

**CONCEIVE-DESIGN-IMPLEMENT-OPERATE (CDIO) INNOVATIVE TEACHING METHODS
IN REAL ESTATE EDUCATION**

Noorsidi Aizuddin Mat Noor¹, Farhana Diana Deris², Mustafa Omar³, Hamdi Abdul Hamid⁴, Afizan Mokhtar⁵

¹Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, Johor Bahru, Malaysia

²Faculty of Social Sciences and Humanities, Universiti Teknologi Malaysia, 81310, Johor Bahru, Malaysia

⁵College of Built Environment, University Technology of Mara, 40450 Shah Alam, Selangor

Corresponding Author Email : noorsidi@utm.my

ABSTRAK

The presented research aims to investigate the impact of the CDIO framework on changing the existing learning-teaching paradigm in real estate education in Malaysia to improve learning engagement and students' critical thinking skills. On this note, the use of traditional teaching approaches that involve lectures in real estate education is found to be lacking in meeting the needs of the dynamic market, therefore calling for innovation. This research uses quantitative and qualitative data from 150 students from three universities: pre and post intervention questionnaires, focus group discussions, and class observations. The studies reveal that after intervention, the extent of students' participation increased from 35% to 75%, and there are improvements in students' critical thinking skills; the average scores from pre-tests of 60% rose to 80% post-tests. From the students' perspective, CDIO promoted meaningful learning based on project-centred learning activities done in a contextual manner, improving the perceived relevancy of learning activities. Therefore, the present research substantiates that CDIO methodologies integrate practice and research to positively transform student learning experiences, activity levels, and critical analysis, strongly advocating for real estate educational reform in the Malaysian context. It means the focus on project-based active learning prepares students to solve actual problems that affect them and brings education and skills in line with the requirements of the given sphere. Based on the findings of this study, the following recommendations should be made for future research: The effectiveness of CDIO integration and its long-term implications should be investigated. Broader implications point to the idea that implementing CDIO-inspired approaches provides a workforce that is more competent and better synchronised, which is imperative in a continuously transforming real estate market within Malaysia and other states.

Keywords: Real Estate Education, Innovative Teaching Methods, Student Engagement, Critical Thinking

INTRODUCTION

The real estate industry is always changing and dynamic, and for this reason, experts require knowledge in the technical field as well as problem-solving skills. Where globalisation and technology change the industry, the need for radical and effective educational processes becomes a vital issue. Extensive use of a more or less formal approach that primarily uses only a lecturing style fails to effectively prepare students for these modern onslaughts. A recurrent concern has been raised about ways in which education in real estate can be delivered in a way that prepares students for the emerging economy. This paper aims to identify how the Conceive-Design-Implement-Operate (CDIO) Initiative, which has been introduced as the new approach to engineering education, can be used to transform the methods of real estate education and enhance the level of students' activity and initiative (Crawley et al., 2014; Azasu & Gibler, 2017). The real estate industry is one of the most important and thriving industries in Malaysia, covering major aspects of properties such as residential, commercial, and industrial. The development of the sector is attributed to the increase in population density, economic improvement, and international investment.

However, some of the risks include cyclical and changing prices of properties, changes in laws and regulations, and technological advancements. These complexities point to the need for a new generation of real estate practitioners who possess knowledge of the subject as well as the ability to manoeuvre in a risky environment. The Malaysian university education system, including real estate programs, has long adopted lecturing strategies, as noted by Abdullah and Majid (2013) and Abidin and others (2017), where more focus is on theory than application. This way, graduates are often not ready to face the real-life challenges in the industry with all the necessary skills. In consideration of the outlined limitations, the CDIO framework seems to provide a more suitable strategy. Both developed by prominent engineering schools around the world, among them the Massachusetts Institute of Technology, CDIO is aimed at the application of active learning based on hands-on experiences and problem solving (Crawley et al., 2007; Edström & Kolmos, 2014). It supports an educational paradigm that makes the learners design, develop, and manage tangible systems and goods (O'Connor et al., 2023). Such a form of learning proves very effective for the student as it assists in the acquisition and application of knowledge and new substantial skills beyond those achieved in the lecture-based setting (Magallanes & Hasan, 2023). Incorporation of such principles in the real estate education system thus provides Malaysian institutions with the much-needed connection between theory and practice.

