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INFLUENCE OF STUDENT PREFERENCES ON THE PERFORMANCE OF CIVIL ENGINEERING COURSE

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Abstract:

This paper is aimed to analyse the performance of Final Year students taking the Principles of Prestressed and Precast Design course in UiTM Cawangan Pulau Pinang in relation to their learning preferences. The results of the students are based on two semesters; i.e. Semester Mac – August 2023 and October – February 2024 covering a total of 247 students. This study examines the correlation between students' preferences, i.e. the course contents, topic preference and learning methods with the students' performance in engineering education. The data on students' preferences are derived from teaching evaluation surveys conducted at the end of the semester, while course outcomes attainment was obtained from the i-RAS monitoring system. Based on the results, despite of the preference for calculation-based learning, lower attainment was observed in Course Outcomes 2 (CO2) which is calculation based compared to Course Outcomes 3 (CO3) which is theoretical based. This result highlights the complexity of student performance that did not directly reflects their preference. The result of the study might also be influenced by

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the students' prior industrial training and hands-on experience in construction, highlighting their ability to have more theoretical knowledge. These findings underscore the importance of aligning instructional methods with desired learning outcomes and offer insights for enhancing engineering education pedagogy.

Keywords:

Civil Engineering Education, Course Outcomes, Students' Preference

Introduction

The outcome-based education (OBE) focuses more on the learning outcomes in the engineering courses offered in universities. Each course will have their own designated course outcomes and programme outcomes tailored to the nature of the subject. These outcomes are essential information that needs to be disseminated to the students to expose them to the expectation of the course they are taking. The course outcomes are directly related to what the students are expected to learn throughout the course. On the other hand, the programme outcomes are usually mapped to the courses based on the engineering graduates' attributes that must be acquired by the students. The objective of this study is to investigate the influence of the student's preferences on the course outcomes performance for a civil engineering course offered in UiTM Cawangan Pulau Pinang. The course is Principles of Prestressed and Precast Concrete Design, which is a compulsory course for the civil engineering bachelor's degree program, CEEC221. The implementation of Outcome-Based Education (OBE) has effectively improved the quality of engineering educational programs and helped reduce variation in the quality of graduates (Qadir et al., 2020).

Since 2007, the Civil Engineering Studies program at UiTM Cawangan Pulau Pinang has implemented Outcome-Based Education (OBE), beginning with awareness programs for both lecturers and students. This initiative aims to embed the OBE culture within the teaching and learning processes across the centre of study. Implementing OBE requires meticulous data management, which has evolved significantly over time. Initially, the program used Microsoft Excel spreadsheets to manage Program Outcomes (POs), then transitioned to the OBE-SCL system, followed by MyCOPO, and now uses the latest Revolution on the Assessment for Student Monitoring System (i-RAS) since 2018. The measurement in the i-RAS system involves the measurement of course outcomes and also the programme outcomes achievement in each course via Microsoft Excel environment (OBE Manual 3rd Edition, 2022). The i-RAS system is developed as a monitoring system to facilitate the Continuous Quality Improvement (CQI) process for each course and the programme as required by the EAC Standard 2020 (EAC Standard, 2020).

This paper focuses on how the students' preferences could affect their course outcomes performance at course level. Students' preferences are often influenced by human nature, reflecting their individual backgrounds, personal interests, favourite subjects, preferred lecturers, and past academic performances. Focusing on the interrelation between student topic preferences, learning methods (face-to-face or online), and course content (theoretical and calculation-based), this research endeavours to analyse how these factors collectively shape the students' academic achievements in this prestressed and precast concrete design course. Understanding students' preferences in engineering education is essential to tailor teaching strategies, enhance students' motivation, promote student-centered learning, and improve the

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overall learning outcomes. Recognizing differences in learning styles improves the effectiveness of education delivery. An ideal learning environment should cater to various learning styles, allowing students to learn in ways they find comfortable (Rosati, 1999). A study by Tulis et al., found that a majority of engineering students prefer active, sensing, visual, and sequential styles based on the Index of Learning Style (ILS) (Tulsi et al., 2016).

