a virtual environment.

The Net Promoter Score (NPS) Methodology

To evaluate the effectiveness and student satisfaction with online Project-Based Learning, this study employs the Net Promoter Score (NPS) methodology. Originally developed by Fred Reichheld in 2003, the NPS is a widely used metric in business to gauge customer loyalty and satisfaction. The NPS is calculated based on responses to a single question: "How likely are you to recommend our product/service to others?" Respondents are classified into three categories: Promoters (scores of 9-10), Passives (scores of 7-8), and Detractors (scores of 0-6) as shown in Figure 1.

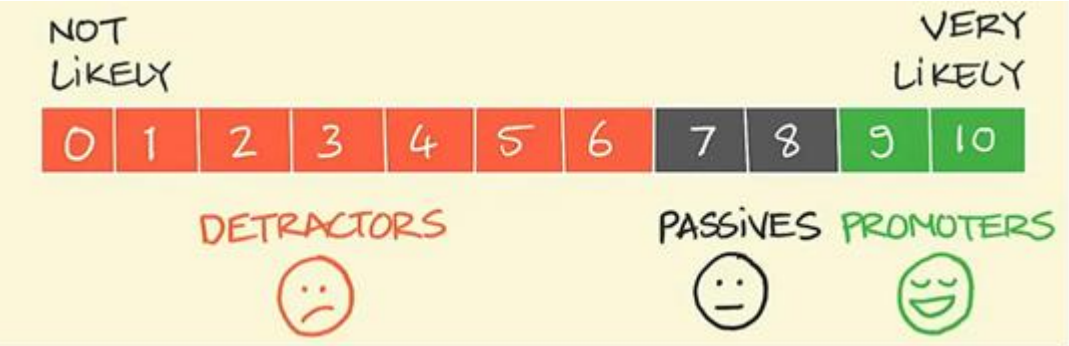

Figure 1: Classification of respondents into three categories

In an educational context, the NPS can be adapted to measure student satisfaction and their likelihood of recommending the learning approach to peers. This study's NPS evaluation provides a quantitative measure of student engagement and satisfaction with the PBL approach in an online setting, offering insights into its effectiveness compared to traditional teaching methods.

Figure 2: NPS result

Objectives of the Study

The primary objective of this study is to assess the resilience and effectiveness of online Project-Based Learning (PBL) in the post-COVID era. By utilizing the NPS methodology, the study aims to:

1. Measure student satisfaction with the online PBL approach.
2. Compare the engagement levels of students in online PBL versus traditional lecture-based online classes.
3. Identify the strengths and weaknesses of the online PBL method in addressing the needs of modern students.
4. Provide recommendations for educators and policymakers on how to enhance the resilience and effectiveness of online education.

Significance of the Study:

This study is significant as it addresses the urgent need to adapt educational methodologies to the evolving preferences and needs of students in a post-pandemic world. The findings will contribute to the body of knowledge on online education, particularly in the context of Project-Based Learning, and offer practical insights for improving student engagement and learning outcomes. By understanding student satisfaction and preferences, educators can better design and implement teaching strategies that are resilient, effective, and aligned with the needs of the digital age.

In conclusion, the transition to online education during the COVID-19 pandemic has underscored the importance of innovative and interactive teaching methodologies. Project-Based Learning (PBL) emerges as a promising approach to engage students and ensure the resilience of the educational process. This study, through the lens of the Net Promoter Score (NPS) methodology, seeks to evaluate the effectiveness of online PBL and provide valuable insights for the future of education in a post-COVID world.

Literature reviews

In the context of online project-based learning post-COVID, the literature reveals several critical themes that have emerged as a response to the pandemic's challenges. The abrupt transition to online learning necessitated by COVID-19 has prompted educators to innovate teaching methodologies to ensure effective learning outcomes. Project-based learning (PBL) has been recognized as a particularly effective pedagogical approach during this period, as it fosters active engagement and collaboration among students, which are essential in an online environment (Tang *et al*., 2021;, Nurtjahjanti *et al*., 2021). Research indicates that active and affective learning environments are crucial for overcoming the obstacles posed by the pandemic, highlighting the need for strategies that promote student interaction and engagement (Nurtjahjanti *et al*., 2021).

