THE APPLICATION OF CDIO MODEL IN THE UNDERGRADUATE CURRICULUM OF TOURISM MANAGEMENT: A QUALITATIVE STUDY*

การประยุกต์ใช้โมเดล CDIO ในหลักสูตรระดับปริญญาตรี สาขาการจัดการการท่องเที่ยว : การศึกษาเชิงคุณภาพ

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Abstract

This research article examined the application of the Conceive – Design – Implement – Operate (CDIO) model in the Undergraduate Tourism Management Curriculum, focusing on its effectiveness in bridging theoretical learning with practical, industry-relevant skills, conducted by the qualitative research, using semi-structured interviews with fifteen key informants, including faculty members and undergraduate students, alongside documentary analysis of curriculum outlines and institutional policies. Content analysis identified four core themes: curriculum integration of CDIO principles, development of digital and AI-driven competencies, enhancement of experiential learning, and challenges in implementation.

The findings revealed that the CDIO model provided a structured learning pathway that enables students to conceptualize, design, and apply innovative tourism solutions, particularly in areas such as AI-enhanced customer service, smart tourism systems, and data-driven destination management. Experiential components including internships, case studies, and simulations were shown to

*Received August 29, 2025; Revised September 12, 2025; Accepted September 17, 2025

significantly strengthen students' teamwork, adaptability, and critical thinking skills. Despite these benefits, challenges emerged, such as limited technological resources, time constraints, and variations in faculty adoption, underscoring the need for institutional support and investment. This study contributed to the body of knowledge by extending CDIO's applicability beyond engineering education into service-oriented disciplines, demonstrating its relevance in cultivating digitally fluent, industry-ready tourism graduates. The findings provided insights for curriculum developers, educators, and policymakers, highlighting CDIO as a promising framework for aligning tourism education with the demands of the digital economy.

Keywords: Application of the CDIO, Tourism Management, Digital Competencies, Experiential Learning

บทคัดย่อ

บทความวิจัยนี้ศึกษาการประยุกต์ใช้โมเดล Conceive - Design - Implement - Operate (CDIO) ในหลักสูตรระดับปริญญาตรีสาขาการจัดการการท่องเที่ยว โดยมุ่งเน้นประสิทธิผลของกรอบดังกล่าวในการเชื่อมโยงการเรียนรู้เชิงทฤษฎีกับทักษะเชิงปฏิบัติที่สอดคล้องกับความต้องการของอุตสาหกรรม การวิจัยใช้ระเบียบวิธีเชิงคุณภาพ โดยเก็บข้อมูลจากการสัมภาษณ์แบบกึ่งโครงสร้างกับผู้ให้ข้อมูลจำนวน 15 คน ซึ่งประกอบด้วยคณาจารย์และนักศึกษาระดับปริญญาตรี ควบคู่กับการวิเคราะห์เอกสารที่เกี่ยวข้องกับโครงร่างหลักสูตรและนโยบายของสถาบัน การวิเคราะห์เนื้อหาพบประเด็นหลัก 4 ด้าน ได้แก่ การบูรณาการหลักการ CDIO ในหลักสูตร การพัฒนาทักษะดิจิทัลและความสามารถที่ขับเคลื่อนด้วย AI การส่งเสริมการเรียนรู้เชิงประสบการณ์ และความท้าทายในการดำเนินการ

ผลการวิจัยพบว่า โมเดล CDIO ช่วยจัดโครงสร้างเส้นทางการเรียนรู้ที่ทำให้นักศึกษาสามารถสร้างสรรค์ ออกแบบ และประยุกต์ใช้แนวทางการท่องเที่ยวเชิงนวัตกรรมได้อย่างเป็นรูปธรรม โดยเฉพาะในด้านการบริการลูกค้าที่เสริมด้วย AI ระบบการท่องเที่ยวอัจฉริยะและการบริหารจัดการแหล่งท่องเที่ยวโดยใช้ข้อมูลเป็นฐาน ส่วนประกอบเชิงประสบการณ์ เช่น การฝึกงาน กรณีศึกษา และการจำลองสถานการณ์ มีส่วนช่วยพัฒนาทักษะการทำงานเป็นทีม ความยืดหยุ่น และการคิดเชิงวิพากษ์ของนักศึกษาได้อย่างมีนัยสำคัญ อย่างไรก็ตาม ยังพบอุปสรรคบางประการ ได้แก่ ทรัพยากรด้านเทคโนโลยีที่จำกัด ข้อจำกัดด้านเวลา และความแตกต่างในการนำไปใช้ของคณาจารย์ ซึ่งสะท้อนถึงความจำเป็นในการสนับสนุนและการลงทุนจากสถาบัน การวิจัยนี้มีส่วนขยายองค์ความรู้โดยแสดงให้เห็นถึงการประยุกต์ใช้กรอบ CDIO นอกเหนือจากสาขาวิศวกรรมศาสตร์ไปสู่สาขาที่เน้นการบริการ ตอกย้ำถึงความสำคัญของกรอบ

