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Integrating Engineering Innovations With Marketing Project Through CDIO-Based Multidisciplinary Project In Polytechnic To Enhance Learning Outcomes

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ABSTRACT

This paper examines the integration of the CDIO (Conceive–Design–Implement–Operate) framework into multidisciplinary Final Year Projects at Politeknik Port Dickson, focusing on collaboration between the Mechanical Engineering and Commerce Departments. Traditionally, marketing plans have suffered from misalignments between Course Learning Outcomes (CLOs), Student Learning Time (SLT), and actual project execution, resulting in limited authenticity, innovation, and industry relevance. The study aimed to: (1) realign the marketing plan syllabus to strengthen the connection between theory and practice, (2) explore the process by which marketing students develop strategies for engineering- based products, and (3) assess how CDIO-based multidisciplinary projects support the achievement of marketing CLOs. Using a qualitative case study approach, data were collected through direct participant observation. Findings indicate that CDIO multidisciplinary projects provided a structured and authentic platform for marketing students to apply theoretical concepts to real engineering innovations, thereby enhancing creativity, critical thinking, and teamwork. Students achieved stronger CLO alignment and produced more relevant marketing campaign materials. The paper concludes by proposing the adoption of CDIO multidisciplinary projects across polytechnics as a means to strengthen project quality, foster 21st-century skills, and improve graduate employability. Replication of this study in other institutions offering diploma-level marketing programmes could yield deeper insights into best practices for managing marketing plan projects

1.0 Introduction

In higher education, aligning academic practices with industry expectations is critical to ensure a well- rounded educational experience that prepares students for the complex demands of the modern workplace (Peng, 2020). Engineering education has seen a shift towards more

practical, outcome-oriented approaches, such as the CDIO framework (Al-Obaidi, 2021). The CDIO framework is an innovative educational framework that emphasises hands-on, project-based learning to bridge the gap between theoretical knowledge and practical application (Peng, 2020). In Malaysia, polytechnics, as prominent TVET institutions, play a vital role in producing skilled workers and technicians for the country's industries (Hairi et al., 2019). These institutions are designed to provide practical, hands-on training that directly addresses the needs of the job market. The integration of innovative educational approaches such as the CDIO framework can significantly enhance the effectiveness of final-year projects, particularly in multidisciplinary contexts involving non-engineering and engineering students (Beldad & Miedema, 2025). Final-year projects in higher education serve as a crucial bridge between academic learning and professional practice, offering students the opportunity to apply their knowledge and skills to solve real-world problems (Yuming, 2024; Ibrahim et al, 2019).

A prominent feature of this effort is the Final Year Project (FYP), which synthesises the technical and soft skills students acquire throughout their academic programmes (Pawar & Patil, 2021). However, the effectiveness of FYPs in achieving these goals depends significantly on how well they are structured and aligned with industry needs and educational outcomes.

To enrich the educational experiences of students, active learning for real-world projects offers opportunities to apply theoretical knowledge in practical business scenarios, fostering individual learning and problem-solving competencies (Bloomer, 2025; Dzaiy & Abdullah, 2024). Such project- based learning experiences are invaluable, as they equip students with specialised skills that are directly applicable to the current needs of the marketplace, skills that may not be thoroughly covered in traditional core courses (Biggs et al., 2022).

1.1 Problem Statement

The current structure of FYP in marketing programmes reveals a significant misalignment between Course Learning Outcomes (CLOs) and actual project practices.

This paper addresses this need by emphasising the critical importance of accurately interpreting the Marketing Plan syllabus, restructuring project expectations, and fostering proactive academic interventions. By incorporating a CDIO-based multidisciplinary approach, this study seeks to create a more authentic and industry-relevant project experience that strengthens alignment with Course Learning Outcomes (CLOs), enhances student competencies, and facilitates the production of market-ready outcomes.

