Developing a work-integrated learning model adjusting to Construction 4.0 concepts

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This paper reflects on the work-integrated learning (WIL) program in an undergraduate Construction Engineering and Management (CEM) department in Indonesia. Given the industrial revolution that has transformed the construction industry into Construction 4.0, concrete steps are needed to bridge the needs of industry for professional workers who are aware of Construction 4.0 concepts. This study aims to develop a WIL model adjusting to Construction 4.0 concepts. A case study of the internship experience that has been conducted for four consecutive years was used to develop the model. This observation was reinforced by a questionnaire survey aimed at students, workplace supervisors and lecturers to evaluate the effectiveness of the internship program in achieving the learning outcomes. The results of this analysis coupled with the findings from the integrative literature review were used to develop a Construction 4.0 WIL model.

Keywords: Construction 4.0; construction students; WIL model; work-integrated learning and teaching

The world has entered the industrial era 4.0 marked by automation, digital transformation and value creation processes. Many industrial sectors are competing to take advantage of this momentum to transform their planning and production processes to be more competitive globally. However, this is not the case with the construction industry. In some countries such as Indonesia, this industry makes a major contribution to the national Gross Domestic Product (GDP) but faces challenges in transforming to the industrial era 4.0. Construction projects are still dominated by paper-based communication and fragmented nature, impacting on the efficiency and performance of this industry. Osunsanmi et al. (2018) argued that the reluctance of construction professionals to change has made the evolution of the construction industry problematic.

Osunsanmi et al. (2018) further stated that the construction industry is a renowned latecomer for the adoption of information technology and digitalization. Their study focused on examining the awareness of construction professionals in implementing Construction 4.0 which showed that the majority of construction professionals are unaware of Construction 4.0 concepts. This challenge is due to the unique characteristics of the construction industry, namely the site-based nature of construction projects and a large number of construction firms that lack incentives to invest and adopt new technology (Kumaraswamy et al., 2002). Efforts to increase the awareness of construction professionals of Construction 4.0 concepts are imperative for the industry. One of these efforts is by educating future construction professionals regarding the importance of Construction 4.0 concepts through experiential learning.

Apart from the benefits of implementing Construction 4.0 concepts, this research found few studies have been conducted in investigating the role of work-integrated learning (WIL) in increasing

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awareness of Construction 4.0 concepts. Most studies are related to the definition, scope, application and challenges of adopting the Construction 4.0 concepts as carried out in the UK, US, Germany, and South Africa (Antunes & Gonzales, 2015; Buss & White, 2017; Montgomery, 2016; Osunsanmi et al., 2018). Therefore, this research addresses this gap by investigating the WIL program implemented by a Construction Engineering and Management (CEM) department in Indonesia with the aim to improve this program by adjusting it to the concepts of Construction 4.0.

The main goal of this study is to develop a WIL model that can be used as a reference for improving and evaluating the integration of construction skills needed in the Construction 4.0 era. The three objectives of this study are: (1) to investigate the experiences of those engaged in the WIL program designed by a CEM department in Indonesia, (2) to identify the key Construction 4.0 concepts that should be introduced to construction students, and (3) to propose a WIL model adjusted to Construction 4.0 concepts.

Following the introductory section, a review of literature is presented which covers the development of Construction 4.0 and the significance of a WIL program for higher education students. Next, an explanation regarding the method adopted in this study is described, followed by the analysis & results section. Elaboration of the findings, which covers results from the internship observation and the development of the Construction 4.0 WIL model, are presented in the discussion section. This paper concludes with a summary of the results and recommendations for further research.

LITERATURE REVIEW

Construction 4.0

The term 'Construction 4.0' is derived from 'Industry 4.0' which was first introduced by Schwab (2015). Industry 4.0 is a series of innovation that allows the integration of both physical and virtual worlds using the Internet of Things (IoT), simulation and virtualization (Heynitz et al., 2016; Zezluka et al., 2016). Many industrial sectors have embraced the significance and benefits of industry 4.0 concepts. However, the construction industry has yet to realize the benefits of digitalization since the adoption of Information and Communication Technology (ICT) is still at the infancy stage (Osunsanmi et al., 2018). Some of the reasons for this challenge are due to the characteristics of the construction industry, namely the site-based nature of construction projects and a large number of construction firms with lack of incentives and investments in new technology adoptions (Kumaraswamy et al., 2002).

Various studies have been conducted to better bridge the concept of industry 4.0 with the construction world. Construction 4.0 revolves around the integration of physical and virtual world through digitalization and ubiquitous cyberspace connectivity. In this era, integration and implementation of data analytics, connected devices, and artificial intelligence technologies were introduced to automate construction processes and activities. The main concept of Construction 4.0 lies in digitizing each stage of construction activities to monitor the progress of planning, implementation and completion of construction works. Rastogi (2017) highlighted four major transformations that marked the Construction 4.0 era, namely technology as the driving force, changes in end users' needs and attitude, shifting of construction focus to mass-customization and production at agile speed, and emphasis on sustainability and green construction. A desktop study by Maskuriy, Selamat, Ali, et al. (2019) has established three clusters of Construction 4.0 concepts, namely technology, security and management. The technology cluster includes a wide range of technologies which can potentially be available in Construction 4.0 such as augmented reality (AR), automatic equipment, internet of things (IOT), and sensors. The security cluster covers the cyber-physical system, data security, environment, and legislative aspects for Construction 4.0. The management cluster relates to innovation, design, performance, quality and digital transformation.