ดังกล่าวในการพัฒนาบัณฑิตด้านการท่องเที่ยวให้มีความพร้อมต่ออุตสาหกรรมและทักษะดิจิทัลที่ทันสมัย ผลการวิจัยยังให้ข้อเสนอแนะที่เป็นประโยชน์แก่ผู้พัฒนาหลักสูตร นักการศึกษาและผู้กำหนดนโยบาย โดยเน้นว่า CDIO เป็นกรอบแนวคิดที่มีศักยภาพในการเชื่อมโยงการศึกษาด้านการท่องเที่ยวกับความต้องการของเศรษฐกิจดิจิทัลได้อย่างมีประสิทธิภาพ

คำสำคัญ: การประยุกต์ใช้ CDIO, การจัดการการท่องเที่ยว, ทักษะดิจิทัล, การเรียนรู้เชิงประสบการณ์

Introduction

The advent of digital technologies, artificial intelligence (AI), and data-driven solutions, has triggered transformative changes across numerous industries, particularly in education, tourism, and organizational operations (Limna & Kraiwanit, 2024; Shaengchart et al., 2025). In particular, the tourism sector is experiencing a profound evolution. These innovations are redefining how tourism services are designed, delivered, and experienced, fundamentally altering both operational practices and customer interactions. As one of the world's most dynamic economic sectors, tourism requires a workforce equipped not only with traditional management expertise but also with digital competencies that enable innovation in areas such as smart tourism, automated service delivery, and technology-integrated visitor experiences (Limna & Kraiwanit, 2023; Limna et al., 2025; Stylianou & Pericleous, 2025). Higher education institutions, therefore, face increasing pressure to design curricula that bridge theoretical knowledge with practical, future-oriented skills, ensuring that students are prepared to thrive in a rapidly evolving digital tourism landscape (Dinan, 2025; Limna, 2025). Within this context, the CDIO model, originally developed for engineering education, has evolved into a versatile framework applicable across diverse disciplines, including Tourism Management. By emphasizing the complete cycle of innovation from conception through design, implementation, and operation the model bridges the gap between theoretical knowledge and practical application. In the field of Tourism Management, CDIO provides a structured approach to developing industry-relevant competencies while fostering transferable skills. Research suggests that the model enhances experiential learning through internships, simulations, and project-based activities, thereby strengthening teamwork, adaptability, and problem-solving abilities. Moreover, the rapid digital

transformation of the tourism sector highlights the need to integrate CDIO into curricula to cultivate digital literacy and AI-driven competencies. Graduates trained under this framework are better equipped to engage with smart tourism systems, data-driven destination management, and AI-enhanced customer service. The model further facilitates interdisciplinary collaboration, connecting academic knowledge with industry practice to address real-world challenges. Accordingly, CDIO is increasingly recognized as a promising approach to aligning Tourism Management education with the demands of the digital economy, enhancing graduates' employability, and fostering readiness for the global labor market (Jambari et al., 2018; Lee et al., 2018; Liu, 2023; Tang & Zhu, 2019; Xin et al., 2021).

Despite the growing recognition of the importance of digital transformation in tourism, limited research has examined how the CDIO model can be adapted and applied within tourism management curricula, particularly at the undergraduate level. Existing studies have focused primarily on engineering and technical disciplines (Halim & Buniyamin, 2016; Lenin et al., 2023), leaving a gap in understanding how this framework can foster the development of digital tourism competencies such as AI-enhanced service delivery, smart destination management, and technology-driven customer engagement. Addressing this gap is critical to ensure that future tourism professionals are equipped with both managerial insight and digital fluency. Therefore, this study aims to examine the implementation of the CDIO model in the undergraduate Tourism Management program, focusing on its role in developing technology-driven tourism skills and AI-enhanced service competencies to better align education with industry needs.

Research Objectives

The primary objective of this study is to examine the implementation of the CDIO model in the undergraduate Tourism Management program at a university in Thailand.

Methodology

1. Research Design

This study employed a qualitative research design. This approach was selected for its ability to capture participants' lived experiences, perspectives, and

insights into skill development and practice-based learning. This design allowed for an in-depth examination of how CDIO principles are integrated into curriculum design, delivery, and student learning outcomes.

