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Impact of Supervisor Consistency on Capstone Project Completion: Insights from an Electrical Engineering Program Course in Indonesia

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ABSTRACT

BACKGROUND & CONTEXT

The capstone project is a mandatory final assignment for engineering students, including those in electrical engineering at Universitas Sebelas Maret, Indonesia. It spans two semesters: semester 7 involves group work under a supervisor, while semester 8 focuses on an individual project with a supervisor. The final project should ideally relate to the capstone topic, but changes in topic or supervisor are permitted, although they may impact the project's completion timeline.

PURPOSE OR GOAL

This research explores how changing topics or supervisors in projects affects student progress, identifying factors that hinder completion and suggesting curriculum improvements.

APPROACH OR METHODOLOGY

A quantitative research approach was used to collect data on capstone group assignments, supervisor preferences, and project completion dates from January to May 2025. The Mann–Whitney U test analysed whether changes in topics or supervisors significantly affected final project completion times.

OUTCOMES

The suggestions aim to enhance management practices for capstone projects, improving efficiency, facilitating timely graduation, and increasing industry readiness for students.

CONCLUSIONS

Consistent supervision in Electrical Engineering projects accelerates student progress, while changing project topics has minimal effect, relevant to similar Indonesian universities.

KEYWORDS

Capstone Project, Supervisor, Consistency, Final Project, Engineering Education.

Introduction

Background of the Study

The percentage of students graduating on time in the Electrical Engineering program Universitas Sebelas Maret remains relatively low, recorded at 60% in 2024, based on the internal monitoring instrument (UNS, 2024). This finding indicates that a significant proportion of students are unable to complete their studies within the expected timeframe. In contrast, Faculty of Engineering, needs to further increase the rate of on-time graduation in order to meet its key performance indicators (UNS, 2019).

A major factor contributing to delayed graduation is the extended time required for students to complete their final projects, as documented in the management review meeting year 2025, which is part of the internal quality audit conducted in the faculty of engineering. This problem is further complicated by a mismatch between the capstone project and the final project requirements, which creates additional workload, confusion, and inefficiencies in supervision and assessment. These challenges often prolong students' completion time and contribute to the performance gap between actual outcomes and institutional targets. Addressing this issue is therefore essential to enhance academic effectiveness and align outcomes with quality standards (UNS, 2025).

According to the Indonesian Accreditation Board for Engineering Education (IABEE), in accreditation criteria for engineering programs which developed according to the graduate attribute exemplars of the Washington Accord, a capstone project synthesizes and employs the knowledge and skills gained throughout an academic program, culminating in an experience that prepares students for their professional careers. Capstone projects are essential in engineering education as they ready students for the job market by showcasing their abilities to potential employers. These projects provide hands-on experience in project management, which is often a key factor in hiring decisions within the engineering field. Additionally, students develop vital skills such as problem-solving, analytical thinking, creativity, and technical proficiency through these projects, all of which are important in the fast-evolving electrical engineering industry. Furthermore, capstone projects present valuable networking opportunities, enabling students to engage with industry professionals, alumni, and prospective employers, which can greatly enhance their career prospects. In conclusion, capstone projects enrich the educational experience by allowing students to apply their knowledge to real-world challenges and collaborate effectively, ultimately equipping them for successful careers in engineering (IABEE, 2023).

The capstone project is a key part of engineering education, especially in the electrical engineering program at Universitas Sebelas Maret. This required final task lasts for two semesters, where the first semester focuses on teamwork with a supervisor, and the second semester centres on individual projects. Even though changes in project topics or supervisors are permitted, such adjustments can greatly impact the timing and quality of project completion. Good supervision is vital for boosting student involvement, motivation, and project success, with studies indicating that matching student interests with supervisor knowledge can lessen delays and enhance results. The research highlights the need for careful pairing of supervisors and students, emphasizing teamwork and communication. It stresses the necessity for organized procedures to connect supervisors based on faculty expertise and student choices to improve project efficiency and tackle challenges, ultimately striving for successful capstone project results.