In general, Construction 4.0 involves the digitalization process which facilitates data analysis so that it provides prompt decision making (Montgomery, 2016 which enables efficient and responsive construction performance (Osunsanmi et al., 2018). Buss and White (2017) argue that Construction 4.0 is a new concept that applies aspects of industry 4.0 through the use of the internet of things (IoT) for information integration for construction stakeholders and the adoption of new technologies such as 3D printing, drones, and laser scanning. The expectation is that the efficiency of construction activities at the design, construction and post-construction stages will increase.

One of the best examples of implementing Construction 4.0 concepts is the development of Building Information Modeling (BIM) technology which has become a vital enabler for digitalization in construction. Many studies have revealed the potential benefits and implementations of BIM in line with Construction 4.0 concepts such as real time schedule monitoring (Axelsson et al., 2018), smart construction with the active collaboration of BIM and IoT (Ding et al., 2018), BIM integrated structural health monitoring system (O'Shea & Murphy, 2020), planning and design decisions for mass-customization housing (Bianconi et al., 2019), and an integration model of BIM and Augmented Reality (Saar et al., 2019).

Thus, adopting Construction 4.0 will improve the cost and time performances of this industry (Osunsanmi et al., 2018). The same opinion was expressed by Maskuriy, Selamat, Maresova, et al. (2019) who describe the various benefits of implementing Construction 4.0, including cost and time savings, quality improvement, effective communication and collaboration, building customer relationships, efficient safety measures, industry branding and image boosting, and sustainability assurance. On the other hand, there are also several challenges in implementing Construction 4.0 such as poor speed of technology adoption, high cost of implementation, operational transformation, requirements of enhanced skills, battle for acceptance by personnel, exposure to data theft, and risk of legal and contractual modification (Maskuriy, Selamat, Maresova, et al., 2019).

Work Integrated Learning for Construction Students

WIL is a term used to describe learning and teaching activities that take advantage of the learning process in a real-world situation within an industry or partner organization. Real-world experience is essential to provide ready-to-work graduates and presents opportunities for students to interact with construction professionals (Fiori & Pearce, 2009). Wandahl and Ussing (2016) argue that there is a disconnection between theory and practice that affects the level of students' readiness for employment in the construction industry. Thus, an active learning approach is needed that emphasizes the importance of experiential learning, a type of learning that is actively focused on the process of experience. Kolb and Kolb (2005) defined experiential learning as the process whereby social knowledge is created and recreated through the transformation of learner's experience. Savage et al. (2009) argue that learners have full responsibility for their learning in an active learning system. Several studies have shown a positive impact of active learning which increases student performance compared with traditional learning (Baker & Robinson, 2016; Freeman et al., 2014; Kvam, 2000; Terenzini et al., 2001).

For instance, Dressler and Keeling (2004) identified four types of benefits of WIL for students including academic, personal, career, and work skills development benefits. Increased discipline thinking and performance in the classroom are included in academic benefits. Improved communication skills and teamwork are included in personal benefits. Career benefits encompass understanding of future career potential and increased employment opportunities. Meanwhile, work skills development benefits include development of professional values and ethics, increased work competence as well as technical skills. Fiori and Pearce (2009) pointed out that internships in the construction industry are mutually beneficial that foster student growth, enhance collaboration between academics and industry partners, and challenge academics to adjust their curriculums. The WIL program is expected to encourage the development of students' confidence and self-efficacy (Subramanian & Freudenberg, 2007) by providing space for students to approach real problems (Bell, 2010). Thus, it provides great opportunities for students to develop problem-solving skills, gain knowledge and hands-on experience, and create possible career paths (Davis, 2010).

As an approach, the WIL program highlights the immersion of real-world activities which can be implemented through several placement strategies such as internships, practicums, and cooperative education. Zegwaard et al. (2020) mentioned two dimensions of WIL models, namely authenticity and proximity. The first refers to the degree of similarity between the learning and the WIL work environment, while the second refers to the physical distance from the workplace environment. Internships and cooperative education are traditional WIL placements where students are part of an organization and learn alongside others in the organization (Zegwaard et al., 2020). This type of placements provide meaningful working experience to students as the authenticity and proximity are high.

In the context of implementing industry 4.0 concepts in the construction industry, the WIL program is one way to increase awareness of Construction 4.0 concepts to the future construction professionals. A study found that construction professionals possess a low awareness level towards Construction 4.0 concepts (Osunsanmi et al., 2018). Likewise, there is no similar research aimed at measuring the awareness level of Construction 4.0 concepts by students (as potential future professionals) and lecturers (as instructors). Given the current technological developments and transformations, it becomes crucial to design a WIL model in line with Construction 4.0 concepts and to facilitate the program effectively.