2. Key Informants

Participants were purposively selected to ensure relevance to the study's objectives. The sample included faculty members responsible for curriculum design and instruction, alongside undergraduate students actively engaged in experiential learning projects. In total, 15 participants were included, exceeding the minimum of 12 interviews recommended by Limna (2025) to achieve data saturation in qualitative research. Key faculty informants were identified based on their involvement in embedding CDIO principles and digital learning strategies, while student participants were selected for their active engagement in AI-driven and experiential modules.

3. Research Instrument

Data collection relied on a qualitative research instrument, specifically semi-structured interview guides designed to elicit in-depth responses. The interview questions were structured around core themes, including technology-driven tourism solutions, AI-enhanced service delivery, and competency development within the CDIO framework. To ensure validity and contextual richness, documentary analysis of institutional records such as curriculum documents, course outlines, and educational policies was conducted, complementing the interview findings.

4. Data Collection

In-depth, semi-structured interviews were the primary method of data collection. Interviews were conducted in English, audio-recorded with participant consent, and later transcribed verbatim to ensure accuracy. Data collection also incorporated documentary evidence, which provided additional insight into curriculum design and institutional priorities. This combination strengthened the study by enabling triangulation of findings, thereby enhancing validity and reliability.

5. Data Analysis

Data were analyzed using content analysis. The transcripts were carefully reviewed, coded, and organized into categories that reflected both faculty and

student perspectives on CDIO implementation, digital competency development, and practice-based learning. As the study employed a qualitative approach, statistical techniques were not applied; instead, the emphasis was placed on thematic depth and analytical rigor in interpreting participant narratives.

Results

The study's findings highlight four major themes reflecting the implementation of the CDIO model within the undergraduate Tourism Management program: 1. curriculum integration of CDIO principles, 2. development of digital and AI-driven competencies, 3. enhancement of experiential and practice-based learning, and 4. challenges in implementation.

Curriculum Integration of CDIO Principles

Faculty members emphasized that the CDIO framework provided a structured approach for aligning course objectives with industry needs. The "Conceive" and "Design" stages were primarily embedded in project-based assignments and classroom discussions, where students developed proposals for tourism initiatives such as smart destination planning or technology-enabled visitor services. The "Implement" and "Operate" stages were integrated into internships, fieldwork, and industry collaborations, offering students practical exposure to real-world scenarios. This progression was viewed as effective in bridging theoretical knowledge with applied skills, allowing students to gradually transition from conceptual understanding to operational execution.

Development of Digital and AI-Driven Competencies

Both students and educators reported that the curriculum increasingly incorporated elements of digital technology and AI applications in tourism. Examples included modules on data-driven destination management, AI-enabled customer engagement, and digital marketing analytics. Students described gaining familiarity with emerging tools such as chatbots and virtual reality platforms, which they viewed as directly relevant to the evolving tourism landscape. Faculty members further indicated that CDIO's iterative structure encouraged students to integrate digital solutions into project design, thus fostering digital fluency and problem-solving skills.

Enhancement of Experiential and Practice-Based Learning

A consistent theme across student interviews was the value of experiential learning opportunities. Activities such as case studies, simulation exercises, and industry-linked projects were highlighted as particularly impactful in developing competencies. Students felt that CDIO's emphasis on hands-on application enabled them to practice teamwork, critical thinking, and innovation. Several participants described their internship experiences as transformative, noting that the structured CDIO stages helped them apply classroom knowledge in workplace contexts.

Challenges in Implementation

Despite positive outcomes, participants also identified several challenges. Faculty members reported limited resources, particularly in acquiring advanced digital tools and AI applications for student use. Time constraints within the academic calendar were another barrier, as comprehensive CDIO cycles often required more time than a single semester allowed. Students also noted inconsistencies in how different instructors applied CDIO principles, which sometimes led to uneven learning experiences. These challenges underscored the need for institutional support, professional development, and resource investment to fully realize the potential of the CDIO model.

Discussion

The findings of this study demonstrate that the CDIO model provides a valuable framework for aligning tourism education with the evolving demands of the digital era. By embedding the stages of Conceive, Design, Implement, and Operate within the undergraduate Tourism Management program, the curriculum moves beyond traditional theory-based instruction and supports the cultivation of practical, industry-ready competencies. This is consistent with previous research in engineering education, where CDIO has been shown to strengthen problem-solving and innovation skills through experiential learning and applied project work (Edström & Kolmos, 2014; Jambari et al., 2018; Lenin et al., 2023). The present study extends these insights into the domain of tourism management, highlighting the model's adaptability to service-oriented and digitally driven contexts.