The integration of hybrid project-based learning, which utilizes digital tools such as animated videos, has shown potential in enhancing students' creative thinking skills. This approach not only caters to diverse learning styles but also encourages the development of critical thinking and problem-solving abilities, which are vital in a rapidly changing educational landscape (Tang *et al*., 2021). Platforms like Moodle have been pivotal in facilitating these online learning experiences. Although Moodle is widely regarded as an effective learning management system, discussions surrounding its limitations for specific learning activities have emerged. Continuous training and support for educators using Moodle can significantly enhance the online learning experience and contribute to faculty professional development (Novianti & Garzia, 2020).

Resilience has surfaced as a fundamental attribute for both educators and students navigating the complexities of online learning during the pandemic. Studies have explored the concept of educational

resilience, emphasizing factors such as self-directed learning and intrinsic motivation as critical components for maintaining effective learning outcomes (Yarni, 2023;, Ang *et al*., 2021). The implementation of project-based learning models has been shown to positively influence student resilience, enabling learners to adapt more effectively to the challenges of online education (Yarni, 2023). As educational institutions transition into the post-pandemic era, there is a growing recognition of the enduring impact of online learning. Educators are reorganizing their teaching methodologies to incorporate elements of virtual learning, underscoring the necessity for resilience and adaptability in the face of evolving educational demands (Naidu, 2021).

Furthermore, the shift to online teaching has prompted significant considerations regarding digital assessments and the ongoing digital transformation within higher education. The pandemic has accelerated the adoption of online learning platforms, which has implications for the future of educational practices and the need for continuous adaptation to new technologies (Cahaya *et al*., 2022). As institutions strive to build resilience in their educational systems, the focus on innovative teaching strategies and the integration of technology will be paramount in ensuring that learning remains effective and accessible for all students (Naidu, 2021).

In summary, the literature underscores the importance of project-based learning, resilience, and the effective use of digital platforms in navigating the challenges of online education post-COVID. The ongoing evolution of teaching methodologies and the integration of technology will be essential in shaping the future of education in a post-pandemic world.

Tools for Teaching

The post-COVID pandemic has forced educational institutions to adapt quickly to new modes of instruction, leading to a surge in the adoption of various online teaching tools. This section discusses the tools employed in implementing resilient online Project-Based Learning (PBL) post-COVID. Each tool's unique advantages will be explored, particularly emphasizing how YouTube's extensive repository of manufacturing process videos can replace on-site visits and its integration with Moodle for quizzes.

Padlet.org: Collaborative Learning Platform

Overview: Padlet.org is a versatile digital platform that enables collaborative learning through virtual bulletin boards where students and teachers can post notes, images, videos, and links. It serves as a dynamic space for brainstorming, project management, and interactive discussions. Figure 3 shows the results after the first introduction class, where students were asked to create one question each and share it on Padlet.