Objectives

The inquiry focuses on understanding the effect of regular supervision on the successful realization of capstone projects, uncover issues that lead to setbacks, and recommend refinements for both curriculum and project administration. Ultimately, the intention is to elevate the number of graduates who finish as planned.

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The paper identifies a research gap, emphasizing the necessity for more comprehensive studies on how supervisor-student dynamics, especially the consistency of supervision and the diversity of topics, influence project results. Additionally, it calls for the institution to enhance the percentage of students graduating on time.

Literature Review

Capstone design, according to the Washington Accord (ABET, 2025), is a final educational experience for undergraduate engineering students, combining what they have learned during their studies into practical projects. This method focuses on collaboration, managing projects, and using engineering principles to address challenging problems, setting it apart from other design methods that might not need such thorough integration or practical application. Definition and Purpose. Capstone design serves as a critical final project, synthesizing all major design concepts learned during the engineering program (Padmanabhan et al., 2018). It involves real-world projects, often in collaboration with industry or community partners, allowing students to apply theoretical knowledge in practical settings (Forbes & Hoople, 2024; Brackin, 2007).

Key Distinctions from Alternative Design Methods Integrating Knowledge: In contrast to standard design courses, capstone projects require students to demonstrate their comprehension of the entire curriculum (Padmanabhan et al., 2018). Real-World Use: Capstone projects aim to tackle real engineering issues, while other design methods might be more conceptual or theoretical (Sadek & Newland, 2024). Capstone design focuses on teamwork and collaboration, equipping students with essential skills for professional environments (Brackin, 2007).

The integration of design experiences in engineering curricula, as emphasized by ABET (ABET, 2025), is essential for preparing students for real-world challenges in their careers. By aligning capstone projects with industry standards, educational institutions can significantly enhance the effectiveness of their engineering programs and better equip students with the skills necessary for success in the workforce. This alignment is crucial, as it fosters a comprehensive understanding of the engineering design process and its practical applications in real-world scenarios (Wilairat et al., 2023). This alignment not only benefits students but also addresses feedback from accreditation bodies regarding the necessity of integrating design into engineering curricula, ensuring compliance with industry expectations (Shaban, 2002). The integration of practical learning experiences, such as capstone projects, is essential for enhancing students' employability and bridging the gap between academic knowledge and real-world application (Oman et al., 2022; Wei, 2024).

Capstone projects are an essential component of engineering education, requiring students to apply the concepts, theories, and skills they have acquired throughout their studies. This practical application is particularly important in engineering fields, where understanding both theoretical foundations and their practical uses is crucial. Often, these projects aim to address real-life issues, with students engaging in initiatives that involve creating new systems, enhancing existing technologies, or developing innovative solutions to specific problems. This hands-on experience is vital for preparing students for their future careers.

Supervisors in Capstone Projects

The effectiveness of supervision in capstone projects is influenced by factors such as the supervisory relationship, assessment processes, and the contextual environment. Key to this relationship is the frequency of academic meetings, which improve communication and clarify expectations (Majdoubi, 2024). The effectiveness of supervision is influenced by the interpersonal dynamics between the supervisor and the student, with a positive relationship enhancing guidance and support (Abiddin et al., 2011).

Effective supervision of capstone projects requires assessing both the process and the final product, enabling supervisors to offer informed feedback and support (Lawson et al., 2015).

Supervisors' informed assessments are vital to maintain consistency in marking, which is essential for the quality of the capstone experience (Lawson et al., 2015).

Creating an inclusive research environment mitigates biases and fosters a supportive atmosphere for students (Majdoubi, 2024). The supervisor's expertise and continuous training are essential for ensuring high-quality supervision, significantly impacting the guidance offered to students (Nam, 2023).