METHODOLOGY

The purpose of this study is to investigate the internship experiences designed as a compulsory unit in a Construction Engineering and Management department and to identify the key Construction 4.0 concepts in order to develop a WIL model which incorporates Construction 4.0 concepts. This study adopts a mixed method approach which includes observation, integrative literature review, and questionnaire survey distribution. Observations were made on a Construction Engineering and Management department in Indonesia which requires an internship program for its students as shown in Table 1. These observation data are in the form of documents (including an internship guide book, log books, reports, and assessment documents) and processes for preparation, monitoring, and completion of the internship program within a period of four years (2016-2019). This study received ethics approval from the Universitas Agung Podomoro, LPPM Project Number: LPPM/RE/001/21.

TABLE 1: Case Study Profile for Observation.

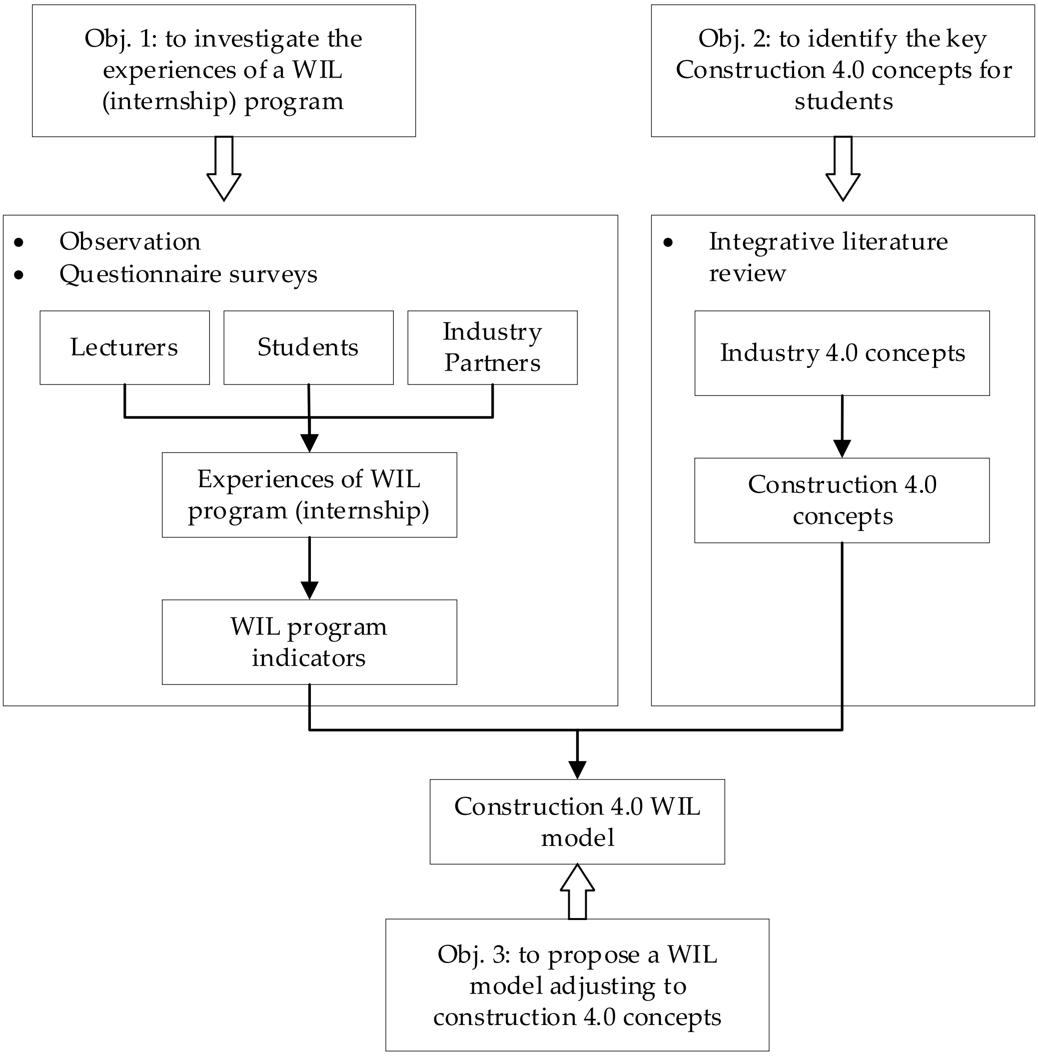
Discipline	Length of course	WIL course type	Placement settings	Allocation to placements	Timing of placements	Duration
Construction Engineering & Management (CEM) – Undergraduate	Four years (full time)	Internship – Compulsory	Industry partners (e.g. contractors, consultants, developers)	Student-sourced and university-allocated placements	2x (third and final year)	9-10 weeks for each

An integrative literature review was conducted to identify Construction 4.0 concepts from extensive literature. A total of 44 publications were retracted from targeted journals for visual examination through reading the abstracts and skimming the contents. At the end of this examination, 15 publications were selected based on their context relevancy for further review. The result of integrative literature review is presented in Table 2. Meanwhile, the questionnaire survey was distributed to students, workplace supervisors, and lecturers at the end of the internship program. It was a quantitative survey in which consent was obtained from all respondents and all personal data was made non-identifiable. These findings were then synthesized to develop a Construction 4.0 WIL model. To better understand the research process, Figure 1 illustrates the research framework for WIL model development in this study.