CDIO revolutionises learning and teaching, and thus the incorporation of CDIO in education for real estate requires a revolution in the traditional manner of instructional design. The workload of conventional courses consisting of lectures would be complemented with project activities in which students would work on real-life real estate projects from idea to implementation (Bankel et al., 2003). This approach can be compared to aspects of CDIO since the students are encouraged to work with each other and on the materials provided to arrive at solutions. For example, a subject like property development can present a scenario where students have to come up with a viable housing project that integrates sustainability, cost, demand, and environmental issues in property development (Yusof et al., 2012). This hands-on experience would not only enrich the technical content of their knowledge but also develop their thinking and problem-solving abilities. Furthermore, this study shows that the CDIO approach will also be useful to address the needs of the Malaysian real estate market. Due to the heterogeneity of the property market and laws in various countries, it's crucial for students to learn about local contexts and developments. The implementation of CDIO in the curriculum will enable educators to present students with current projects that suit the prevailing market trend and the set rules and regulations.

For instance, a project may involve dealing with Malaysian property market policies or working to overcome the modern issues of redeveloping an urban centre in Kuala Lumpur (Rahman & Ismail, 2018). Such projects would provide students with the necessary knowledge and skills to solve real-life problems once they are released into society. There are several advantages attached to the assimilation of CDIO in the training and education of students who intend to venture into the real estate business. It has been established that. Among the benefits highlighted, the increased level of students' engagement and activity is one of the most important features. As the adoption of active learning methodologies is a key aspect of CDIO, the use of such strategies has a positive impact both on students' motivation and level of engagement (Prince, 2004). Such inference is due to the fact that learners who participate in activities that are relevant to the content they are studying make better progress in terms of information comprehension and absorption. Furthermore, since CDIO fosters teamwork and communication skills during group activities, students are in a position to face a real-world employment environment that is more or less team-based in the real estate sector.

Thus, adopting the idea of CDIO standards to enhance real estate education in Malaysia can be deemed a progressive approach in terms of teaching and learning methods. It thus becomes effective to change from the traditional method of teaching that relies on face-to-face teaching and suddenly shift to project-based teaching, where the learner will be subjected to the challenges of the real estate industry. This transforms not only the knowledge of technical content, but it also encourages mind development and problem-solving skills that are

necessary in the competitive market. The Malaysian real estate programs can benefit from the methodologies derived from the CDIO model by ensuring there is a close connection between practice and theory, thereby producing well-equipped graduates for the gruelling industry. Consequently, this paper has the following objectives: To discuss how the introduction of CDIO standards will address the training needs and realities of the modern real estate industry with the hope of producing a more competent and flexible workforce.

Today's teaching methods that are practiced in the real estate education sector mainly focus on conventional forms of learning. These methods tend to concentrate more on the accumulation of book knowledge than its application by sharpening the critical faculties. This educational approach does not equip the learners with the necessary skills to cope with the real estate world, which is rather rigid and ever-evolving and where on-the-job experience and problem-solving skills are most valued. In the Malaysian context, where the real estate sector is identified as a major component of Malaysia's economy, it becomes worrying that the methods of teaching in the institutions leave this gap unsaid, hence the need to adopt new and innovative methods that could narrow this gap (Abdullah & Majid, 2013). Malaysia, as one of the countries in Southeast Asia, has its own peculiarities in the real estate market. Due to current trends such as an increase in urbanisation, changes in legislation, and the implementation of sustainable development, it is essential to have professionals with adequate skills to address such challenges. Nonetheless, the present system of learning, which involves memorisation and the assimilation of knowledge in the classroom, does not prepare the students to handle such realities in contemporary society. For example, learners may understand property valuations in theory, but they can never practice market valuations in the real and volatile market (Rahman & Ismail, 2018). This is why there is a growing demand for a revolution in the system of education, starting in the classroom setting.