While these factors are critical for effective supervision, it is also important to recognize that challenges such as varying supervisor styles and institutional constraints can hinder the supervisory process. Addressing these issues is essential for optimizing the capstone project experience.

Structured supervisor matching has been shown to improve project success and student satisfaction. Collectively, these studies suggest that enhancing supervisor matching and investing in training for faculty supervisors can lead to better student performance and project outcomes, enriching the overall educational experience. This study highlights the importance of strategic project and supervisor selection in enhancing student engagement and success in capstone courses, aligning with findings from previous research on effective mentorship and project design (Hart & Polk, 2017; Cooper & Goodell, 2014).

Supervisors play a pivotal role in guiding students through their capstone projects, fostering essential skills such as project management and teamwork, which are crucial for success in the engineering field (Khan & Bashir, 2013).

The findings will emphasize the importance of structured supervision and its impact on student motivation and project success in engineering capstone courses. Effective supervision is essential for optimizing student development and project success, as it directly influences motivation and the acquisition of key engineering competencies (Delson, 2001; Shurin et al., 2023).

Moreover, fostering a strong supervisory relationship can enhance student motivation and engagement, ultimately leading to improved project outcomes and professional readiness. Effective supervision practices are essential for ensuring that students remain engaged and motivated throughout their final year projects, particularly in the engineering field (Rusli et al., 2023).

However, the process of assigning and maintaining supervisors throughout a student's project journey can be complex. Students may initially work with one supervisor for a Capstone project, express a preference for another for their Final Project, and ultimately be assigned a third. Such transitions raise questions about the continuity of guidance and its potential effects on student progress. Furthermore, the alignment of a student's field of interest with their supervisor's expertise is often assumed to be beneficial, but its empirical impact on project achievement warrants investigation. Establishing a consistent supervisory relationship is essential, as it fosters trust and promotes effective communication, ultimately enhancing student engagement and project success in engineering education (Mazid, 2009; Huang & Sharma, 2007).

Additionally, many capstone projects emphasize teamwork, reflecting the collaborative nature of engineering work. Through these projects, students learn to work together, leveraging each member's strengths while also honing their communication, project management, and conflict resolution skills. Furthermore, the role of the supervisor is critical in guiding students through their projects. Faculty members provide valuable advice, support, and expertise, helping students navigate challenges and refine their project concepts. A successful match between supervisors and students can significantly enhance the mentoring experience, leading to improved project outcomes.

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Methodology

Participant Selection

The meticulous and considerate selection process aimed at identifying participants for capstone projects should place great importance on emphasizing a broad spectrum of skills, experiences, and backgrounds among the individuals involved, as this diversity is essential for enriching the collaborative experience, which subsequently nurtures the creation of innovative and creative solutions to intricate problems. Within this context, the participants in focus are students enrolled in the Electrical Engineering program at Universitas Sebelas Maret in Indonesia, specifically from the 2021 intake year, who are presently facing the academic challenges of their eighth semester. This cohort comprises a total of 67 students, and the information regarding their experiences and projects was carefully collected during various intervals, including June 2024, December 2024, and from January to May 2024. The participants have shown strong interests in three specific fields of study: Control and Mechatronics (CM), Power Engineering (PE), and Computer Engineering and Telecommunications (CET), highlighting their diverse academic interests and career goals. As they are all in their eighth semester, they are collectively involved in the final project (FP) phase, which represents a crucial milestone in their educational path. The reason for selecting participants from the 2021 cohort is that these students have already gained considerable experience and have developed a thorough understanding of the capstone project processes and final project expectations.

