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Impact of experiential learning and case study immersion on the development of entrepreneurial self-efficacy and opportunity recognition among engineering students

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ABSTRACT

The 'how' of teaching method varies in its effectiveness with 'what' learning outcome it intends to achieve, and for 'whom' the course is targeted. We employed a longitudinal research design to examine the effectiveness of experiential learning and case study immersion to develop entrepreneurial self-efficacy and opportunity recognition among engineering students. Data were collected from two undergraduate cohorts who undertook an entrepreneurship course with different pedagogical approaches. The t-test results showed no statistically significant difference in self-efficacy. However, there was a statistically significant difference in opportunity recognition. The effectiveness of the two approaches differed when a paired t-test was conducted. Educators should adopt an approach that is constructively aligned to a specific learning outcome. Whilst teaching 'about' entrepreneurship through case study immersion is effective to develop the cognitive ability of non-business students to recognize opportunity, in contrast, experiential learning or teaching 'through' entrepreneurship is more effective to develop their self-efficacies.

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non-business students; opportunity recognition; self-efficacy; teaching about entrepreneurship; teaching through entrepreneurship

1. Introduction

Entrepreneurship education (EE) has emerged since the 1980s as one of the key economic agendas for most nations aspiring for a transformation from job-seekers to job creators and balanced citizens with entrepreneurial mindset (Aronsson, 2004; Crawford, 2019; MEB, 2015; NEP, 2019). The mission of EE has evolved from promoting entrepreneurship as an academic discipline in the early 1990s to grooming aspiring entrepreneurs among students in the 2000s, and recently aimed towards developing graduates with entrepreneurial competency (Hägg & Gabrielsson, 2019). The most recent mission has been triggered by a call to bridge the mismatch between graduate attributes and industry demand (Chetwynd, Aiken, & Jefferis, 2018) for crucial, yet previously underemphasized cross-cutting skills (Andrade, 2020), such as creative problem-solving, informed decision-making, adaptability to work with uncertainty, and resilience in the face of

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adversity. These are among the traits that not only successful entrepreneurs would exhibit but are also sought-after by employers to enhance corporate performance in various industries (Ağca, Topal, & Kaya, 2012; Antoncic & Hisrich, 2003; Institution of Engineering and Technology, 2017; Soriano, Felício, Rodrigues, & Caldeirinha, 2012). Accordingly, the learning outcomes of EE for engineering students have been tailored to develop professional skills including creativity, product development, and opportunity identification skill (Duval-Couetil, Shartrand, & Reed, 2016), in contrast to EE for business students that focuses more on business creation outcome metric (Huang-Saad, Morton, & Libarkin, 2018).

In meeting these demands, entrepreneurship educators play crucial roles in designing an effective pedagogy that can achieve the desired EE learning outcomes. The current literature on entrepreneurship in higher education outlines that entrepreneurial self-efficacy and intention are among the critical affective measures in any entrepreneurial student development (Huang-Saad et al., 2018). Furthermore, in a systematic review of engineering entrepreneurship education assessment research literature, Huang-Saad et al. (2018) discovered that opportunity recognition has been among the understudied cognitive outcomes, and they called for future research to identify characteristics of EE program that are most effective in developing this global entrepreneurship skill. Other scholars have also recommended for further exploration of opportunity recognition (Aamir, Atsan, & Erdem, 2019) as the cognitive outcomes of EE (Nabi, Liñán, Fayolle, Krueger, & Walmsley, 2017).

Evidently, student's self-efficacy can be enhanced through perceived learning from EE, which, in turn, raises their intention to become entrepreneurs (Zhao, Seibert, & Hills, 2005). Nonetheless, literature has also emerged offering contradictory findings, indicative of the ineffectiveness of EE in developing both entrepreneurial self-efficacy and opportunity recognition-related skill such as creativity and market awareness (Oosterbeek, Van Praag, & Ijsselstein, 2010). This implies that the impact of EE on entrepreneurial student development remains inconclusive.