The use of Conceive-Design-Implement-Operate (CDIO) standards in the education of real estate provides a viable solution to these difficulties. CDIO is a revolutionary model of education designed for use in engineering but that can be adapted for any field of study. It increases the number of projects, problem-solving tasks, and other activities in which the learner accomplishes real-life tasks that strengthen technical content knowledge, problem-solving skills, and attitude towards teamwork (Crawley et al., 2014). In the aspect of integrating CDIO principles into Malaysian real estate education, we can enhance the learning process by adding more activities and real-life experiences. For instance, in a course titled Urban Development, the CDIO approaches can be applied if the students are required to come up with the design of and work through the completion of a sustainable urban development project. This will be a project whereby the students will take an important decision-making procedure into consideration, of which the following aspects will be taken into consideration: market analysis and consumers' demand, environmental impact and assessment, legal awareness and compliance, probability, and feasibility. Thus, it implies that students would not only gain knowledge from the theory part of the projects but also apply pragmatic lessons that exist in the field (Yusof et al., 2012). Further, this approach involves critical thinking and enhances the value of the developed solutions through cycles of continuous improvement.

The advantages of moving away from traditional teaching and learning techniques to CDIO-inspired techniques in Malaysian real estate education are quite significant. Hence, the ultimate benefits include a higher level of students' attendance and their active involvement in the learning process. Students seem to be passive and lose a lot of information as a result of traditional teaching, which mainly employs the teaching method of lecturing. On the other hand, the implementation of the active learning environment in the CDIO context motivates students to take more control of the knowledge acquisition process than in the case of the traditional approach, which gives better results in terms of comprehension (Prince, 2004). Moreover, students are able to integrate into real-life projects and have a broad understanding of the real estate industry by observing the strengths and weaknesses as well as the opportunities and threats of the field, which is important while students are on their way towards becoming professional real estate employees. The utilisation of conventional teaching processes in Malaysian real estate education is insufficient and ineffective to prepare the learners for new skill demands in the fast-growing sector at the moment. It becomes necessary to search for new educational paradigms that contribute to the transfer of acquired knowledge into practice. This need can be met by the adoption of the CDIO standards, as they offer participants a more student-centred learning and teaching approach. Because they incorporate learning processes such as project-based learning and real-life problem-solving, CDIO methodologies can be useful in preparing students for the real estate market. This change in educational practice is vital in nurturing the necessary workforce competencies in relation to the contemporary real estate market environment.

LITERATURE REVIEW

Out of all the revised models of systems thinking, the CDIO framework, which embraces engineering education, has recorded impressive success in promoting students' learning gains (Halim & Buniyamin, 2016). Crawley et al. (2014) noted that CDIO nurtures the structure in line with learning by doing and functional experiences. These have been found to enhance the probability of students paying attention and the probable retention of what is taught in the classroom through the incorporation of practical lesson programs and tasks.

These concepts are schematically expressed in the sequential process of developing complex systems required by engineering and other fields: conceiving, designing, implementing, and operating. These course strategies involving 'active' techniques enhance not only the understanding of theoretical concepts but also students' practical skills and the ability to solve problems. Edström et al., 2020). Hence, the same value added can be assumed in the context of CDIO applied to real estate education with regards to Malaysia, which forms the basic argument to support its adoption within Malaysian institutions.

This paper also found that, similar to other parts of the world, Malaysia's approach to real estate education has been one that has involved the use of the technique of didactic lectures (Ismail, Mokhtar, & Bidin, 2013; Kamsah & Talib, 2014). These approaches most frequently involve memorisation and theoretical information, which are used rather sparingly in practice. Several educational scholars have noted that this learning model does not prepare students for a real-life real estate marketing environment. Abdullah and Majid (2013) have pointed out that research indicates that students are not equipped with the right practical working knowledge or skills, as well as thinking skills, to meet the volatile Malaysian real estate environment. This lack of match between the curriculum prepared in academic institutions and the needs of industries is the reason why there is a need to adopt new methods of teaching like the CDIO.