1.2 Research Objectives

The objectives of this study are threefold:

i. Examine how the marketing FYP syllabus can be realigned to strengthen the link between theory and practice.

ii. Explore the multidisciplinary process of marketing students developing strategies for an engineering-based product.

iii. Assess how the CDIO-based multidisciplinary project supports the achievement of the marketing project’s Course Learning Outcomes

1.3 Significance of the Study

This study contributes to curriculum enhancement in Malaysian polytechnics by emphasising the importance of accurately interpreting course syllabi and informing the effective implementation of multidisciplinary projects. It supports academic leaders and lecturers in aligning intended learning outcomes with teaching practices while highlighting the value of cross-

departmental collaboration. By addressing real-world challenges, the study promotes the development of 21st-century skills among students.

2.0 Literature review

2.1 Syllabus Interpretation and Curriculum Realignment

Syllabus serves as the foundational blueprint for curriculum delivery, ensuring that both educators and students understand the learning expectations, content scope, and intended outcomes (Bano et al., 2019). However, discrepancies often surface in how educators interpret and translate syllabus content into actionable teaching strategies, which directly impacts the learning experiences and outcomes of students (Liventsova et al., 2019). Misinterpretation or outdated instructional practices, however, can lead to misaligned assessments, unrealistic student output expectations, and ineffective learning experiences (Ross, 2024).

In the case of Malaysian polytechnics, the misalignment between the Marketing Final Year Project (FYP) expectations and student capabilities was evident when students were tasked with end-to-end product and marketing strategy development within a single 14-week semester. Such expectations often stretched beyond the SLT and diverged from the prescribed CLOs.

The recurrence of food-based and engineering-oriented product innovation themes in marketing FYPs highlighted a systemic issue that student were not receiving adequate interdisciplinary support, especially in areas beyond their academic training. This lack of collaboration resulted in final outputs that failed to meet industry standards (Alsmadi et al., 2024). In response, academic leaders undertook a syllabus reinterpretation exercise, emphasising clarity in project scope, realistic timelines, and better integration with relevant disciplines, such as engineering and design.

2.2 Industry Feedback and the Call for Academic Intervention

Industry feedback has become an essential tool in curriculum development, offering external validation of student preparedness and the practical relevance of academic training (Warman et al., 2021). Employers often point out deficiencies in both the hard skills and soft skills of graduates, especially in areas critical for innovation and market success, such as practical engineering know-how, teamwork, communication, and problem-solving. Therefore, alignment between academic practices and industry expectations is critical for producing work-ready graduates who can navigate the complex demands of modern workplaces.

At the polytechnic level, real-world critiques such as those raised during the marketing FYP exhibitions highlight valuable discrepancies that require academic redress. For example, while marketing students are adept at market research and promotional tactics, their lack of understanding of the intricacies involved in product design, materials selection, and manufacturing processes often results in projects that are either conceptually flawed or practically unsustainable. The critiques brought attention to the fact that marketing students were being assessed on tasks outside their domain such as technical product design, which typically falls within engineering expertise. As a result, marketing students struggled to present coherent, technically sound, and marketable products. These underdeveloped projects not only reflected poorly on student performance but also raised concerns about the overall effectiveness of the curriculum. Hence, a need emerged to explore more robust, integrated, and collaborative educational frameworks that can support such multidisciplinary tasks while staying within the boundaries of academic and resource constraints (Baune et al., 2024; Alsmadi et al., 2024).

2.3 CDIO Framework as a Multidisciplinary Solution

The Conceive–Design–Implement–Operate (CDIO) framework, initially developed for engineering education (Bhatnagar et al., 2020), is increasingly being adopted across various disciplines to enhance practical learning and problem-solving skills (Namasivayam et al., 2019).

Although traditionally associated with engineering, CDIO has gained traction in non-engineering academic disciplines for its potential to enhance applied learning and problem-solving capabilities. In the CDIO framework, the final year project falls under Standard 6 & 7, which refer to Engineering Workspaces and Engineering Practice, respectively. By emphasising hands-on experience and multidisciplinary collaboration, CDIO aims to produce graduates who are not only academically knowledgeable but also practically competent and ready to innovate (Alsmadi, 2024).