Scholars have long debated the characteristics of 'what' T&L approaches in EE are effective to achieve the intended outcomes (Higgins & Elliott, 2011). Dubbed inherently transformational (Kakouris & Liargovas, 2021), experiential learning has been the most widely adopted T&L approach (Dhliwayo, 2008; Kassean, Vanevenhoven, Liguori, & Winkel, 2015; Neck, Greene, & Brush, 2014; Pittaway & Cope, 2007). Experiential learning requires students' participation to apply entrepreneurship knowledge and act entrepreneurially in a practical project simulating a real-world environment. Nonetheless, scholars continue to dispute the contradictory findings on the impact of experiential learning on EE (Kakouris & Liargovas, 2021; Lackéus, 2020). It is plausible that what works well in one learning environment might not work as well in another. This is because the 'how' of teaching delivery seems to vary in its effectiveness with 'what' content the teaching intends to deliver, and for 'whom' the EE course is targeted (Hägg & Gabrielsson, 2019; Kamovich & Foss, 2017). Therefore, the adaptation of any teaching and learning (T&L) approaches from business community to engineering community would require a careful consideration as beliefs also vary between disciplines (Kakouris, 2016).

From the research methodological perspective, there has been a critique on the lack of rigorous experimental design to establish the causal claims in most of the EE impact assessment studies (Longva & Foss, 2018). It seems that what we know about the impact

of EE on self-efficacy and opportunity recognition is largely based on cross-sectional studies that lack the details of instructional strategy to guide practitioners and educators from the engineering context (Huang-Saad et al., 2018). By employing a longitudinal research design, this study aims to examine the effectiveness of experiential learning (teaching 'through' entrepreneurship) and case study immersion (teaching 'about' entrepreneurship) to develop entrepreneurial self-efficacy and opportunity recognition among engineering students. Specifically, we seek to answer the following research questions:

(i) Do engineering students' self-efficacy and opportunity recognition differ between Group 1 (case study immersion) and Group 2 (experiential learning) at the end of the entrepreneurship course?
(ii) Do engineering students' self-efficacy and opportunity recognition in both Group 1 (case study immersion) and Group 2 (experiential learning) improve at the end of the entrepreneurship course?

The next section gives an overview of the impact of EE on self-efficacy and opportunity recognition, followed by a review on teaching non-business students 'about' and 'through' entrepreneurship. The third section is concerned with the methodology used for this study. The fourth section analyses the results of the independent t-test and the paired t-test. The effectiveness of each instructional strategy in developing self-efficacy and opportunity recognition is discussed in section 5.

2. Literature review

Overview of the impact of entrepreneurship education on self-efficacy and opportunity recognition development

Entrepreneurial self-efficacy is students' self-belief that they are competent to perform entrepreneurial actions to successfully become entrepreneurs (Chen, Greene, & Crick, 1998; McGee, Peterson, Mueller, & Sequeira, 2009). In view of the fact that students' entrepreneurial self-efficacy is a strong predictor of entrepreneurial intention (Barbosa, Gerhardt, & Kickul, 2007; Laviolette, Lefebvre, & Brunel, 2012) and behaviour to run business (Tornikoski & Maalaoui, 2019), the role of EE to develop this attribute (Gedeon & Valliere, 2018; Karimi, Biemans, Lans, Chizari, & Mulder, 2016; Mozahem & Adlouni, 2021; Sánchez, 2011; Zhao et al., 2005) has been studied extensively (Huang-Saad et al., 2018). A seminal finding in this area was made by Zhao et al. (2005), who proved that the influence of perceived learning from EE on intention to become entrepreneurs is mediated by self-efficacy. Moreover, a number of studies have discovered positive findings on the impact of EE on self-efficacy development. For instance, using a comprehensive self-efficacy scale developed by Gedeon and Valliere (2018), Mozahem and Adlouni (2021) discovered in their cross-sectional research that undergraduate business students who took the entrepreneurship course had a higher level of entrepreneurial self-efficacy, than students who did not take the course. Similar findings are also reported in another longitudinal study of undergraduate students from multiple disciplines (Sánchez, 2011). In another attempt to compare EE courses that are offered as compulsory and elective, Karimi et al. (2016) discovered that both modes bring significant positive impacts on students' self-efficacy. Nonetheless, their study did not offer an adequate explanation of the characteristics of T&L

approaches that were adopted in each mode. The implication from the findings would have been far more persuasive if pedagogical approaches had also been observed and assessed. Indeed, pedagogical clarity has been highlighted as one of the criteria to ensure the quality of higher education research in any contexts (Evans et al., 2021).