Data Collection Methods

The elements that require gathering comprise three unique and crucial segments, each fulfilling a distinct purpose within the complete framework. The initial component is specifically related to the capstone project aspect, where the data collected includes various factors such as the students involved, their unique interests, the groups they are part of, the designated capstone design supervisor, and the particular areas of expertise that each supervisor holds. This phase occurs during the seventh semester of the academic program, during which students are required to form teams of three to four members. Each team is then assigned a single supervisor who manages the capstone design project, and the topic chosen for the project is a mutual agreement made between the students and their designated supervisor. It is crucial to note that the grouping of students and the selection of topics occur before the start of the seventh semester, specifically in July 2024. Once the seventh semester officially starts, students will begin working on their capstone projects, culminating in the creation of a detailed report presented at the semester's end to both their peers and their assigned supervisor. The second component of the data collection process takes place at the end of the capstone design project, concentrating specifically on the individual final project that each student is required to undertake. It is highly recommended that students persist with their capstone design project as they transition into their final project; still, if a student decides to modify their topic or supervisor, they can freely do so without incurring any penalties. During this stage of data collection, the information gathered includes specifics about the student along with their chosen field of interest, the topic or title they wish to pursue for their Final Project, their desired supervisor, and that supervisor's related interests. This data collection is set to occur in December 2024. Following this, in January 2025, the academic program will finalize decisions regarding the final projects and subsequently assign a Final Project supervisor to each student. It is important to emphasize that, at this point, some students may find themselves with different topics or supervisors than those they had during their Capstone Design project. The third component of the data collection process relates to the time when students participate in a seminar showcasing the final outcomes of their projects. This seminar is held only after the projects have been completed, and the relevant data for this phase will be collected from January to May 2025. The following variables were utilized in the analysis:

1. capstone supervisor: the supervisor assigned to the student's Capstone Project.

2. wanted FP supervisor: the supervisor preferred by the student for their Final Project.
3. assigned FP supervisor: the supervisor officially assigned to the student's Final Project.
4. student's field: the academic field of the student.
5. supervisor's field: the academic field of the supervisor.
6. progress seminar date: the month in which the student's progress seminar was held.

Data Analysis

In the examination of educational processes, particularly those concerning student oversight in capstone and final projects, statistical techniques can yield valuable insights into trends and discrepancies between student expectations, assigned supervisors, and academic outcomes. A remarkable non-parametric method for executing this style of research is the Mann-Whitney U Test, which considers if there are major differences between two distinct groups. In contrast to parametric tests like the independent-samples T-test, the Mann-Whitney U test does not require the assumption of normal data distribution, making it particularly suitable for categorical or ordinal educational data (Nazish & Kang, 2024).

With regard to capstone and final project supervision, the dataset encompasses the variables mentioned previously.

The Mann-Whitney U Test can be employed in various manners with this dataset. For instance, one might explore whether students who were paired with their preferred supervisor (Wanted FP supervisor = Assigned Final Project supervisor) finished their progress seminar significantly sooner than those assigned a different supervisor. In this case, the two groups consist of students whose preferred and assigned supervisors align, and students whose preferred and assigned supervisors do not align.

The U statistic is obtained by ranking all progress seminar dates across both groups and subsequently assessing the difference in rank sums between the two groups. A smaller U value signifies a greater distinction between the groups. The corresponding p-value indicates the likelihood of witnessing such a difference if there were no genuine effect of supervisor alignment on progress seminar scheduling. A p-value lower than a standard significance threshold (e.g. 0.05) would suggest that students with aligned supervisors tend to complete their progress seminar significantly sooner (or later) than those with misaligned supervisors.

Moreover, the test could be broadened to make comparisons across different fields. For example, one might investigate whether discrepancies between a student’s field of study and the supervisor’s field lead to delays in seminar completion. Once more, the Mann-Whitney U test would compare the ranked seminar dates of students with aligned versus misaligned academic backgrounds.

Findings

The finding that has emerged from this analysis pertains to the intricate and multifaceted relationship that exists between the various fields of interest of students and their respective supervisors, which encompasses not only the alignment of the topics of the course delivery and the final projects, but also includes the compatibility of the capstone project with the assigned supervisor, as well as the comparison between the desired supervisor match and the actual supervisor assignment, all of which are analyzed in relation to the duration allocated for the seminar.