The CDIO framework emphasises the importance of hands-on experience and multidisciplinary collaboration and has been shown to improve innovation and entrepreneurship in higher education (Cui, 2020). By fostering collaboration between marketing and engineering students, CDIO-based projects can simulate real industry practices, where marketers and engineers must work together to conceptualise viable products and marketing strategies (El Achkar & Alsaba, 2024; Tan & Vicente, 2019).

This not only mirrors the dynamics of the actual workplace but also enriches students' educational experience through authentic, interdisciplinary learning (Alsmadi, 2024). Furthermore, the CDIO framework facilitates a more structured and effective approach to problem-solving, as it requires students to integrate multiple perspectives, manage projects from inception to completion, and effectively communicate their ideas to diverse audiences.

The integration of CDIO into the FYP structure encourages students to follow a logical project progression, conceiving ideas, designing prototypes with technical support, implementing strategies through marketing campaigns, and operating or presenting these solutions in real-world contexts. This model fosters student engagement and ensures that projects remain within the realm of academic feasibility while reflecting real industry scenarios.

2.4 Challenges in the Existing FYP Structure

Feedback and critiques from industry experts are crucial in FYP presentations and exhibitions because they can pinpoint gaps that require academic attention and correction (Jamaludin et al., 2023).

However, critiques from industry panels during marketing plan exhibitions (Student Exhibition and Evaluation Day -SEED 2018-2021) have highlighted misalignments between the intended learning outcomes, actual project execution, and student capabilities. Specifically, these critiques noted that marketing students often presented new product development (NPD) frequently involving food-based or engineering-heavy products without sufficient technical input or collaboration, resulting in subpar, underdeveloped work. This situation prompted academic leaders to initiate a comprehensive review and reengineering of the marketing plan syllabus to realign project scopes with Course Learning Outcomes (CLOs), Student Learning Time (SLT), and industry relevance. Despite the merits of project-based learning, existing Marketing plan structures in marketing programs present several challenges. Chief among them is the unrealistic expectation that students must complete product design and marketing campaigns within one semester. This not only places undue pressure on students but also often leads to superficial or incomplete project outcomes. The limited resources available, both in terms of academic support and infrastructure, exacerbate these issues.

Moreover, the lack of established interdisciplinary collaboration models limits students' ability to develop well-rounded projects. Without the technical expertise of engineering students or faculty, marketing students often rely on assumptions during the design phase. This reliance results in flawed product prototypes and marketing strategies that are based on hypothetical, non- functional, or untested products.

Table 1: The Conventional Student Project Process in Marketing Programmes

Step	Activity	Explanation of Conventional Practice	Outcomes and Observations
1	Supervisors Determined Theme	Supervisors selected and assigned project topics based on previous templates or general themes such as "entrepreneurial products," "eco- friendly packaging,". Sometimes students were required to explore	Students often lacked ownership of the project idea, leading to disengagement and a tendency to recycle past ideas without introducing innovation, thereby limiting the originality and relevance of project outcomes.
2	Briefing to Students	Supervisors gave a general briefing to students about project requirements, deliverables, and deadlines. This was typically a one-way communication model.	Students understood the structure but not the purpose or potential industry relevance. No interdisciplinary exposure was provided.
3	Supervisors Supervise	Supervisors guided students throughout the semester, focusing on documentation, basic product creation, and report submission. Supervision often followed a checklist or assess student based on rubrics. Supervisors adhered strictly to instructions from the Head of Program, resulting in limited autonomy to select suitable innovations, themes, or product types.	While expectations were met procedurally, the creative and critical thinking elements were limited. Feedback loops with the industry were usually received only during the final presentation. This meant there was no time for further improvements, as the project had already reached its final stage; however, feedback from stakeholders indicated that enhancements could be made if more time were available within the CDIO cycle.
4	Students Develop Products	Students worked as a group to create products based on the given theme, often working within their comfort zones (e.g., DIY gifts, baked goods, handmade crafts, add-on flavour, etc.).	Resulting products lacked technical rigour, were often repetitive, and did not reflect real marketing challenges or innovations. The products sometimes fail to showcase the real marketing promotional materials. Wasting time in product development rather than creating a marketing campaign.