Despite these positive findings, there has been an opposite instance of ineffective role of EE in developing self-efficacy (Oosterbeek et al., 2010). Scholars have then started to investigate the impact of different pedagogical approaches on EE learning outcomes. For instance, undergraduate business students who were enrolled in an instructor-centred entrepreneurship course with passive listening to content developed a higher level of objective (grades) and subjective (self-reported entrepreneurial and managerial skills) learning outcomes, compared to students who learned using the student-centred approach with an emphasis on active experiential learning (Ismail, Sawang, & Zolin, 2018). This observation from a Southeast Asian learning culture provides a contradicting perspective to those observed from the western regions (Rasmussen & Sørheim, 2006). This evidence reinforces our argument that what works well in one learning environment might not work as well in another. Adaptation of any T&L approaches from business community to engineering community would require a careful consideration. Besides, the adaptation should also address the limitation of these earlier cross-sectional studies as the authors called for future research to apply a longitudinal study of between 6 months and a year.

This limitation is not uncommon since findings from several systematic reviews on the application of experimental design in EE impact research, revealed a substantial lack of methodologically rigorous studies (Carpenter & Wilson, 2021; Longva & Foss, 2018; Nabi et al., 2017) that incorporated control groups (Rideout and Gray, 2013; Nabi et al., 2017), longitudinal design with measurements taken before the instructional intervention (Bae, Qian, Miao, & Fiet, 2014), and inadequate details of instructional intervention approaches (Nabi et al., 2017). Mukesh, Pillai, and Mamman (2020) addressed these methodological concerns and examined the impact of action learning and instructor-centred learning to develop entrepreneurial intention and self-efficacy among undergraduate business students. In contrast to the findings from Ismail et al. (2018), they unfolded the weakness of traditional instructor-centred learning, which has commonly been adopted as a primary approach in most universities (Mukesh et al., 2020). Most of the research examined thus far suffers from the fact that the samples are all business students, limiting generalizability to other educational backgrounds. Furthermore, critics from a systematic literature review and research agenda for EE in higher education have also argued that impact measures have focused on short-term subjective measures, but instead should also explore novel impact indicators, particularly cognitive (Huang-Saad et al., 2018) and affective outcomes (Nabi et al., 2017), such as opportunity recognition and creativity (Aamir et al., 2019).

From a broad entrepreneurship perspective, opportunity recognition outlines individuals' capability of '*being alert to potential business* opportunities, *actively searching for them, and gathering information about new ideas on products or services*' (Kuckertz, Kollmann, Krell, & Stöckmann, 2017, p. 92). For entrepreneurship education scholars, opportunity recognition is interpreted as complex and non-linear thinking (Sardeshmukh & Smith-Nelson, 2011) ability to 'connect the dots' (Baron, 2006) or construct meaningful patterns and concepts (Baron, 2006, Hunter, 2013) that leads to

an identification of ideas translatable into value creation. As opportunity recognition is one of the key attributes of a successful entrepreneur (Abd Rahim, Mohamed, Amrin, & Masrom, 2021), numerous studies have attempted to explain the role of EE to build this crucial skill (Cui, Sun, & Bell, 2019; Hashim, 2017; Hassan, Saleem, Anwar, & Hussain, 2020; Karimi et al., 2016; Suteerachai, Suksod, & Somjai, 2019). For instance, a cross-sectional study of 15 higher education institutions in China demonstrated the positive impact of EE with a range of pedagogies on students' alertness to opportunity (Cui et al., 2019). This view is supported by another set of cross-sectional findings regarding how different dimensions of know-what, know-why, and know-how (Williams Middleton & Donnellon, 2014) in entrepreneurship education can positively influence opportunity recognition among the final-year business students in Palestinian universities (Hashim, 2017). Another cross-sectional evidence of Thai students also experienced the beneficial effect of cognitive entrepreneurial training and education on their opportunity recognition (Suteerachai et al., 2019). The positive impact of EE on opportunity recognition had also been observed in few earlier studies a decade ago (DeTienne & Chandler, 2004; Munoz, Mosey, & Binks, 2011).