TABLE 2: Key Construction 4.0 Concepts.

No	Concepts	Components	References
1	Technology	Automation; smart technology; ICT support; IoT; additive manufacturing, sensor tools, real time communication, BIM, robotics	Bianconi et al., 2019; Ding et al., 2018; Maskuriy, Selamat, Ali, et al., 2019; Maskuriy, Selamat, Maresova, et al., 2019; Montgomery, 2016; Osunsanmi et al., 2018; Rastogi, 2017; Rojko, 2017; Tay et al., 2018
2	Digitalization	Data driven; virtualization of the real world; big data; cloud computing; augmented reality; simulation and modelling; digital work environment	Bianconi et al., 2019; Maskuriy, Selamat, Ali, et al., 2019; Maskuriy, Selamat, Maresova, et al., 2019; Montgomery, 2016; Osunsanmi et al., 2018; Rastogi, 2017; Rojko, 2017; Saar et al., 2019; Tay et al. 2018
3	Management	Innovation; transformation to improve performance and quality; flexibility; system integration; cyber planning; end users focused; investment on R&D; supply chain optimization	Axelsson et al., 2018; Bianconi et al., 2019; Maskuriy, Selamat, Ali, et al., 2019; Maskuriy, Selamat, Maresova, et al., 2019; Montgomery, 2016; Rastogi, 2017; Rojko, 2017
4	Security	Cyber system; data access; data security; threats to smart environments	Maskuriy, Selamat, Ali, et al., 2019; Maskuriy Selamat, Maresova, et al., 2019; Rojko, 2017
5	Sustainability	Integration of society, economy and environment; green construction; design for end-of-life	Dancz et al., 2018; Maskuriy, Selamat, Ali, et al., 2019; Maskuriy, Selamat, Maresova, et al., 2019; Montgomery, 2016; Rastogi, 2017

FIGURE 1: Research framework for Construction 4.0 Work-Integrated Learning model development.



There are three types of questionnaires aimed at three different parties involved in the internship process carried out by the CEM department of Podomoro University. The first type was aimed at 35 students who were involved in the internship program. Since it is a self-evaluative type, it has a five-point Likert scale with '1' representing 'strongly disagree' to '5' representing 'strongly agree' on the twelve provided statements. The second type addressed the 47 workplace supervisors involved. The number of supervisors can exceed the number of students considering that there were interns who had more than one supervisor. There was a total of nine questions that must be evaluated by a supervisor based on a five-point Likert scale with '1' representing 'very poor' to '5' representing 'excellent'. The third questionnaire was aimed at lecturers who must evaluate nine questions with the same Likert scale as the supervisors.

An evaluative questionnaire survey was developed and given to students at the end of their internships. Previous studies have shown reliable results which reflect student learning through the use of surveys (Benton & Cashin, 2014; Jackson, 2018; Karim et al., 2019; Matoti & Junqueira, 2012). Smith (2014) argues that self-assessment may be useful for exploring student exposure to the professional environment yet may not be the most valid means of measuring the achievement of learning outcomes. For this reason, this study also provided workplace supervisors' and lecturers' assessments.

Workplace supervisors may provide their assessments which include work-based projects, observation, evaluation reports and simulation practices (Jackson, 2018). Milne and Caldicott (2016) found that most assessments given by supervisors were generally associated with employability skills and performance-based. Meanwhile, lecturers, as academic mentors for interns, may provide assessments which include cognitive ability improvement and work skills development. The development of questionnaire was carried out based on the five construct dimensions as shown in Table 3, which include cognitive abilities, professional traits, intrinsic motivations, management abilities, and social abilities.

The obtained data was then analyzed using descriptive statistics involving mean and standard deviation (SD). Mean and SD were applied to test whether the items contain approximately the same proportion of information about the measured constructs (Yin et al., 2011). The means indicate the averages of all respondents' responses per question item, while the SDs indicate the extent of deviation for that item. To determine the consistency of the survey responses, Cronbach's Alpha was employed. In this study, five construct dimensions were determined by authors, namely: (1) cognitive abilities (relates to mental capability in acquiring knowledge through internship experience), (2) professional traits (refers to the professional characteristics that interns are expected to develop including integrity and decision making), (3) intrinsic motivations (refers to the inherent motive and satisfaction of students when undergoing an internship program), (4) management abilities (relates to collection of management skills such as time management and reporting), and (5) social abilities (relates to competencies that facilitate better interaction between the interns with others within the organization).

TABLE 3: Questionnaire questions classification based on construct dimensions.