Table 1 shows the conventional process of handling a marketing project. Before the reengineering efforts guided by SCAMPER's "Rearrange" principle, the Marketing FYP at Malaysian polytechnics followed a more conventional, linear process. This approach was supervisor-centric, where themes were predefined, and student agency was limited. Although the structure was clear and easy to manage, it often failed to reflect real-world industry challenges or promote interdisciplinary collaboration. This table outlines the four major steps typically followed under the conventional method, explaining how each phase was implemented and highlighting the limitations that later triggered a need for pedagogical innovation.

The conventional process of handling the Marketing FYP offered structure and basic guidance, can be improved to foster creativity and real-world relevance. In the absence of industry feedback loops and interdisciplinary collaboration, many student projects tended to recycle previous concepts and struggled to produce truly impactful marketing materials. This challenge was compounded by the fact that a significant portion of time was allocated to product development, even though the primary learning outcome was to design and present effective marketing materials for either an existing product or a newly developed one requiring promotion. These gaps highlighted the urgency for curriculum reengineering.

3.0 Methodology

This study employed a qualitative approach using the direct participant method. The primary informant was the Marketing Final Year Project (FYP) coordinator, who also served as a project supervisor, providing first-hand insights into the re-engineering of the marketing plan project for the current semester. Data were obtained from her direct involvement in guiding students, revising project structures, and integrating multidisciplinary elements, including the adaptation of a completed Mechanical Engineering Department project from the previous semester as the basis for the Marketing Plan project.

The SCAMPER technique was applied as the creative framework to address gaps in the conventional FYP approach, enabling the systematic challenge of assumptions, generation of innovative ideas, and redesign of processes to align more closely with industry needs. The direct participant method allowed the informant to engage actively in the project context, capturing

detailed decision-making processes and interactions that provided rich, context-specific insights into curriculum re-engineering.

3.1 Research Design

Stage 1: Understanding the SCAMPER Technique

The SCAMPER method is a systematic framework for creative thinking and problem-solving, widely utilised in product development, innovation, and process improvement. It encourages systematic ideation by prompting users to think from seven different perspectives.

Table 2 presents each SCAMPER element and describes its role in fostering innovation within the context of the Final Year Project (FYP).

Table 2: SCAMPER Elements

Elements in SCAMPER	Guiding Question	Simple Explanation
S – Substitute	What alternative elements or resources can be substituted or used in place of the existing ones?	Change one part of the product, service, or idea with something else (e.g., use eco-friendly packaging instead of plastic).
C – Combine	What can be merged or joined together?	Mix two ideas, products, or processes to create something new (e.g., combine a coffee shop with a bookstore).
A – Adapt	What can be adjusted to fit a new use or situation?	Modify the idea to serve another purpose or audience (e.g., turn a children's board game into an educational tool).
M – Modify (Magnify / Minify)	What can be made bigger, smaller, or changed in form?	Alter size, shape, or feature to improve or innovate (e.g., create a mini version of a popular snack for easy carrying).
P – Put to another use	How else can this be used?	Find a new function or market for an existing idea (e.g., using shipping containers as pop-up shops).
E – Eliminate	What can be removed or simplified?	Eliminate unnecessary steps to streamline processes, such as simplifying the sign-up procedure in an application.
R – Rearrange (or Reverse)	What happens if we change the order or do it differently?	Switch the sequence or flip the idea for a fresh perspective (e.g. delivery package at night)

By guiding students and supervisors through these perspectives, the SCAMPER method offers a systematic approach to generating innovative ideas and rethinking the conception, development, and execution of marketing plans.

4.0 Discussion of analysis and findings

This section explains the findings of each research objective.