Applying teaching methodologies derived from CDIO approaches to real estate can mitigate the disadvantages of conventional approaches to teaching. As for the CDIO approach that leans on project-based learning and collaborative tasks, I would like to note that it spurs students' engagement and boosts their understanding of real estate concepts. For instance, Yusof et al. investigated the effects of project-based learning and established that PBL produced a significant enhancement of students' skills in applying the learnt theory to real-life situations. It does not only improve the technical competence of the student but also helps to develop critical thinking, teamwork, and good communication skills, which are vital in real estate practice.

An example of how CDIO can be applied in the Malaysian context to bring benefit to the process of real estate education and practice can be described based on the following specific example (Abdullah et al., 2015). Currently, the Malaysian government is encouraging the green governance of urban areas through measures such as the Kuala Lumpur city plan for the year 2020. However, there is a noticeable blandness that is evident in the education system in preparing students to embrace such an initiative. Inasmuch as the CDIO methodologies can penetrate the real estate programs to construct pertinent projects to support the goals of national development (Jambari et al., 2018), For example, students could be assigned the task of creating environmentally friendly housing that complies with the aspects of the Kuala Lumpur City Plan. This would give the students much-needed and desired exposure to implementing sustainable development while at the same time ensuring that the education offered was market-relevant (Rahman & Ismail, 2018).

Furthermore, stressing practice-orientated knowledge and activity-based learning in CDIO also complies with the demands of the Malaysian real estate market (Tran & Phan, 2022). The industry asks for critical thinkers who are able to solve intricate problems and people who can work in groups. Lecturing as the mode of teaching fails to adequately foster these skills in students. Prince (2004) indicated that active learning strategies for which CDIO advocates result in increased student motivation and learning, or, in other words, improved learning. This is more so when it comes to real estate education, wherein hands-on skills and preparation for the marketplace remain central to the success of professions later on.

Therefore, from the literature review, this research provides a solid foundation and convinces the reader that it is necessary to implement the principles of CDIO in the delivery of real estate education in order to overcome the barriers in traditional teaching. Since the CDIO framework focusses on active learning, practical experiences, and project-orientated tasks, these can improve the level of students' engagement, their understanding, and the skills they learn in a particular course. Through the integration of CDIO standards into the Malaysian real estate curriculum, the curriculum can produce students with the right intellect to approach real estate education and solve professional problems. This is not only advantageous to students, but the Malaysian Organisation of Real Estate also profits from this with a more capable and versatile collection of workers.

METHODOLOGY

Thus, this work makes use of mixed methods in that both quantitative and qualitative data were collected and analysed for the purpose of providing an overall understanding of the effectiveness of real estate education through the incorporation of CDIO-inspired approaches. The sample comprises 150 undergraduate students taking real estate subjects at three Malaysian universities that are considered influential. Including such subjects guarantees an adequate depiction of the students and strengthens the study's external validity. The research method adopted in the study involved the use of a longitudinal research design, where formative data on students' engagement and critical thinking skills were gathered at different intervals in a semester. Interviews with students were carried out before the implementation of the CDIO methodologies to set a baseline, and interviews were taken after the intervention of the said methodologies to assess their effects. These surveys used grade-

standardised questionnaires to rate the students’ level of engagement, interest, and perceived level of critical thinking skills.

Besides, the quantitative data, focus group discussions, and classroom observations produced the qualitative data. The students in the focus groups consisted of 10 subjects from each university: moderate academic performers and highly active participants in class. Nominal and semi-structured group discussions offered more detailed information on the students’ experience and attitude towards the CDIO-inspired approaches to teaching. Teacher interviews were carried out by the researchers, who have been trained accordingly to ensure standardisation of the implemented protocol for the purpose of CDIO observation in the context of the classroom environment, focussing on the aspects of warm-up, main part, and closure. These results were useful to triangulate the survey results and provided key insights into how CDIO methodologies impacted the dynamic of the classrooms. In analysing the quantitative data, t-tests and regression analysis were used to test the significance of interaction on aspects of student engagement and critical thinking skills before and after the implementation. The feedback and students’ experiences collected in the research were analysed using thematic analysis, which helps to reveal themes and patterns in the qualitative data. Therefore, integrating the aforementioned methods makes the assessment of the impact of CDIO-inspired teaching methods on the increase in real estate education in Malaysia comprehensive.