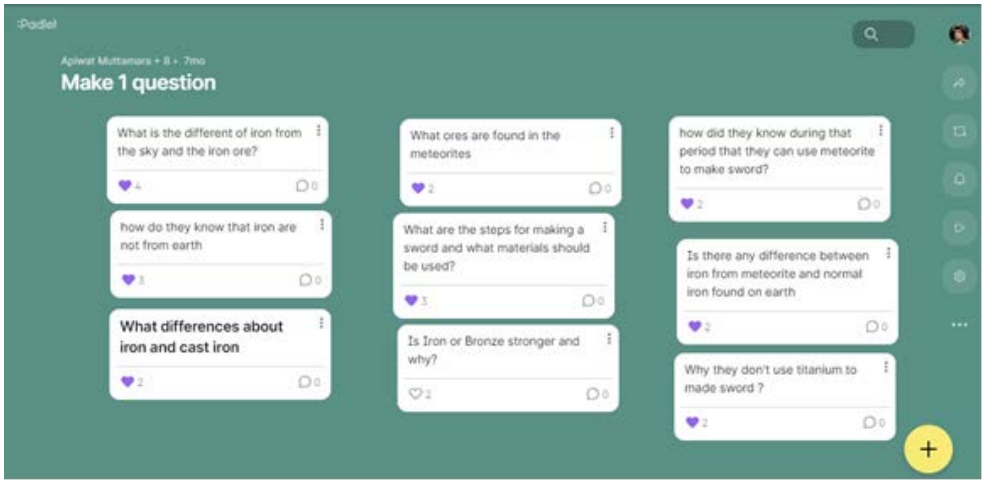

Figure 3: Results after the first introduction class

Advantages:

1. Ease of Use: Padlet's user-friendly interface allows both teachers and students to create and share content effortlessly. This simplicity encourages active participation and collaboration.
2. Real-Time Collaboration: Students can work on projects together in real-time, sharing ideas and resources instantly. This feature is particularly useful for group projects and peer reviews.
3. Multimedia Integration: Padlet supports various media types, enabling students to incorporate videos, images, and documents into their posts. This multimedia approach enhances engagement and aids in understanding complex concepts.
4. Organization and Accessibility: Teachers can organize content into different boards, making it easy for students to access and navigate through the course materials. Padlet boards can also be embedded into other platforms like Moodle, providing a seamless learning experience.

Method of Use: In the context of Project-Based Learning, Padlet can be used to:

- Initiate Projects: Teachers can create a Padlet board for each project, outlining the objectives, resources, and timelines. Students can post their initial ideas and research findings.
- Collaborate and Share**:** Groups can use Padlet to share their progress, get feedback from peers, and refine their projects based on collective input.
- Showcase Final Projects**:** Completed projects can be presented on Padlet boards, allowing for a virtual showcase where other students and teachers can view and comment.

YouTube: Visual Learning and Remote Site Visits

Overview: YouTube is a vast repository of video content, including educational videos, tutorials, and documentaries. It is an invaluable tool for visual learning, providing access to a wide range of topics and real-world applications.

Advantages:

1. Accessibility: YouTube is accessible to anyone with an internet connection, making it a convenient resource for students and teachers.
2. Diverse Content: The platform hosts a plethora of videos on almost any topic imaginable. For PBL, this means students can find detailed explanations, demonstrations, and case studies relevant to their projects.
3. Visual Learning: Videos cater to visual learners by demonstrating processes and concepts in a way that text cannot. This is particularly useful for complex subjects like manufacturing processes, where seeing the process in action is crucial.
4. Subtitles and Quizzes: Many YouTube videos come with subtitles, which can be utilized to create quizzes on platforms like Moodle. This feature enhances comprehension and provides a means to assess understanding.
5. Virtual Site Visits: During the pandemic, on-site visits to manufacturing plants or other industries became impossible. YouTube videos of manufacturing processes serve as a substitute, providing students with the necessary visual experience without physical presence.

Method of Use: Incorporating YouTube into PBL can be done through:

- Embedding Videos in Course Materials**:** Teachers can embed relevant YouTube videos into Moodle or Padlet to provide supplemental learning materials.
- Virtual Field Trips: Curating playlists of manufacturing process videos allows students to explore different processes virtually. These can be followed by discussions or assignments to assess comprehension.
- Interactive Quizzes: Using YouTube's subtitle feature, teachers can create quizzes on Moodle based on the video content. This not only ensures students have watched the videos but also tests their understanding of the material.

Moodle: Comprehensive Learning Management System

Overview: Moodle is a powerful Learning Management System (LMS) used for creating and managing online courses. It supports various activities such as assignments, quizzes, forums, and wikis, making it an ideal platform for PBL.