A study by Mushtaha et al., (Mushtaha et al., 2022) recommends adopting a Hybrid-Flexible (HyFlex) model, combining face-to-face and e-learning techniques, as the preferred approach for future teaching and learning processes. This hybrid approach should be tailored to the nature of each course rather than relying solely on one method. Survey analysis reveals that over 70% of respondents appreciate the flexibility offered by online learning in terms of where and when it can be implemented, benefiting both students and academicians. However, the rapid adoption of eLearning during the COVID-19 pandemic had negative effects on users' mental health and social interactions. The built environment plays a crucial role in e-learning education and performance (Tleuken et al., 2022), with the recommendation to enhance residential facilities differently for urban and non-urban areas to indirectly support e-learning. To better understand students' preferences for online learning, more variables should be considered, such as campus life, group projects, feedback, resource accessibility, and socioeconomic status. These factors are linked to background knowledge, teaching methods, home online class setup, comfort levels, and evaluation methods (Selvaraj et al., 2021).

The transition to Online Distance Learning (ODL) has also significantly impacted assessment methods, shifting from conventional face-to-face written exams to alternative assessments like self-researched projects, online video presentations, and quizzes (Gupta et al., 2023). While ODL offers flexibility, it also presents challenges, particularly with network coverage issues, internet stability, and device compatibility. Self-motivation and discipline are essential for ODL, as it requires students to independently manage their learning (Radzi, 2023). Problems such as college server instability and learning management system failures highlight the need for improvements (Lee, 2020). Tracking student attendance and engagement remains difficult as students learn from different environments. Additionally, educators' lack of technical and computational skills adds to the challenges of ODL (Alqahtani et al., 2023). A survey by Selvaraj et al., (Selvaraj et al., 2021) involving undergraduate students found that more than 90% agreed that direct face-to-face interaction is necessary for effective learning, indicating a preference for traditional classes due to communication and discussion limitations in online learning. Furthermore, the lack of human contact, limited outdoor activities, and difficulty in communicating with friends, along with increased distraction, depression, and stress, emerged as challenges in the online education (Garcia-Castelan et al., 2021 and Akir et al., 2012).

Based on the literatures, engineering students generally prefer learning methods that support direct interaction, clear guidance, and the ability to revisit content when needed. In face-to-face settings, they value in-person engagement with instructors and peers, which facilitates real-time feedback and collaborative learning. In online learning, they appreciate recorded lectures, which allow them to learn at their own pace and review material as often as needed for better understanding. Moreover, practical, calculation-based content is often favoured over theoretical material, especially in engineering, where hands-on problem-solving aligns with students' interests. The significance of students' motivation in education is also crucial, focusing on personal needs and behavioural motives as fundamental concepts in psychology and pedagogy (Andreev et al., 2020) . The type of assessments given to the students also

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affected the performance of the students exhibiting that it is not due to the knowledge given by the university (Ravi, 2023).

This study involves 247 students taking the CES525 course from two semesters, i.e. Semester March – August 2023 and October – February 2024. There are three course outcomes measured for this course as shown in Table 1. These course outcomes are assessed based on the four topics taught and mapped to the three course outcomes as presented in Table 2.

Table 1: Course Outcomes For This Course

CO	Description
CO1	Propose the relevant principles of the prestressed and precast concrete to suit their applications.
CO2	Design the prestressed concrete element
CO3	Conclude the design principles of precast and prestressed elements, joints and connections between members, and the general practices in precast-prestressed concrete construction

Table 2: Topics In This Course

Topic	Title
Topic 1	Introduction and principles of prestressed and precast concrete structures (CO1)
Topic 2	Analysis and design of prestressed concrete sections (CO2)
Topic 3	Design principles of precast elements and joints (CO3)
Topic 4	General practices and handling of precast-prestressed components (CO3)

Methodology

The study's methodology involved collecting data through a teaching evaluation form administered using Microsoft Forms. This form was distributed to students at the end of each semester to gather feedback specifically from those enrolled in the CES525 course. The study spans two semesters: March - August 2023, with 205 students, and October 2023 - February 2024, with 42 students. The primary objective of this research is to explore students' preferences regarding various aspects of the course, including content type, topic selection, and learning methods. This feedback is crucial for the Continuous Quality Improvement (CQI) process, aiming to enhance teaching and learning methods. Data concerning the course outcomes were obtained from the i-RAS system for analysis. Additionally, students were asked to comment on their preferred learning methods and provide reasoning for their choices, allowing for a more comprehensive understanding of their preferences and experiences.