Analysis of Supervisor Matching

Table 1 presents data, analyzed using the Mann-Whitney U test, detailing how specific factors influence the final project seminar's duration. The table focuses on four key elements: the Project & Capstone Topic, the congruence of Student & Supervisor Fields, the assigned Capstone & Project Supervisor, and the difference between the Wanted & Assigned Supervisor.

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Tabel 1: Effect of corresponding factors on final project seminar timing

Matching Factor	U-Statistic	P-Value	Significant?	Impact on Seminar Time
Project & Capstone Topic	5270.75	not specified	No	No clear effect
Student & Supervisor Field	418.5	0.222	No	Mild, not statistically significant
Capstone & Project Supervisor	332	0.0024	Yes	Shorter time (median: 10 vs 12 months)
Wanted & Assigned Supervisor	247.5	< 0.0001	Yes	Shorter time (median: 10 vs 12 months)

The study examines the relationships between various matching factors and seminar duration in academic projects. Key findings include:

1. Project & Capstone Topic Match: No notable impact on seminar duration (U-Statistic: 5270.75, P-Value not specified).
2. Student & Supervisor Field Match: Slight effect, yet not statistically significant (U-Statistic: 418.5, P-Value: 0.222).
3. Capstone & Project Supervisor Match: Notable impact, with paired students finishing seminars more quickly (U-Statistic: 332, P-Value: 0.0024; median duration: 10 vs 12 months).
4. Wanted & Assigned Supervisor Match: Highly significant, suggesting faster seminar completion when students are paired with their chosen supervisors (U-Statistic: 247.5, P-Value: < 0.0001; median duration: 10 vs 12 months).

This highlights the importance of student preferences in the supervisory process, as having a supervisor that aligns with a student's choice can greatly enhance the efficiency of their seminar completion. In summary, the results indicate that while some matching factors do not significantly impact seminar duration, having a match between the capstone project and the supervisor, as well as aligning students with their preferred supervisors, can lead to shorter completion times.

Impact on Capstone Project Efficiency

Effective supervisor matching not only streamlines project workflows but also enhances the overall educational experience, ultimately leading to improved student outcomes in capstone projects.

The process of effectively matching supervisors for students, taking into account not only the continuity of the project but also the preferences expressed by the students themselves, has been shown to considerably decrease the amount of time that is required to prepare for and participate in seminars.

On the other hand, matches that are made solely at the topic level or field level, which may seem relevant, do not have a statistically significant impact on the timing of students' readiness for seminars.

It is clear that maintaining continuity with supervisors and ensuring that they are well-aligned with the preferences and interests of the students represent the most influential factors that can be leveraged in order to enhance the overall efficiency of capstone projects.

More recent data indicate positive progress. By July 2025, the on-time graduation rate had increased to 76%. This suggests that effective supervision plays a crucial role in accelerating the completion of final projects, which in turn contributes to higher rates of on-time graduation

Discussion

Implications for Engineering Education Practices

The findings of this extensive research suggest quite convincingly that placing a high priority on maintaining continuity with supervisors, while also ensuring that there is a strong alignment with the preferences and interests of students, can lead to a significant enhancement in the overall efficiency with which capstone projects are completed, which, in turn, ultimately translates into notable improvements in the educational outcomes experienced by students. Moreover, the study robustly indicates that academic institutions should take proactive measures to implement systematic and well-structured supervisor matching processes, which are designed specifically to enhance both project efficiency and student satisfaction, thereby fostering a more productive and enriching learning environment for all involved parties. The meticulous process of matching supervisors with students represents a critical and fundamental aspect of academic programs, particularly in the context of capstone projects, where the culmination of students' learning experiences is put into practical application and demonstration. The findings emphasize that adopting a thoughtful and deliberate approach to this supervisor-student matching process has the potential to yield significant improvements in both the efficiency of project execution and the overall readiness of students for their upcoming seminars.