A key contribution of this research lies in identifying how the CDIO framework supports the development of digital and AI-related skills. The integration of modules on AI-enabled customer service, data-driven destination management, and smart tourism technologies reflects the growing consensus that tourism professionals must be digitally fluent to remain competitive (Pan et al., 2020: Stylianou & Pericleous, 2025; Vafokulova et al., 2024). Students' positive perceptions of these learning opportunities reinforce prior findings that higher education institutions play a critical role in preparing students for technology-intensive workplaces (Dinan, 2025; Zhang & Hu, 2025). By embedding digital competencies across the CDIO cycle, the program helps students transition from conceptual understanding of technology to its operational application in real-world tourism scenarios.

The study also underscores the value of experiential and practice-based learning. The strong emphasis students placed on internships, case studies, and simulations resonates with Lee et al. (2018), and Bui et al. (2025) who argued that CDIO fosters learning experiences that are both contextually meaningful and transferable to industry. These findings suggest that when coupled with real-world exposure, CDIO can cultivate critical soft skills such as teamwork, adaptability, and creativity that are increasingly sought by employers in the tourism sector.

At the same time, challenges emerged regarding the uneven implementation of CDIO principles, limited digital infrastructure, and time constraints within the academic calendar. These findings align with concerns raised in earlier CDIO studies, which noted that successful adoption requires sustained institutional support and investment in resources (Crawley et al., 2014; Halim & Buniyamin, 2016). Without such support, there is a risk of fragmented implementation that may limit the effectiveness of the framework. Addressing these challenges will be essential if the model is to deliver consistent, long-term benefits for both students and faculty.

Overall, the findings position the CDIO model as a promising approach for fostering innovation-oriented and digitally competent graduates in Tourism Management. While originally developed in engineering contexts, this study demonstrates its capacity to respond to the evolving skill requirements of the

tourism industry, particularly as it navigates digital transformation and AI-enhanced service delivery.

Body of Knowledge

This study expands the body of knowledge by demonstrating how the CDIO framework, traditionally applied in engineering education, can be effectively adapted to the field of Tourism Management to address the challenges of digital transformation. By aligning the stages of Conceive, Design, Implement, and Operate with curriculum design, the research illustrates how experiential learning enhances students' ability to integrate theoretical knowledge with practical application, particularly in areas such as AI-driven customer service, smart tourism solutions, and data-driven destination management. The findings contribute to three critical dimensions: first, they extend CDIO into service-oriented education, affirming its transferability across academic disciplines; second, they highlight the framework's potential in fostering digital and AI competencies, thereby preparing graduates for technology-intensive industries; and third, they reinforce the value of experiential learning in bridging higher education with industry practice through internships, simulations, and case-based projects. Collectively, these contributions enrich academic discourse on curriculum innovation and establish CDIO as a flexible pedagogical model for cultivating industry-ready, digitally fluent professionals in the tourism sector.

Conclusion This study explored the application of the CDIO model within the undergraduate Tourism Management curriculum, with a particular focus on its role in preparing students for a digitally transformed tourism industry. The findings demonstrate that CDIO provides a structured and adaptable framework that bridges theoretical knowledge with practical, industry-relevant skills. By guiding students through the stages of Conceive, Design, Implement, and Operate, the model supports the integration of digital tools, AI applications, and experiential learning into the educational process. Students reported enhanced readiness for industry demands, particularly in areas such as smart tourism, AI-driven customer service, and data-based destination management.

At the same time, challenges were identified, including resource constraints, uneven faculty adoption, and time limitations that hindered the full

execution of CDIO cycles. These issues highlight the importance of institutional support and strategic investment in technology infrastructure and faculty development. Despite these limitations, the research underscores the promise of CDIO in transforming tourism education into a more applied, innovative, and future-oriented domain.

Recommendations

Based on the findings of this study, several suggestions are offered for enhancing the effectiveness of the CDIO model in undergraduate Tourism Management education:

Strengthen Digital Integration

Universities should expand the use of AI-driven tools, data analytics platforms, and smart tourism technologies in coursework and projects. Embedding these technologies within CDIO cycles will ensure students are equipped with competencies directly applicable to industry demands.

Enhance Faculty Preparedness

Regular workshops, training sessions, and peer-learning initiatives should be established to equip faculty with knowledge of CDIO pedagogy and emerging digital tourism practices. This will ensure consistency in implementation across courses.

Expand Experiential Opportunities

Partnerships with hotels, tour operators, and destination management organizations should be deepened to provide students with internships, live projects, and case-based simulations that reflect real-world industry challenges.

Future Research

Future studies could employ mixed-method approaches or larger-scale surveys to validate and extend the results. Comparative studies across multiple universities or countries could provide a broader perspective on how institutional environments shape CDIO adoption in tourism education. Future investigations could examine other critical areas such as sustainability, intercultural communication, and crisis management to explore how CDIO can be leveraged to address broader challenges in global tourism.

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