Results and Discussion

This section presents the findings of the study, highlighting how students' preferences impact the course outcomes of CES525. Table 3 displays the course outcomes distribution for the CES525 course as stipulated in the syllabus. The distribution of course outcomes shows that CO2, which is calculation-based, has the highest distribution at 49%, while the theoretical outcomes CO1 and CO3 have lower distributions at 17% and 34%, respectively. CO2 covers the topic related to the analysis and design of the prestressed concrete beam which requires the students to apply their knowledge by referring to the standard codes.

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Table 3: Course Outcomes Distribution

CO1	CO2	CO3
17%	49%	34%

Course Content And Topic Preferences

Figure 1 presents the analysis of students' preferences reveals a significant inclination towards calculation-based learning methods over theoretical approaches, with 67% of the student's favouring calculations. This preference aligns with the majority selection of Topic 2 as shown in Figure 2, which focuses on the analysis and design of prestressed concrete sections and garnered 40% of preferences. Topic 1 followed with 29%, while Topics 3 and 4 received smaller percentages. These findings reflect the typical preferences of engineering students, who often favour hands-on problem-solving and the application of concepts over memorization and theoretical exposition. Based on the statistical analysis using JASP, the standard deviation for the course content and topic preference are 0.47 and 0.359, respectively. These relatively low standard deviation shows that the students' responses are generally uniform and does not vary widely. This result shows that most students have similar perception on both course content and topic preference.

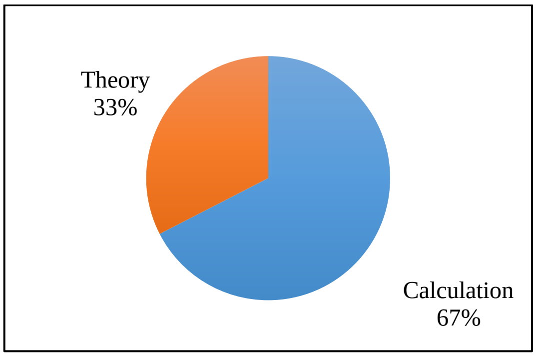

Figure 1: Course Content

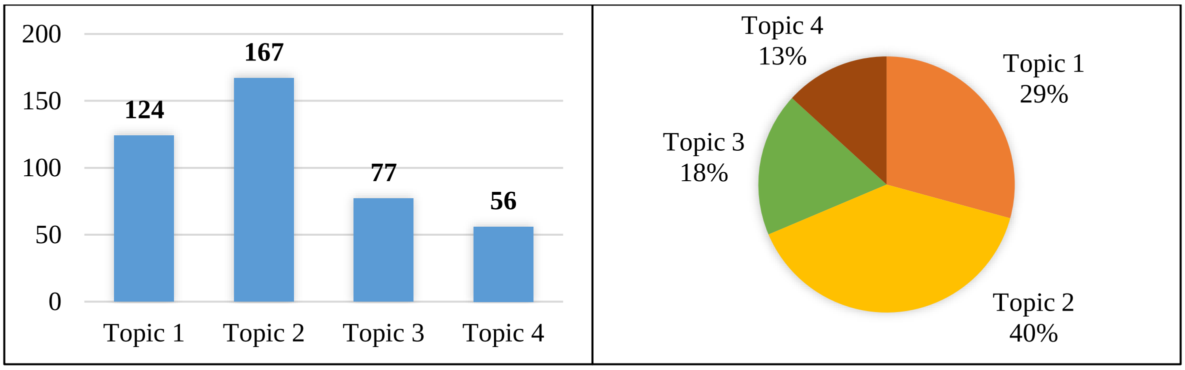

Figure 2: Topic Preference

Table 4 displays students' average performance across course outcomes, indicating higher achievement in CO3 compared to CO1 and CO2. In Table 5, performance is further broken down by assessment type, revealing that the mini project yields the highest attainment, possibly due to its collaborative group work nature. Online quizzes also show notable performance. These findings highlight the impact of assessment methods on student achievement and

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emphasize the importance of diverse pedagogical approaches for optimizing learning outcomes.