Despite this evidence, to date, there has been no consensus among scholars as to whether opportunity recognition can be nurtured through education, as other scholars have reported contradictory findings. For instance, Hassan et al. (2020), who examined cross-sectional data from both undergraduate and postgraduate business students in India, discovered that entrepreneurship education serves as a booster in nurturing the influence of self-efficacy on intention but not on opportunity recognition. This observation could be due to the inconsistency of the entrepreneurship course syllabus across various classes (Hassan et al., 2020). On the other hand, Karimi et al. (2016) discovered no significant impact of compulsory and elective entrepreneurship courses at six Iranian public universities covering a wide range of different class characteristics on undergraduate students' perception of opportunity identification. They raised a concern that further studies should begin to explore how different T&L methods and learning environments could improve learning outcomes to nurture opportunity recognition. Considering all of this evidence, it seems that what we know about the impact of entrepreneurship education on opportunity recognition is largely based on cross-sectional studies and lack the details of instructional strategy to guide practitioners and educators to adopt the most suitable and effective T&L methods in the engineering student context.

As a matter of fact, there have been suggestions for future study to focus on non-business students studying EE using various instructional strategies to expand the relatively small body of literature on the impact of EE on engineering students (Huang-Saad et al., 2018; Lüthje & Franke, 2003). These instructional strategies are such as teaching 'about' entrepreneurship that refers to a content-laden and theoretical approach to give a general understanding of the phenomenon; teaching 'for' entrepreneurship that refers to an occupationally oriented approach to provide budding entrepreneurs with the requisite knowledge and skills; and teaching 'through' entrepreneurship refers to a process-based and often experiential approach where students go through an actual entrepreneurial learning process (Lackeus, 2015).

In this study, we examined the impact of instructional interventions of teaching 'about' and 'through' entrepreneurship on engineering students. The details of both modes are described in the methodology section of this article. We placed emphasis on teaching 'about' and 'through' entrepreneurship because both modes are relevant to the formal education setting, while the teaching 'for' entrepreneurship mode is omitted in this study. This is because teaching 'for' entrepreneurship is usually met in the non-formal or informal settings.

3. Methodology

3.1. Data collection and ethical consideration

Respondents in this study were second year undergraduate students from two independent cohorts of the undergraduate program in Industrial Design at a public university in Malaysia. Both groups undertook the same compulsory course module, titled 'Introduction to Entrepreneurship', but designed with different instructional strategies. Both cohorts were taught by the same instructor, who conducted T&L activities using experiential learning and case study immersion approaches.

Both experiential learning and case study immersion approaches are based on syllabi for Malaysian institutions of higher learning, guided by Ariffin and Hamidon (2017) and the Entrepreneurship Unit, Ministry of Higher Education. These syllabi guided instructor to choose either one from seven projects/activities to be conducted in a particular semester. The selection is among i. entrepreneurial project execution, ii. case study immersion, iii. online business simulation, iv. apprenticeship, v. social entrepreneurship, vi. entrepreneurship week, and vii. event management. Generally, if the selection is entrepreneurship week, students will be assigned in groups to choose one viable business idea (product/service) and plan their activities independently, including selecting products, conducting operations, and carrying out marketing strategies. All groups will be required to sell their products/services during the entrepreneurship week, which is held within or outside the university for two to 5 days. On the other hand, if the selection is social entrepreneurship project, students will be required to choose and run at least one project that will contribute to the community's income. Event management is another optional project for students to create and generate income from events such as festivals, conferences, ceremonies, formal parties, concerts, and training.