Continuity with Supervisors

A key factor highlighted in this investigation is the importance of maintaining continuity with supervisors throughout the project. When students have the same supervisor for the entire duration of their project, they can develop a stronger and more productive working relationship, which improves communication and guidance. This continuity allows for deeper discussions, timely feedback, and a clearer understanding of project expectations, all of which contribute to a more refined final product that meets academic standards.

Student Preferences

Incorporating students' preferences and interests into the supervisor matching process is another crucial element that deserves attention. When students feel that their interests, goals, and career aspirations align with their supervisor's expertise, they are more likely to be motivated and engaged in their work. This alignment not only creates a more enjoyable educational experience but can also enhance the quality of the capstone project, as students are more willing to invest time and effort into subjects they are genuinely passionate about.

Ineffectiveness of Topic-Level Matching

Research findings clearly show that matching students with supervisors based solely on topic or field of study often does not yield the desired results. While it may seem logical to pair students with supervisors who have specialized knowledge in a specific area, this approach often overlooks the unique needs, preferences, and aspirations of individual students. Such superficial matching can lead to disengagement and may prolong the preparation time for seminars, as students might struggle to connect with their supervisors or feel disconnected from their projects.

Impact on Seminar Readiness

The success of capstone projects is closely linked to how well-prepared students are for their seminars. When students are thoughtfully matched with supervisors who understand their goals and can provide relevant support, they are much better prepared to present their work confidently and clearly. This preparation not only improves the quality of the seminar presentation but also contributes significantly to the students' professional development in ways that extend beyond the classroom.

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Impact on Student Graduation on Schedule

Recent statistics show encouraging advancements. By July 2025, the rate of on-time graduations had risen to 76%. This points to the necessity of diligent monitoring to facilitate quicker project completion, which subsequently boosts punctual graduation statistics.

Recommendations for Supervisor Matching Practices

1. Prioritize supervisor continuity: It is highly advisable to maintain the same supervisor throughout both the capstone and project phases in order to ensure a consistent and enriching mentoring experience for the students involved.
2. Honor student preferences for supervisors as much as possible during assignments: In the process of assigning supervisors to students, it is essential to take into account and respect the individual preferences expressed by students regarding their choice of supervisor to the greatest extent feasible, as this can significantly enhance their motivation and engagement.
3. Use this data to guide supervisor allocation policy and improve project planning timelines: By analysing and utilizing the data gathered from previous supervisory assignments and student feedback, we can effectively inform and shape our supervisor allocation policies, ultimately leading to more efficient project planning timelines and improved overall outcomes for future projects.

Conclusion

Summary of Key Findings

The continuous and diligent supervision provided in various Electrical Engineering initiatives plays a significantly critical role in substantially boosting and enhancing the overall advancement and progression of students in this field, while at the same time, any changes or alterations made to the specific project topics tend to show a rather minimal or negligible impact on the outcomes, especially when considering the performance in relation to similar higher education institutions located in Indonesia.

Future Research Directions

Future studies should examine how supervisor-student relationships affect various factors over time, including project completion duration, student performance, and industry acceptance of their work. Looking into how steady supervision impacts the quality of capstone projects and graduates' job placements and career paths can yield important findings. Furthermore, research might investigate how industry professionals view students' work, focusing on how effective supervisor matching and mentorship influence graduates' readiness and skills in the engineering job market. This all-encompassing strategy will improve educational systems that better equip students for successful careers in engineering sectors.

The study suggests several improvements: conducting research with larger and more diverse student groups to enhance applicability, utilizing qualitative methods like interviews to gain insights into experiences during supervisor changes, implementing longitudinal studies to track student progress over time, examining mediating factors that connect consistent supervision to timely advancement, and exploring alternative metrics of student success beyond exam results, such as project quality and presentation skills.

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