Table 4: Average Course Outcome Performance

Course outcomes	March – August 2023	October 2023 – February 2024	Average attainment
CO1	53%	73%	63%
CO2	70%	59%	65%
CO3	73%	70%	72%

Table 5: Course Outcome Performance By Assessments

Assessment type	March - August 2023			October - February 2024			Average attainment		
	CO1	CO2	CO3	CO1	CO2	CO3	CO1	CO2	CO3
Test 1	50	59	-	74	53	-	**62**	**56**	**-**
Quiz	75	64	69	61	65	84	**68**	**64.5**	**76.5**
Mini Project	-	85	90	-	88	88	**-**	**86.5**	**89**
Test 2	-	68	68	-	39	62	**-**	**53.5**	**65**

The analysis of CES525 course outcomes reveals that, although students mostly prefer calculation-based learning, CO3 (theoretical content) shows higher attainment compared to CO2 (calculation-focused). This suggests a potential mismatch between student preferences and performance, possibly because theoretical content demands deeper cognitive engagement and also the requirement of external knowledge. Furthermore, these students are already in their Final Year, where they had attended their Industrial Training in the previous semester. Therefore, they are more exposed to the real construction work which is closely related to Topic 3 and 4 that is measuring CO3. This result in more ability for the students to elaborate their answers in questions related to the facts related to the construction methods and industry.

Figure 3 presents the grade achievement of students for both semesters reported in percentages. The percentage of students achieving Grade B increased significantly in semester October 2023 – February 2024 even though lower CO2 attainment was observed. This achievement is compensated by better attainment in CO1 and CO2 despite the student’s preference.

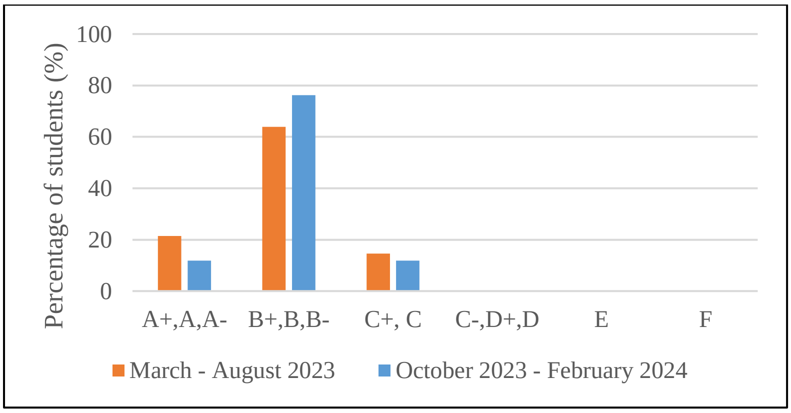

Figure 3: Grade Achievements Of Students

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Learning Methods

Figure 4 provides insights into students' preferences regarding teaching delivery methods, showing that a substantial majority 85% of respondents prefer face-to-face learning over online instruction. This preference for traditional classroom interaction is further explained in Figure 4, which summarizes the reasons behind this inclination. Key reasons include the value of direct interaction with instructors for clarifying doubts, the opportunity for real-time engagement with course material, and the benefits of peer interaction and collaborative learning experiences facilitated by in-person classes. These findings underscore the enduring importance of interpersonal connections and experiential learning opportunities in the educational journey of engineering students, highlighting the crucial role of face-to-face instruction in fostering a dynamic and enriching learning environment.

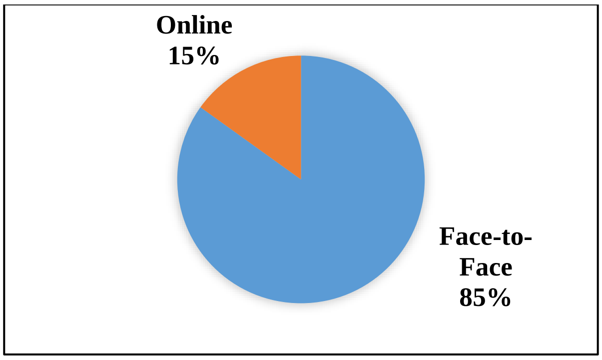

Figure 4: Learning Methods

In this study, 85% of students expressed a preference for face-to-face learning over online classes. The primary reasons cited include direct communication with lecturers, enhanced focus and concentration, hands-on interaction, peer support, and the motivating classroom environment. These factors collectively contribute to a more engaging and effective learning experience compared to online settings. Details of the key factors are as follows:

a) **Direct Communication and Interaction:** Students appreciate the ability to ask questions and communicate directly with lecturers in face-to-face settings, facilitating immediate feedback and clearer understanding of complex topics.