Research Objective 1:

Examine how the marketing FYP syllabus can be realigned to strengthen the link between theory and practice

Table 3: Syllabus Interpretation Before and After Re-engineering

Syllabus Component	Conventional Interpretation (Before Re-engineering)	Revised Interpretation (After Re-engineering)
Course Name & Code	Treated as a standalone Marketing Plan subject	Positioned as a Marketing Plan (Final Year Project) integrated with multidisciplinary inputs (e.g., engineering, communication)
CLO (Course Learning Outcome)	Interpreted as "to create a new product and develop marketing materials."	Interpreted as "to create marketing materials based on innovation or product."
SLT (Student Learning Time)	SLT exceeded. Focus on grading product creation and basic marketing outputs	SLT within stipulated hours. Focus on evaluating marketing strategies, industry relevance, and collaboration outcomes
Hours for Theory	Adequate	Adequate

Hours for Practical	The majority of the hours are allocated to product development, with additional time required for the development of the Marketing Plan.	Hours redistributed to marketing research, marketability study, marketing material content creation, and stakeholder engagement
Assessments for Project	Focused on new product development/innovation (prototype, reports, presentations)	Focused on marketing material and promotional campaigns development for a product that was already developed.
Deliverables	New product prototypes plus marketing posters, presentation	Comprehensive marketing package (posters, videos, surveys, campaigns, product launching, presentation) for an existing product with innovation

Research Objective 2:

Explore the multidisciplinary process of marketing students in developing strategies for an engineering-based product.

In this study, "Rearrange" from the SCAMPER framework was selected as it best represents the changes targeted for the MP development process. Rearrange involves restructuring existing processes to achieve better outcomes. Here, it was used to realign syllabus learning outcomes, student learning time, and an inter-programme multidisciplinary approach to address previous critical feedback from industry panellists.

Table 4 outlines the sequential steps taken to reengineer the MP project process at a Malaysian polytechnic. Each step reflects the application of "Rearrange", which is part of an institutional response to industry feedback, highlighting inconsistencies and limitations in student project outcomes. Each row details a specific step that reflects the application of the "Rearrange" technique. This strategic process encompassed management decision-making, syllabus review, interdepartmental collaboration, and the implementation of new supervisory practices.

The comparison in Table 3 highlights a significant shift in how the MP syllabus is interpreted and implemented. Previously, the emphasis was on students creating entirely new products alongside basic marketing materials, which diluted the focus on core marketing competencies. Following the re-engineering process, the syllabus was realigned to integrate existing innovations, particularly those originating from engineering programs. This alignment enabled students to focus on developing comprehensive and industry-relevant marketing strategies and materials. This adjustment not only streamlined the allocation of time and assessment weightage but also strengthened the connection between theoretical learning outcomes and practical, real-world marketing applications.

Table 4: Application of "Rearrange" in the Reengineering of Marketing Plan

Step	Activity	Explanation of Rearrangement	Outcomes and Insights
1	Marketing Plan Exhibitions	The exhibitions highlighted recurring product-based projects that lacked technical depth. Traditionally, marketing students worked in isolation from other departments.	Sparked concern from industry evaluators; became the catalyst for systemic review.
2	Industry Feedback to Top Management	Industry panellists questioned the feasibility and quality of marketing students designing products without technical backing. This prompted a review at the leadership level.	Created urgency and legitimacy for academic leaders to initiate a reform.
3	Syllabus Revisit by Academic Leaders	The marketing syllabus, particularly for the FYP course, was critically reviewed. Learning outcomes, Student Learning Time (SLT), and project deliverables were scrutinised.	Found misalignment between CLOs and actual student outputs, especially in product design expectations.
4	Academic Team Discussion on Syllabus and Implementation	Marketing lecturers discussed practical implementation gaps and proposed changes to reduce	An agreement was reached to integrate interdisciplinary approaches to enhance authenticity.

5	Approach the Engineering Heads of Engineering Departments (HoDs) for Collaboration	A new initiative was undertaken to formally engage the HoDs in exploring potential collaborative project development.	Engineering HoDs expressed support, recognising mutual benefits for both student groups.
6	Discussion Among Engineering and Marketing Project Supervisors	Joint meetings were conducted between supervisors from both departments to coordinate timelines, clarify expectations, and align assessment rubrics.	Enhanced coordination resulted in greater clarity regarding project scope, task allocation, and supervision plans.
7	Briefing from Engineering Supervisors to Marketing Students and Supervisors	Engineering supervisors provided orientation to marketing students on the product development process and limitations.	Marketing students gained realistic insight into what products could be developed, improving proposal quality.
8	Marketing Materials Development for Engineering Projects	Marketing students were assigned to develop branding, promotional strategies, and communication materials for engineering-developed prototypes.	Clear role distinction allowed marketing students to focus on their core competencies while collaborating meaningfully.