Construct Dimensions	Questions for students	Questions for supervisors	Questions for lecturers
Cognitive abilities	Q1, Q10	Q1	Q1
Professional traits	Q3, Q4, Q5, Q6	Q2, Q3, Q4, Q9	Q2, Q3, Q4, Q7, Q9
Intrinsic motivations	Q7, Q11, Q12	-	-
Management abilities	Q2	Q6, Q8	Q6, Q8
Social abilities	Q8, Q9	Q5, Q7	Q5

FINDINGS

This section focuses on results of the questionnaire survey as a quantitative approach in this study. Table 4 to 6 presents the calculations of means and SDs for each group of respondents. The reliability statistics are presented in Table 7. It was found that the internal consistency for each group of respondents provides alpha coefficient of more than 0.9, suggesting that the items have very high internal consistency.

TABLE 4: Students' perceptions on work-integrated learning experience.

No	Questions	Mean	SD
Q1	I am able to carry out the assigned tasks	4.31	0.58
Q2	I always discipline while working (not coming late or being absent)	4.00	0.69
Q3	I can follow instructions given by my supervisor	4.60	0.50
Q4	I have shown the proper attitude of a professional	4.29	0.57
Q5	I was given more responsibility and trusted by my supervisor	4.17	0.71
Q6	I own and take the initiative for my work	4.29	0.62
Q7	I love my job and intend to pursue a career in this industry	4.09	0.74
Q8	My supervisor is friendly and briefs me a lot	4.66	0.48
Q9	My colleagues are very helpful and provide knowledge to me	4.54	0.56
Q10	My assignments correspond to what I have learned on campus	3.94	0.91
Q11	I feel comfortable working at the company where I am interning	4.34	0.73
Q12	I feel that my works are well recognized and accepted by my supervisor	4.43	0.61
	Average	4.30	0.64

The first construct addressed the cognitive ability shown by students during their internship periods. Q1 on the three questionnaires and Q10 on the students' questionnaire represent this construct. The analysis shows that in general students have the cognitive abilities required to carry out tasks during their internships with a mean of 4.31 and 4.54 out of a possible 5 points for students' and supervisors' questionnaires. However, according to lecturers, students still need to improve their cognitive abilities during the internship period even though they already have a good foundation.

TABLE 5: Supervisors' perceptions on work-integrated learning experience.

No	Questions	Mean	SD
Q1	Intern can understand the assignment/task	4.54	0.55
Q2	Intern complies with applicable regulations and policies	4.57	0.54
Q3	Intern is responsible and reliable	4.46	0.55
Q4	Intern is open to new experiences	4.50	0.66
Q5	Intern can express ideas and opinions properly and correctly	4.04	0.79
Q6	Intern can work together in teams or independently	4.52	0.51
Q7	Intern can establish good relationships with supervisors and co-workers	4.46	0.59
Q8	Intern can provide reports on their work properly	4.41	0.62
Q9	Intern has integrity and a positive and constructive attitude	4.46	0.55
	Average	4.44	0.59

The second construct addressed the professional traits shown by students during their internship periods. This construct includes Q3-Q6 of students' questionnaire, Q2-Q4 and Q9 of supervisors' questionnaire, and Q2-Q4, Q7 and Q9 of lecturers' questionnaire. In general, it can be concluded that students have shown good professional traits during the internship by the fact that these items have means above 4.00, except for Q7 and Q9 of lecturers' questionnaire. In this context, lecturers argue that students are still unable to provide innovation or creative ideas during the internship period. Meanwhile, the third construct is related to intrinsic motivations so that it was only aimed at students as internship participants. There are three questions (Q7, Q11 and Q12) where it can be concluded that students have developed positive intrinsic motivations during the internship period with means above 4.00.

TABLE 6: Lecturers' perceptions on work-integrated learning experience.

No	Questions	Mean	SD
Q1	Student can understand the assignments given at work	3.92	0.28
Q2	Student complies with internship program regulations and maintain the University's reputation	4.50	0.52
Q3	Student is responsible and reliable	4.50	0.65
Q4	Student has integrity and a positive and constructive attitude	4.36	0.93
Q5	Student can express ideas and opinions properly and correctly	3.43	0.76
Q6	Student always coordinate with his/her lecturer	3.50	0.76
Q7	Student has creative ideas that add value to the company/project where he/she is interning	3.36	1.01
Q8	Student can write a good internship report	3.71	0.91
Q9	Student is always present at work (as evidenced by a filled internship journal)	3.93	0.83
	Average	3.91	0.74

The fourth construct dimension is related to management ability which is outlined in Q2 of students' questionnaire, and Q6 and Q8 of supervisors' and lecturers' questionnaire. The analysis found that based on students 'and supervisors' perceptions, students had shown good management skills (with means above 4.00) which included time management, reporting management, team work, and coordination. On the other hand, according to lecturers, although students have a sufficient foundation of management ability, it needs to be improved especially in relation to coordinating and reporting skills. The last construct addressed the social ability which includes Q8-Q9 of students' questionnaire, Q5 and Q7 of supervisors' questionnaire, and Q5 of lecturers' questionnaire. It was found that according to the perceptions of students and supervisors, students had shown good social abilities, while according to the lecturers this ability still needed to be improved.