Advantages:

1. Structured Learning Environment: Moodle provides a structured environment where teachers can organize course materials, assignments, and assessments. This structure helps students navigate through their coursework systematically.
2. Interactive Activities: Moodle supports a wide range of interactive activities, including forums for discussions, quizzes for assessments, and assignments for project submissions. These activities facilitate active learning and engagement.
3. Resource Integration: Teachers can integrate resources from other platforms. This integration creates a cohesive learning experience for students.
4. Tracking and Reporting: Moodle's tracking features allow teachers to monitor student progress and engagement. Detailed reports provide insights into student performance and areas that may need additional support.
5. Customizable and Scalable: Moodle is highly customizable, allowing institutions to tailor the platform to their specific needs. It is also scalable, capable of supporting a large number of users and courses.

Method of Use: For implementing PBL in an online setting, Moodle can be used to:

- Course Setup: Create a dedicated course for each project, outlining the objectives, resources, and timelines. Embed Padlet boards and YouTube videos as necessary.
- Interactive Learning: Utilize forums for discussions, wikis for collaborative writing, and quizzes for assessments. Interactive activities keep students engaged and facilitate deeper understanding.
- Assignments and Submissions: Set up assignments where students can submit their project work. Teachers can provide feedback and grades directly through Moodle.
- Progress Tracking: Use Moodle's tracking tools to monitor student engagement and progress. Generate reports to identify students who may need additional support.

PBL Case Study: High-Pressure Cylinders Manufacturing Process Using YouTube and Transcripts

Project-based learning (PBL) is an instructional methodology that encourages students to learn and apply knowledge and skills through an engaging experience. In the context of education, leveraging multimedia resources can significantly enhance the learning experience. This case study explores how

a YouTube video on the manufacturing process of high-pressure cylinders can be integrated into a PBL framework, utilizing transcripts to create interactive quizzes and discussion prompts.

Methodology for Study

The study involved 22 undergraduate students enrolled in the Manufacturing Processes courses, which adopted the Project-Based Learning (PBL) approach. The participants were divided into groups and tasked with completing projects using the tools discussed throughout the course. However, it is important to acknowledge the limitation of the sample size in this study. The relatively small sample of 22 students may limit the generalizability of the findings to a broader population. For future studies, increasing the sample size and considering a more diverse group of participants would enhance the robustness and credibility of the results. Addressing such limitations helps to strengthen the validity of the conclusions and ensures a more comprehensive understanding of the PBL approach's effectiveness.

Video Selection

The YouTube video selected for this case study provides a detailed overview of the manufacturing process of high-pressure cylinders. This video was chosen for its comprehensive coverage of the topic, clear explanations, and visual appeal, making it an ideal resource for engineering students.

Transcript Extraction

The transcript of the video was extracted using YouTube's auto-generated captions. Additionally, ChatGPT was employed to generate and refine the transcript, ensuring accuracy and completeness. The transcript provides a text-based version of the video content, which is essential for creating quizzes and discussion materials. Below is an excerpt from the transcript:

6. Start: The manufacturing process begins with raw materials in the form of discs.
7. Heat Treatment: Discs are heat-treated at 730°C for 36 hours to enhance their properties.
8. Chemical Baths: Discs undergo a series of five hot chemical baths to prepare the metal.
9. Deep Drawing: Using a mandrel press, the discs are gradually shaped into cylinders through a deep drawing process.
10. Stretching: The cylinder is stretched further with another press applying up to 800 tons of force.
11. Forming: The closed bottom end of the cylinder is shaped into a concave form to reinforce the base.
12. Slicing: A band saw slices off up to 10 cm from the other end, which will become the top of the cylinder.
13. Hot Spinning: The top end is heated to 982°C and spun at 1000 RPM to shape the edges into a curve.
14. Tempering: The cylinders are heated in a furnace at 900°C and 650°C with cooling periods in between to strengthen the metal.
15. Cutting: A cutting tool carves open the neck and cuts internal threads to provide a secure fit for the valve.
16. Shot Blasting: The surface of the cylinders is cleaned using a process called shot blasting, where tiny steel pellets are shot at high speed.
17. Pressure Testing: The cylinders are filled with water, sealed, and tested under pressure to ensure they can withstand high pressure.
18. Marking: The shoulder of the cylinder is marked with legally required information such as manufacturing date and serial number.