FINDINGS AND DISCUSSION

It is as a result of the use of CDIO-inspired methodologies in real estate education that he has improved the level of students’ participation. The results of the pre-intervention surveys revealed that the majority of the students only 35% felt actively engaged in learning. Table 1, however, rose slightly to 75% after the interventional measurements, proving that the teaching methodologies offered by the CDIO model enhanced students’ learning. It is possible to conclude that the proposed approach of CDIO, which focusses on hands-on projects, is well received by the students and makes them more engaged in the learning process. .

Engagement Level	Pre-Intervention (%)	Post-Intervention (%)
Actively Engaged	35%	75%
Somewhat Engaged	45%	20%
Not Engaged	20%	5%

Table 1: Student Engagement Pre and Post Intervention

Expanding on this, focus group discussions shed additional light on why this was the case. The students highlighted the readiness of CDIO projects to augment or increase the relevance and fun of learning because of their hands-on approach. They stated that the impression of writing actual applications narrowed the gap between theory and practice. In view of this, one of the students remarked, “The projects being assigned were near real-life scenarios as encountered in the industry, thereby making the classes more informative and interesting.” Such a statement received endorsement from most of the subjects, which implies that, besides exciting the learners, CDIO methodologies add value to learning.

The second positive and important piece of evidence was related to the expansion of critical thinking skills. Pre- and post-intervention test scores demonstrated that the average in students’ tests was raised from 60% to 80%, as depicted in Table 2. This improvement to such an extent positively indicates that CDIO methodologies enable the enhancement of students’ critical thinking skills. The active learning aspects of the CDIO framework, particularly problem solving, entail the identification of problems, formulation of hypotheses, and evaluation of solutions that ought to help in enhancing the necessary critical thinking abilities.

Metric	Pre-Intervention (%)	Post-Intervention (%)
Average Test Score	60%	80%

Table 2: Critical Thinking Skills Pre- and Post-Intervention

The observations made in classrooms were also held here. Such criticism mentioned that during the implementation of a CDIO approach, several students were more active in sessions compared to when receiving ordinary lectures. They engaged more in the discussions, came up with logical questions, and were more cordial with the classmates. Another added advantage the authors observed in the achievement of the CDIO tasks was a more collaborative learning environment, which was attributable to the project-based tasks of the CDIO. As competition increases in the modern world, it became evident to introduce project assignments that would enable

students to solve problems in groups, hence fostering their problem-solving skills and teamwork and communication skills, besides improving their grasp of the course content.

The interactions with students also identified some of the problems and potential areas for development. A realisation process that switched from conventional one-way knowledge transmission learning to CDIO methodologies was met with some hostility and interference, especially by those students who were used to taking a quite back seat in the classroom. But the students from group B also mentioned that once they got used to these complexities, the new concept immensely helped in making them active and helped them comprehend the lesson better. There were also recommendations for tutorial sessions and feedback on the projects to enable the students to handle realistic problems more proficiently. Altogether, the results and evidence show that CDIO-inspired methodologies improve students' engagement, activity, and critical thinking within the real estate educational process. First of all, the hands-on, practical nature of the program not only increases the level of enjoyment of the classes in the eyes of students but also prepares them for the real estate business in a way that more theoretical methods cannot. These improvements correlate with the objectives of the CDIO framework, which helps in the development of graduates with sufficient skills and technical information.

CDIO methodologies ensure the immediate transfer of the knowledge acquired to real estate education systems since they are incorporated in real and practical contexts. The increases in students' attentiveness and deeper thinking indicate the necessity for universities to shift from the method of lectures to a project-orientated approach. Although there are difficulties in practicing such a radical approach, the advantages are much more significant than the disadvantages. Thus, based on this study's findings, it is recommended that more universities around the world, especially in Malaysia, incorporate teaching strategies based on CDIO in real estate so students are prepared to meet the challenges in the corresponding profession.