TABLE 7: Reliability statistics.

Set of items	N of items	Cronbach's Alpha	Interpretation
Students	12	0.997	Excellent
Supervisors	9	0.998	Excellent
Lecturers	9	0.989	Excellent

DISCUSSION

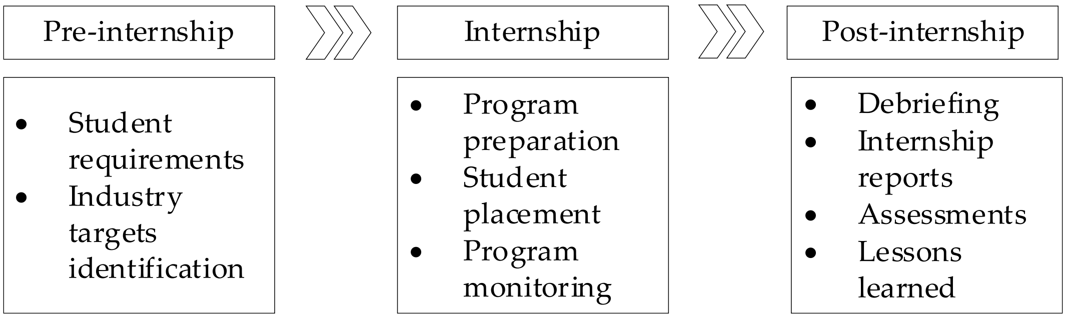
Work-Integrated Learning in Construction Education: Case of CEM Internship Program

The internship program is an integral part of the CEM department of Podomoro University. It is a compulsory subject and a mandatory graduation requirement. Students are required to carry out two internship programs (conducted in their third and fourth year) with a duration of 9-10 weeks for each internship. The strength of this program lies in the collaboration between the CEM department and various industry partners including contractors, consultants and developers. In 2016, internships were started by the first batch of CEM students involving four industry partners (three contractors and one developer).

The observation shows that the internship process at the CEM department consists of three stages, namely pre-internship, internship, and post-internship (Figure 2). In the pre-internship stage, students are selected based on academic requirements to be able to take part in an internship program. Students who pass the selection are given various preparatory materials and briefings including the provisions for the internship, procedures for implementing and monitoring the internship, code of ethics, and aspects of internship evaluation. At the internship stage, participants carry out an internship at their respective placements and must coordinate with the appointed workplace supervisor and lecturer.

The last stage includes a debriefing program, preparation of internship reports and final presentations by participants. During the debriefing program, an interactive session is held as a forum for sharing interns experiences with other students who have not yet participated in the internship program. Furthermore, to assess the success of the internship program as a WIL course, an evaluation metric of students' learning must be developed. Hwang (2019) mentioned three evaluation metrics, namely technical report, oral presentation, and peer evaluation. Similarly, observations at CEM department show four metrics for evaluating students' learning, i.e. students' self-evaluation (10%), supervisors' evaluation (20%), lecturers' evaluation (35%), and final evaluation (35%).

FIGURE 2: Internship process as observed from the case study.



Observations show that the implementation of a CEM internship program at Podomoro University has succeeded in achieving Schonell and Macklin's criteria for good practice in WIL as presented in Table 8. The first criterion is institution embeddedness in which the internship program as a WIL strategy is an integral part of a CEM department and is embedded in the curriculum. The internship program improves relationships between stakeholders (academics and industry partners) and provides a platform for better communication for those involved in the program. Before participating in an internship program, CEM students are required to have the theoretical knowledge and technical skills to perform in the workplace environment. Here, pre-internship was delivered to ensure that students fulfilled certain requirements as listed by the department.

The CEM department recognizes the importance of workplace supervisors in the internship program. Together with lecturers, supervisors were asked to be actively involved in the mentoring, monitoring and evaluating the student performances. Meanwhile, learning outcomes are expected and outcomes achieved when students have completed their internship programs. The CEM curriculum offers the integration of theoretical and practical knowledge required for students to perform in the industry. The internship program is considered to have multiple impacts that not only improve the ability of students, but also the ability of lecturers and supervisors in organizing, mentoring and monitoring student performances. Martin et al. (2019) found that internship programs enabled supervisors to complete more tasks and have more time to focus on their current roles.

Pedagogically, internships present real-world practices as the main approach to teach students practical problems. It refers to the integration and alignment of theory, practice and skill development to ensure lessons are reflected in learning outcomes (Schonell & Macklin, 2019). This can be achieved through mentoring, presentations, and reflective lessons. Finally, the CEM department believes that assessment is integral to the internship activity and provides four types of assessments targeted to students, lecturers, and workplace supervisors. Based on the survey, it can be concluded that this internship program has had a positive impact on student experiential learning with 'excellent' ratings (above 4) according to interns and supervisors' perceptions and 'good' (with 3.91) by lecturers.