The application of the "Rearrange" element of the SCAMPER method enabled the academic team to reconceptualise and restructure the design and execution of final-year marketing projects. This re-engineering process involved reorganising tasks, stakeholders, and lecturers' expectations to reflect real-world marketing practices through interdisciplinary collaboration more accurately. As a result, student engagement improved, project authenticity increased, and alignment with Course Learning Outcomes (CLOs) was restored—ultimately addressing the concerns raised by industry professionals and enhancing the educational value of the FYPs.

Research Objective 3:

Assess how the CDIO-based multidisciplinary project supports the achievement of the marketing project's Course Learning Outcomes.

Figure 1 illustrates the inter-department integrated curriculum designed to support the Marketing FYP through a CDIO-based multidisciplinary approach. Two key departments, namely the Commerce Department and the Mechanical Engineering Department, had collaborated by aligning their respective courses and learning outcomes (CLOs).

The Commerce Department focuses on the Marketing Plan course, where students are tasked with creating a comprehensive marketing campaign. Simultaneously, the Mechanical Engineering Department runs Project 1 and Project 2, requiring students to develop innovative engineering products

These parallel courses converge through shared assessments and deliverables: marketing students produce posters, promotional videos, reports, and presentations to market engineering products, while engineering students deliver product prototypes, reports, and presentations.

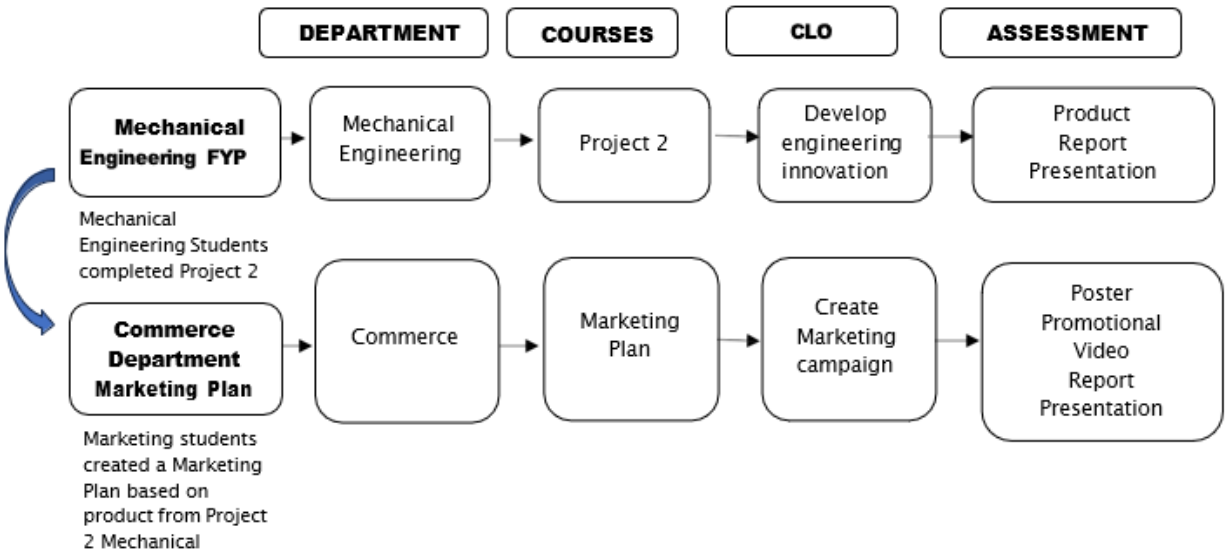

Figure 1: Inter-Department Integrated Curriculum for Marketing Plan

This integrated structure demonstrates how real-world interdisciplinary collaboration is embedded into the curriculum, ensuring marketing students apply theoretical knowledge to tangible innovations and achieve their CLOs more effectively, while engineering students gain exposure to market validation and promotional strategies. This synergy reflects the CDIO principle of connecting Conceive, Design, Implement, and Operate stages across disciplines, resulting in more relevant, industry-ready outcomes for both programs.