19. Valve Installation: The valve is tightly screwed onto the neck to create a leak-proof seal.
20. Painting: The cylinders are painted for corrosion resistance and aesthetics.
21. End: The manufacturing process is complete, and the high-pressure cylinders are ready for use.

Using the extracted transcript, various interactive content types were created, including quizzes, discussion prompts, and matching exercises. Figure 4 illustrates examples of quizzes created in Moodle, showcasing their potential for interactive assessments that align with specific learning objectives. Designing an effective quiz begins with clearly defining its purpose, such as evaluating knowledge, reinforcing key concepts, or fostering critical thinking skills. Selecting the appropriate question type is crucial—options such as multiple-choice questions are suitable for knowledge recall, matching questions facilitate association of ideas, and essay questions encourage analytical responses. To maximize the quiz's effectiveness, it is essential to ensure clarity, engagement, and an appropriate level of challenge. This can be achieved by employing precise language, logical organization, and incorporating relevant visuals or examples.

Accessibility and fairness are also vital considerations in quiz design. Providing clear instructions, maintaining consistent formatting, and offering accommodations for diverse learners ensures inclusivity. Additionally, integrating feedback into the quiz enhances the learning experience by clarifying correct and incorrect responses, enabling students to identify and address gaps in their understanding. For instance, discussion prompts can be incorporated to deepen engagement and encourage application of knowledge. Examples include:

Prompt 1: Discuss the importance of using a seamless design for high-pressure cylinders. How does this design contribute to safety?

Prompt 2: Evaluate the role of tempering in the manufacturing process. Why is it necessary to alternate between heating and cooling?

These prompts further illustrate how quizzes can stimulate critical thinking and connect theoretical knowledge to practical applications.

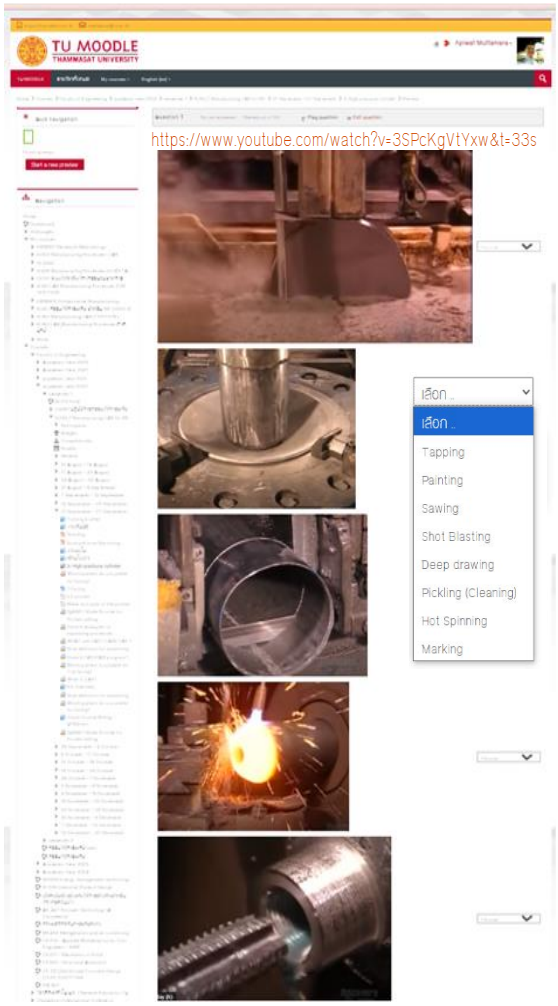

Figure 4: Matching quizzes from moodle

Results and Discussion

A survey was conducted to assess the effectiveness and student satisfaction of the online Project-Based Learning (PBL) approach. The survey was administered by the program office to ensure unbiased results. The Net Promoter Score (NPS) methodology was utilized to categorize students' satisfaction and derive actionable insights for future improvements. The survey results are illustrated in Figure 5, which categorizes students into three groups: Promoters, Passives, and Detractors.