TABLE 8: Work-integrated learning good practice criteria.

Schonell & Macklin's Criteria (2019)	Observation at CEM Internship Program
Institution embeddedness	Internship is embedded in the curriculum and become an integral part to CEM department.
Relationships	Internship is mutually beneficial for academics and industry partners, supported by clear communication and agreed responsibilities between all parties involved.
Student preparation	Students are equipped with the necessary theoretical and technical knowledge to perform in the industry, pre-internship program has been delivered prior to the actual internship period.
Supervision	Supervisions are conducted by lecturers and workplace supervisors who provide feedback on learning and tasking as well as professional and practice supports for students.
Learning outcomes	Learning outcomes cover professional standards (integrity, ethics and responsibilities), capacity building (independence, adaptation, self-confidence), cognitive ability (critical thinking, analytical and problem solving), and social ability (communication and team work).
Curriculum	The program facilitates integration of theoretical foundation with complexity of real work in the industry, conducted twice in the third and fourth year, and is a mandatory unit for graduation.
Pedagogies	It includes mentoring, oral presentations, and reflective lessons.
Assessment	Assessments reflect the complexity of experiential learning, provided by all parties involved and consists of four types of evaluation.

Positive feedback has been provided by both interns and industry partners regarding the internship program that has been implemented for four consecutive years. This confirms the findings in previous studies that have shown a positive impact of active learning which increases student performance compared with traditional learning (Freeman et al., 2014; Kvam, 2000; Terenzini et al., 2001). On the other hand, there was also negative feedback, especially related to the short duration of the program. This feedback is an important evaluation for the CEM department to refine the internship program by providing an internship of longer duration in the curriculum.

Preparing for the Future Skills: Construction 4.0 Work-Integrated Learning Model

In addition to the above findings, the CEM department should also pay attention to the transformation of the construction industry by incorporating Construction 4.0 concepts into the internship program. Future construction professionals must be prepared to address complex, dynamic and technological-based problems in global contexts. Construction education must be developed in accordance with the current development to provide students with necessary skills and tools to overcome these challenges while maintaining sustainable aspects in its curriculum. Developing a WIL model adjusting to Construction 4.0 concepts is one way to achieve this target. Through integration of conventional education and the current transformation, this model can reinforce broader applicability of Construction 4.0 concepts to all aspects of construction disciplines.

The proposed WIL model as illustrated in Figure 3 is a synthesis of the observations on the internship experience at the CEM department of Podomoro University with the concepts needed to deal with the development of Construction 4.0. It covers three basic elements in experiential learning, namely learning, teaching and working experience. The integration of these three elements forms a learning system that emphasizes mutually beneficial relationships of academics and industry partners, by providing a real work environment through industry engagement, and developing a practical curriculum to prepare students as ready-to-work in the Construction 4.0 era through mastery of the required technology. In this context, students are prepared to master five clusters of Construction 4.0 concepts, namely technology, digitalization, management, security, and sustainability in the construction industry. For this reason, WIL programs such as internships, project-based learning (PBL), and other forms of WIL must consider appropriate work placements and technologies.

In addition, the WIL process can take advantage of technological advances so that it does not need to be done face-to-face. Lecturers may use online communication to monitor interns placed in various locations or even overseas. The achievement of learning activities is carried out by looking at the development of interns in five dimensions, namely cognitive abilities, professional traits, intrinsic motivations, management abilities, and social abilities. Meanwhile, assessment can be carried out in accordance with best practices that have been applied by the CEM department including student's self-evaluation, supervisors 'evaluation, lecturers' evaluation, and final evaluation.

Figure 3 also presents the recommended WIL process starting from initiation, industry engagement, implementation, and evaluation. At the initiation stage, the university must determine the requirements that students should meet in order to carry out the WIL program properly. These requirements are generally in the form of the fulfillment of minimal theoretical and practical subjects. The university must also determine the target industry according to the needs. Furthermore, the university is advised to make a guideline regarding the WIL program so that the procedure becomes clear to all stakeholders. At the industry engagement stage, universities and students should establish good communication with the targeted industry. At this stage, the university and students will provide information regarding the implementation of the WIL program to the industry, including benefits for industry partners and workplace supervisors. Written agreement may be required to create a legal partnership between university and industry partners. Furthermore, briefings or workshops can be conducted as a means of delivering practical information before the WIL program is executed.

At the implementation stage, students must carry out certain preparations, including personal needs, immunizations, and visas (for overseas placements). Student placement is determined based on an agreement between stakeholders on certain considerations such as the availability of accessibility, accommodation, and the achievement of expected learning outcomes. During execution, supervisors and lecturers are actively involved in the process of mentoring and monitoring students. The last stage is evaluation where assessments related to the achievement of learning outcomes by students are carried out. It is recommended that the university to carry out a debriefing meeting to review WIL program implementation and to explore lessons learned for the improvement of future program execution.