5.0 Conclusion and Future Research

This study examined how MP project management practices in Politeknik Port Dickson, Malaysia, could be enhanced through the CDIO framework. Findings revealed a gap between curriculum intentions and practice—students often focused on product creation rather than marketing strategy, leading to misaligned CLOs, overstretched SLT, and limited industry relevance.

By re-engineering the syllabus and embedding multidisciplinary collaboration between marketing and engineering students, the MP development process shifted toward producing meaningful marketing outcomes for real innovations. This approach demonstrated how CDIO can bridge theory and practice, foster creativity, and strengthen academic–industry linkages. Nonetheless, there are a few implications from this study that institutions can learn from:

5.1 Managerial Implications:

Polytechnics should realign the Course Learning Outcomes (CLOs) and Student Learning Time (SLT) to reflect realistic workloads while ensuring marketing-focused outcomes. In addition, cross-department collaboration should be formalised through clear structures for joint planning and supervision. Assessment rubrics need to be revised so that they effectively measure teamwork, innovation, and interdisciplinary competencies. Furthermore, industry partnerships should be strengthened to enable the co-creation of project themes, thereby ensuring their relevance to current market needs.

5.2 Practical Implications:

Curriculum developers, Final-Year Project coordinators, and supervisors should focus on developing a capstone project syllabus that is dynamic and accommodates clear content encapsulating discipline-specific knowledge. They should also guide students in creating marketing materials for existing innovations while using the CDIO stages to structure projects in a systematic manner. Additionally, real industry feedback should be embedded into project reviews before the final presentation to enhance the quality, relevance, and applicability of the project outcomes.

As a final reflection, this study demonstrates that integrating the CDIO framework into marketing projects strengthens the connection between theory and practice, enriches the overall learning experience, and equips graduates with the competencies needed to be industry-ready (Bloomer, 2025). Moreover, with sustained institutional support and effective cross-department collaboration, Malaysian polytechnics can transform Final-Year Projects into exemplary models of practical, innovative, and future-focused education. Furthermore, the approach outlined in this study can be replicated across other institutions offering similar programs, thereby advancing the quality of marketing project practices in polytechnics nationwide.

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Author Contributions

Mohamad N. H.: Conceptualisation, Methodology, Writing; **Mohd Nawi D.**: Validation of Data, Writing and Editing; **Primadona P.**: Proofreading and Editing. All authors reviewed and approved the final version.

Conflicts of Interest

The authors declare that the manuscript has not been published previously, is not under consideration elsewhere, and all authors have approved its submission. The authors further declare that there is no conflict of interest regarding the publication of this manuscript.

6.0 References

Al-Obaidi, K. M. (2021). Implementing the CDIO framework in engineering education: A review of best practices and outcomes. International Journal of Engineering Pedagogy, 11(1), 45–56. https://doi.org/10.3991/ijep.v11i1

Alsmadi, H., Kandasamy, G., Al Kafri, A., & Zahirah, K. F. (2024). Empowering computing students through multidisciplinary project-based learning (PBL): Creating meaningful differences in the real world. *Social Sciences & Humanities Open*, *10*, 101180.

Bano, A., Ali, M., & John, S. (2019). Issues of syllabus designing practices and quality assurance at higher education level. *Global Social Sciences Review (GSSR)*, *4*(4), 135-145.

Baune, B. T., Fromme, S. E., Aberg, M., Adli, M., Afantitis, A., Akkouh, I., & Ziller, M. J. (2024). A stratified treatment algorithm in psychiatry: a program on stratified pharmacogenomics in severe mental illness (Psych- STRATA): concept, objectives and methodologies of a multidisciplinary project funded by Horizon Europe. *European archives of psychiatry and clinical neuroscience*, 1-12.