b) **Increased Focus and Concentration:** Many students find that they can concentrate better in a classroom environment, as it minimizes distractions commonly found in online settings, allowing them to stay focused and engaged during lessons.

c) **Improved Understanding and Engagement:** The interactive nature of face-to-face classes, including hands-on exercises and in-depth teaching, helps students gain a deeper understanding of both theoretical and calculation-based content.

d) **Interactive Learning Environment:** Face-to-face learning fosters a more interactive environment, encouraging active participation and two-way communication between students and lecturers, enhancing the overall learning experience.

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e) **Peer Support and Collaboration:** Being in a classroom with peers provides students with the opportunity to discuss and clarify concepts with friends, offering additional support beyond the lecturer's explanations.

f) **Motivation and Classroom Dynamics:** The classroom environment, including the presence of friends and the lecturer's teaching style, motivates students to be more engaged and attentive, making the learning process more enjoyable and effective.

Figure 5 shows the word cloud that summarizes the key points noted by the students in showing their preference towards face-to-face learning. The main points highlighted is engagement, response and direct feedback that can be given during the face-to-face class. This reveals that the classroom environment with the presence of lecturers and fellow friends is still relevant even in this new era that is mostly dominated by the online and cloud learning.

Figure 5: Word Cloud On Reasons Of Students' Preference To Face-To-Face Learning

However, only 15% of students prefer online learning over face-to-face learning. This percentage indicates that the majority of students favour face-to-face learning, with more than twice as many students choosing it as their preferred mode of learning. There are several reasons why some students prefer online learning, which are closely related to the independent learning process. The key points highlighted by these students include the ability to review recorded lectures at their own pace, the flexibility to study on their own schedule, and the convenience of revisiting course materials whenever needed. Figure 6 exhibited the word cloud on the key points on online learning. Three main points that is highlighted are access, convenient and flexible. Reasons of students' preference to online learning are detailed out as follows:

a) **Ability to Replay and Review**: Students appreciate the ability to replay recorded lectures, which allows them to review material at their own pace. This flexibility is especially helpful for revisiting complex topics and ensuring better understanding.

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b) **Convenience and Flexibility**: Online learning offers the flexibility to study at any time, which is particularly beneficial for students with varying schedules. This convenience allows learners to fit their studies around other commitments.

c) **Enhanced Understanding**: The option to rewatch lectures multiple times helps students grasp difficult concepts more thoroughly. This repeated exposure can lead to a deeper understanding of the material.

d) **Study Aid for Exams**: Recorded lectures serve as valuable resources for exam preparation, allowing students to revisit and revise topics as needed. This helps reinforce learning and aids in retention of information.

e) **Reduced Pressure**: Online learning can reduce the pressure of needing to immediately understand material during a live session. Students can take their time to digest information and seek clarification as needed.

f) **Combination with Face-to-Face Learning**: Some students prefer a hybrid approach, using online lectures for theoretical content and face-to-face sessions for practical or calculation-based subjects. This combination maximizes the strengths of both learning modes.

Figure 6: Word Cloud On Reasons Of Students' Preference To Online Learning

Conclusion

In conclusion, it's evident that students' preferences do not always align with course outcomes. Despite a preference for calculation-based learning, the lower attainment observed in CO2 compared to CO3 highlights the complexity of student performance. Calculation-based assessments may require more fundamental knowledge, while theoretical-based assessments can draw upon basic understanding and on-site experience, particularly relevant given the students' completion of industrial training. The limitation of this research is that it primarily focuses on students' preferences related to course content, topic selection, and learning methods, along with an assessment of course outcomes achievement. However, it does not encompass broader program outcomes, which would provide a more comprehensive view of students' overall development across the program. Additionally, demographic data of students was not included in the analysis, limiting insights into how factors such as age, gender, academic background, and other personal characteristics might influence students' preferences and course outcomes. The absence of demographic context restricts the study's ability to identify potential patterns or correlations that may vary across different student groups. For future research, expanding the scope to include program outcomes and student demographic data would provide a more comprehensive understanding of factors influencing learning preferences and performance.

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