Among those seven projects/activities, this study selected and compared the effectiveness of two instructional strategies: entrepreneurial project execution (experiential learning) and case study immersion as the approaches for teaching 'through' entrepreneurship and teaching about entrepreneurship, respectively. The details of these approaches are summarized in Table 1. This study ensured research ethical compliance as students from both cohorts were well informed during the early semester about the conduct of either one of these seven approaches based on the syllabus endorsed by the Ministry of Higher Education Malaysia. Individual participant data had been anonymized in the analysis and reporting. Participants provided their consent to participate in the study through e-learning (university learning management system) at which they responded to the questionnaire.

Table 1. Profile of respondents and details of instructional strategies.

Sample demographic/ Instructional strategies	Case study immersion (Group 1)	Experiential learning (Group 2)
Sample size	23	25
Number of responses (N)	23	25
Gender		
Male	9	13
Female	14	12
Age		
20 years old	6	10
21 years old	16	13
22 years old	1	2
Data collection	t_1 (September 2019) t_2 (February 2020)	t_1 (September 2020) t_2 (February 2021)
Teaching and learning activities	Teaching 'about' entrepreneurship (Kakouris & Liargovas, 2021): Exposure to real business through case studies. Students choose established ventures (SMEs in Malaysia) to gain deeper understanding (data collection through document review/ observation/ interviews) of sustainable entrepreneurship and how it can be put in place. Students performed comparative analysis using SWOT and business model canvas (Ariffin & Hamidon, 2017)	Teaching 'through' entrepreneurship (Kakouris & Liargovas, 2021): Students choose one viable business ideas (product/service), pre-launch new venture, gain income, and document all related activities for reporting (Ariffin & Hamidon, 2017)

3.2. Data analysis

The data were analysed using the Statistical Package for Social Sciences (SPSS) Version 22.0. The mean values of continuous variables rated by the students prior to attending the entrepreneurship course and after course completion were compared using a paired t-test. The test was intended to examine whether students' entrepreneurial self-efficacy and opportunity recognition differed significantly (t_2-t_1) at the end of the entrepreneurship education course for both types of instructional strategies. An independent samples t-test was also performed to compare any differences in students' entrepreneurial self-efficacy and opportunity recognition between the two instructional strategies after the course completion (t_2).

4. Analysis and results

Students from both groups were asked to complete the same set of entrepreneurial attribute questionnaires, which were made available on the e-learning platform at the onset of the course (t_1) in September and upon course completion (t_2) in February. The outcome measures (opportunity recognition and self-efficacy) are tabulated in Table 2. Students were asked to indicate the level of their agreement/disagreement on the statements based on the Likert scale [Scale: Strongly disagree (1), Disagree (2), agree (3), Strongly agree (4)]. Both outcome measures met the minimum requirement of internal consistency, with Cronbach alpha's values above 0.7. These values indicate the

trustworthiness and the extent to which the data for both measures were reliable and fulfil one of the criteria that ensures the quality of higher education pedagogical research (Evans, Kandiko Howson, Forsythe, & Edwards, 2021).

On average, students from both groups responded at t_1 that they often think of the idea of starting a new business and they like to think of new and creative ways to do things. Their average scores were somewhat lower [$M(t_1) \leq 3$] on the incidence to identify ideas that can be turned into new products/services, ability to identify new business opportunities in the market and sensitiveness to business opportunities. In terms of their self-efficacy at t_1, both groups indicated low perceptions [$M(t_1) \leq 3$] on their knowledge on the process and practical details needed to start a business and how to develop an entrepreneurial project. They also indicated low self-beliefs that they were ready and competent to start a business.

An independent samples t-test was conducted to compare students' self-efficacy scores at the end of the course (t_2) between Group 1 (case study immersion) and Group 2 (experiential learning). As tabulated in Table 3, there was no statistically significant difference ($t = -0.435$, $p = 0.625$) in the scores for Group 1 ($m = 2.782$, $sd = 0.590$) and

Table 2. Descriptive statistics.