Beldad, A. D., & Miedema, H. A. T. (2025). Introducing a framework for designing an interdisciplinary engineering curriculum: educating new engineers for complex sociotechnical challenges. *European Journal of Engineering Education*, 1-18.

Bhatnagar, R., Crook, S., & Latha, R. (2020). Integrating CDIO in engineering curricula: A global perspective. Journal of Engineering Education Transformations, 33(2), 120–135.

Biggs, J., Tang, C., & Kennedy, G. (2022). *Teaching for quality learning at university 5e*. McGraw-hill education (UK).

Bloomer, P. (2025). Preparing Design Students for an Omnidimensional Future in MultiMedia. In *Conference Proceedings. The Future of Education, June 2025*.

Cui, F. (2020). Application and evaluation of “CDIO” in innovation and entrepreneurship education in higher vocational colleges. Journal of Physics: Conference Series, 1629(1), 012077. https://doi.org/10.1088/1742- 6596/1629/1/012077

Dzaiy, A. H. S., & Abdullah, S. A. (2024). The use of active learning strategies to foster effective teaching in higher education institutions. *Zanco Journal of Human Sciences*, *28*(4), 328-351.

El Achkar, J. H., & Alsaba, M. (2024). Dynamic Integration of Sustainability and Climate Change in Engineering Curricula Via CDIO. In *20th International CDIO Conference*.Crawley, E. F., Malmqvist, J., Östlund, S., Brodeur,

D. R., & Edström, K. (2014). Rethinking engineering education: The CDIO approach (2nd ed.). Springer

Hairi, F., Idris, N., & Ariffin, M. A. M. (2019). Enhancing TVET delivery in Malaysian polytechnics: A case for CDIO-based curriculum transformation. TVET@Asia, 12, 1–14. https://tvet-online.asia/issue/12/hairi-et-al/

Ibrahim, M. N., Nazir, N., & Ahmad Osman. S. (2019), The effectiveness of FYPMS in increasing the quality of final year students project management. (2019). *International Journal of Technical Vocational and Engineering Technology*, *1*(1), 54-63.

Jamaludin, N. L., Ali, A., & Isa, S. S. (2023). Challenges in Malaysian design industry: managing design and decision-making processes. FormAkademisk: Research Journal for Design and Didactics, 17(1). https://doi.org/10.7577/formakademisk.5695

Liventsova, O. A., Skvortsova, T. V., & Fedorova, N. S. (2019). Teacher interpretation and implementation of syllabus in classroom practice. Journal of Curriculum Studies and Instruction, 4(1), 15–28.

Marijan, D., & Gotlieb, A. (2022). Industry–Academia research collaboration in software engineering: The Certus Model. arXiv. https://doi.org/10.48550/arXiv.2204.11039

Namasivayam, K., Zheng, W., & Hardgrave, B. (2019). Expanding CDIO into non-engineering disciplines: Enhancing practical learning in business and management education. International Journal of Engineering Education, 35(2), 445–459.

Pawar, P., & Patil, R. (2021). Bridging academic learning and industry expectations: A study on final year projects in engineering education. Journal of Engineering Education Transformations, 35(3), 10–15. https://doi.org/10.16920/jeet/2021/v35i3/157706

Peng, Y. (2020). Addressing the gap between education and industry: The role of experiential learning and competency-based education. Journal of Higher Education Policy and Management, 42(4), 393–407. https://doi.org/10.1080/1360080X.2020.1757055

Ross, E. (2024). Teachers' interpretation of curriculum as a window into 'curriculum potential'. *The Curriculum Journal*, *35*(1), 38-55.

Tan, B. T., & Vicente, C. S. (2019). Fostering interdisciplinary collaboration through CDIO-based projects: A case study of marketing and engineering students. Proceedings of the 15th International CDIO Conference, 145–156.

Yuming, H., Ningze, G., Yang, Z., & Fei, C. (2024). Exploration and practice of project-based blended teaching mode based on OBE-CDIO concepts-example of "Project Planning and Control". In *SHS Web of Conferences* (Vol. 209, p. 01013). EDP Sciences.