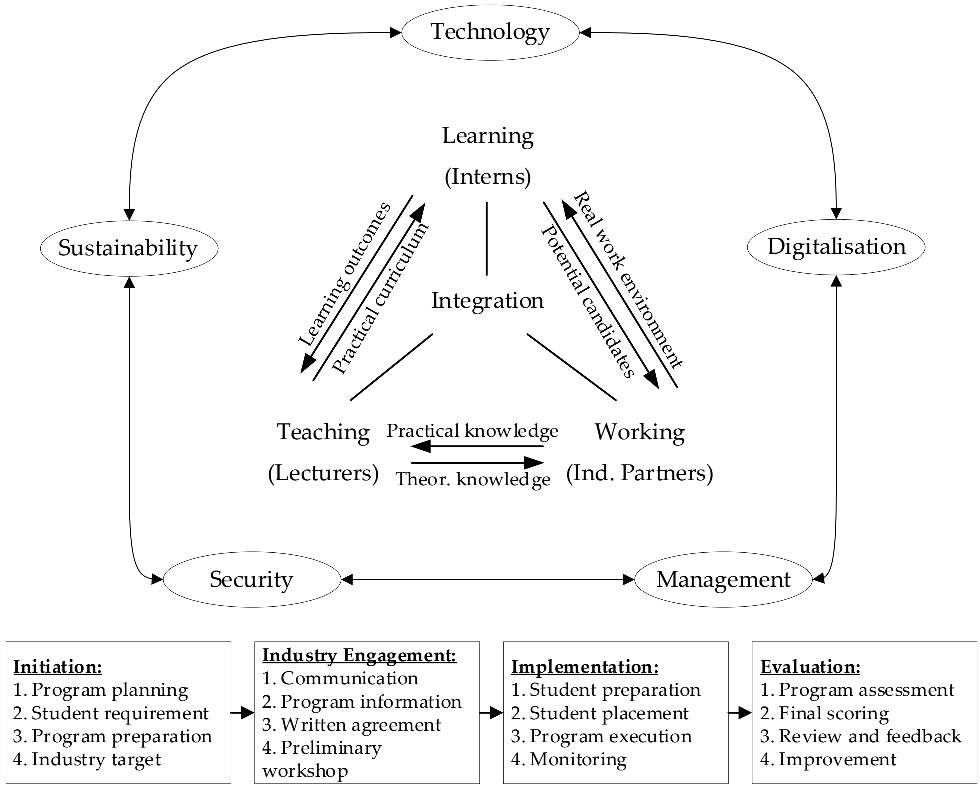
In brief, the implementation of WIL programs must consider the following key aspects:

- The designated WIL course must be established. This includes the objective, and a statement about the various aspects of WIL activities (e.g. selection, placement, monitoring, evaluation, etc.)
- Detailed preparation regarding academic and non-academic requirements must be considered. Academic requirements include the fulfilment of grade point averages and required subjects

while non-academic requirements include acceptable behavior, confidentiality, ethics, immunization and visas (if placement is abroad).

- The duration of the program must be considered according to the WIL credit course and the time available. A minimum of 9-12 weeks duration is required for a full-time basis program while a longer duration may be required for a part-time basis program.
- WIL program consists of: the three stages of pre-internship, internship and post-internship; involve authentic engagement with partner organizations; be assessed in line with the University's Assessment policy; comply with relevant government regulations and University policies and instructions.
- The WIL activities may vary in different locations and/or with different cohorts. It can be in form of internships, project-based learning, work-directed learning, etc. and can be offered online and offline, full-time or part-time basis.

FIGURE 3: Construction 4.0 work-integrated learning model.



CONCLUSION

This paper aims to develop a WIL model adjusting to Construction 4.0 concepts. This study used a mixed method research design to investigate the internship experience of a CEM department and identify the key Construction 4.0 concepts that should be incorporated in the WIL program. The analysis carried out has been successful in synthesizing the findings of observations, literature reviews and surveys into a Construction 4.0 WIL model. While it took a case study of construction students from Podomoro University, the developed WIL model is flexible enough to be adopted in other institutions. Universities can contribute and compete through alignment of academic learning outcomes and industry needs, by adjusting to the Construction 4.0 concepts.

However, many issues still need to be addressed, including the development of Construction 4.0 concepts in Indonesian and global contexts. Future studies can be carried out by investigating the challenges of implementing WIL in the fourth industrial era such as privacy concerns, online monitoring issues, and lack of regulations and instructions. Further study to define and validate the Construction 4.0 concepts and WIL model by relevant stakeholders is also needed. In addition, students can encounter negative experiences during WIL programs such as discrimination, harassment, and exploitation in their placements. Not many studies related to the impact of negative experiences on students have been conducted. Finally, the WIL adaptation model is also important to research so that it can be validated and evaluated for its effectiveness. The development of WIL should also adjust to the development of the industrial revolution given the potential for the emergence of industry 5.0 which focuses on personalization, namely the harmonization of human intelligence with cognitive computing. With the integration between human and machine, potential workers must be upskilled to produce better performance in all aspects of production.

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