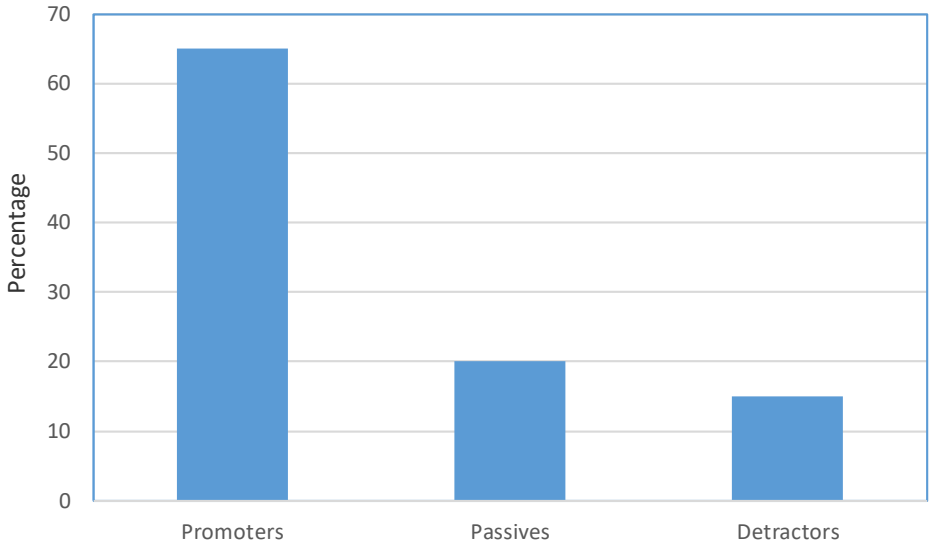

Figure 5: survey results, student satisfaction with PBL approach

- Promoters (65%): These students expressed high satisfaction, praising the visual and practical aspects of the YouTube videos. They found the content engaging and informative and appreciated the interactive quizzes and discussions, which significantly enhanced their understanding of manufacturing processes.
- Passives (20%): Moderately satisfied, these students viewed the PBL approach as somewhat effective but not markedly better than traditional methods.
- Detractors (15%): This group felt the reliance on video content did not align with their learning preferences and recommended incorporating more diverse instructional materials.

The Net Promoter Score (NPS) was calculated using the formula: NPS = Percentage of Promoters − Percentage of Detractors = 65% − 15% = 50%.

- Students in this category expressed high satisfaction with the PBL approach, particularly appreciating the interactive and collaborative elements provided by Padlet, the visual learning through YouTube, and the structured environment of Moodle.
- These students were moderately satisfied but identified areas for improvement, such as more timely feedback on assignments and additional interactive content.
- Students in this category were less satisfied, citing issues like technical difficulties, a lack of engagement in discussions, and a need for more direct interaction with instructors.

Conclusions

The results from the NPS survey indicate a predominantly positive response to the online PBL approach, with an NPS score of 50% reflecting a resilient and favourable reception among students. This section discusses the key findings and provides insights into the strengths and areas for improvement based on student feedback. The integration of YouTube videos and transcripts into the PBL framework has proven to be an effective method for teaching complex manufacturing processes. The high NPS score highlights a favorable response from students, with many appreciating the practical and interactive elements of the course.

However, to further enhance the learning experience and address concerns raised by detractors, it is recommended to improve instructor engagement. Strategies such as incorporating more live sessions, increasing interaction through discussion forums, or providing real-time feedback could better cater to students who felt disconnected due to the heavy reliance on video content. Additionally, diversifying instructional materials to include hands-on activities or supplementary resources might help engage different learning preferences. By continuously refining the approach and addressing these concerns, educators can create an even more resilient and engaging learning environment that meets the needs of all students.

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