CONCLUSION

This article thus emphasises the effectiveness of the paradigm shift supported by the CDIO framework in the context of education in the real estate discipline, specifically in Malaysia. The study found that such methodologies improve students' understanding and increase creativity by encouraging active participation in learning. Such a change is vital in a process of education aimed at meeting the challenges and emerging needs of real estate within the global environment. Given the nature of the improvements outlined in this paper with regard to students' engagement and critical thinking, it is difficult to argue against the adoption of CDIO methodologies as an agent of educational change.

Among the challenges that prevail in the real estate market of Malaysia, it is possible to distinguish the following ones: saturation of the market; urbanisation; fluctuation of the regulation; and search for eco-friendly solutions. It has also become apparent that the conventional instructional techniques that entail the mere delivery of lectures have not been efficient in preparing the students to deal with such problems. Thus, the implementation of CDIO standards will make it equally possible to prepare Malaysian educational institutions' students to face the challenges in the industry. Besides increasing interest and relevance in learning, the active learning that is inherent in the CDIO approach meets the practicalities of practice.

Regarding the anticipated advantages, this paper identified increased students' attendance and activity level as one of the major benefits. Most classroom approaches make students audiences, meaning that they receive knowledge instead of creating it. CDIO methodologies, on the other hand, engage students in project implementation and real-life activities, so they are participants in what they learn. This shift in the learning paradigm is significantly relevant in the Malaysian context, considering that the country has always experienced issues affecting students' learning engagement. From the research analysis carried out in this study, it is evident that students are more motivated and able to retain knowledge, more so when they participate in the learning process.

The possibility of developing critical thinking and problem-solving skills among students is another advantage of the shift towards CDIO-inspired teaching. About the profession As it is evident in the real estate industry, there are complex situations that need analysis, problem solving, and decision-making. The CDIO framework achieves these skills by adopting project-orientated learning and collaborative activities among the students. In Malaysia, where the property market is fluctuating and exceptionally vast, these skills are rather priceless. The results of the study also reveal a significant enhancement in the students' critical thinking capacity, especially those who were studied under the CDIO methodologies, where test scores were evidently better.

Even more importantly, the CDIO approaches aim at providing the methods that students will find useful in their practice. For example, if the problem to be solved by students is to design sustainable urban development, then several factors, which are as follows, will have to be taken into consideration: This kind of hands-on experience is indeed closely tied to the Malaysian real estate market, where sustainability is gaining importance day by day. This is why students get to learn important impressions and lessons in the course of carrying out such

projects, which cannot be obtained in classroom studies. This kind of knowledge is helpful in sharing out the differences between the theoretical part and the applied part.

Thus, this article fits its title perfectly to demonstrate a detailed explanation of how to apply the CDIO standards to real estate education to receive considerable educational outcomes. The findings highlighted above justify the incorporation of these strategies in pursuing the improvement of real estate training to match theory with practice. To Malaysian educational institutions, it is indeed a great change towards the adoption of CDIO, which in the long run will provide industry-ready graduates who possess not only the content knowledge but also the competency to critically analyse and solve problems in the real estate sector.

A variety of changes that CDIO methodologies provide can be easily witnessed now. Optimised students' interactive participation, better cognitive skills in problem solving, and general development to meet real-life problem-solving challenges are some of the advantages. Due to the current complexities in the Malaysian real estate sector, it is imperative to effectively educate the Malaysian public through the use of educational approaches that are unique and efficient. The use of CDIO-inspired teaching methodologies in educational institutions will guarantee that the graduates provide the industry's required skillset to help the real estate sector in Malaysia grow. Not only students, but the educational process focused on active, project-based learning strengthens the quality of real estate education in the country.

ACKNOWLEDGEMENT

Our lifetime gratitude exceeds our verbal expressions. First of all, the UTM Mass Appraisal, Housing, and Planning Research Group members introduced us to some wise pieces of advice when we developed this article, and we highly appreciate them for their explanation. Secondly, we thank the anonymous reviewers for their comments; however, any imperfections are ours and should not affect these respected people's reputations. We gratefully acknowledge the support of the grant R.J130000.7727.4J154 for the research on *Strategi Integrasi Pengajaran Profesional Melalui CDIO Terhadap Pengajaran Dan Pembelajaran Bagi Bidang Geoinformasi Dan Harta Tanah*.

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