	Case study immersion (Group 1)					Experiential learning (Group 2)				
Measure	$M(t_1)$	$M(t_2)$	$SD(t_1)$	$SD(t_2)$	Cronbach's α	$M(t_1)$	$M(t_2)$	$SD(t_1)$	$SD(t_2)$	Cronbach's α
Opportunity recognition (Abd Rahim et al., 2021)										
I often think of the idea of starting a new business (although I do not necessarily run a business)	3.12	3.28	0.85	0.72	0.801	3.12	3.33	0.60	0.48	0.773
I like to think of new and creative ways and approaches to do things	3.10	3.23	0.52	0.57		3.20	3.24	0.60	0.44	
I often identify ideas that can be turned into new products or services	2.69	3.07	0.60	0.65		3.00	2.81	0.50	0.40	
I am able to identify new business opportunities in the market	2.57	3.15	0.78	0.62		2.84	3.00	0.47	0.45	
I am always sensitive to business opportunities in my environment	2.62	2.95	0.76	0.82		2.96	2.95	0.54	0.59	
Entrepreneurial self-efficacy (McGee et al., 2009)										
I know how to develop an entrepreneurial project	2.35	2.78	0.83	0.74	0.898	2.16	2.96	0.37	0.56	0.897
I know the process and practical details needed to start a business	2.30	2.96	0.70	0.56		2.32	3.00	0.48	0.43	
To start a business and make sure it succeeds is easy for me	2.17	2.39	0.83	0.78		1.88	2.39	0.60	0.78	
I am ready to start a viable business	2.70	2.83	0.82	0.65		2.76	3.00	0.44	0.52	
If I try to start a business, I will have a high probability of success	2.78	2.96	0.74	0.64		2.76	2.91	0.66	0.67	

i. t_1 onset of course, t_2 course completion
ii. Scale: Strongly disagree (1), Disagree (2), Agree (3), Strongly agree (4)

Table 3. T-test results.

Measure	Case study immersion (Group 1) M	Experiential learning (Group 2) M	t-value	Effect size
Self-efficacy	2.782	2.852	−0.435	-
Opportunity recognition	3.243	3.067	1.327*	0.03

*p < 0.05, **p < 0.01

Table 4. Paired t-test results.

	Case study immersion					Experiential learning				
Measure	$M(t_1)$	$M(t_2)$	$M(t_2 - t_1)$	t	Effect size	$M(t_1)$	$M(t_2)$	$M(t_2 - t_1)$	t	Effect size
Self-efficacy	2.46	2.78	0.32	−2.31*	0.48	2.34	2.85	0.51	−5.07**	1.05
Opportunity recognition	2.91	3.24	0.33	−3.40**	0.71	3.00	3.07	0.07	−0.89	-

*p < 0.05, **p < 0.01 [Cohen's (1988) effect size: 0.2 small; 0.5 medium; 0.8 large]

Group 2 (m = 2.852, sd = 0.490). However, students' opportunity recognition showed a statistically significant difference (t = 1.327, p = 0.001) between the scores for Group 1 (m = 3.243, sd = 0.535) and Group 2 (m = 3.067, sd = 0.306). The magnitude of differences in means is small (effect size = 0.03).

A paired t-test was conducted to evaluate whether both self-efficacy and opportunity recognition were significantly different between the onset of the course (t_1) and course completion (t_2). This test was aimed to compare the effectiveness of the two instructional strategies to develop the intended outcomes. The paired t-test results in Table 4 show that students' entrepreneurial self-efficacy was significantly higher after taking an entrepreneurship course designed with either experiential learning (t = −5.07, p = 0.00) or case study immersion (t = −2.31, p = 0.03). Noticeably, the effect size was larger for experiential learning (effect size = 1.05) compared to case study immersion (effect size = 0.48). The students who took the case study immersion course showed an improved ability to develop opportunity recognition skills (t = −3.40, p = 0.003, effect size = 0.71). However, those who took the experiential learning course did not show statistically significant developmental changes (t = −0.89, p = 0.383).

5. Discussion and implications

Effectiveness of instructional strategies to develop self-efficacy and opportunity recognition among engineering students

This study was designed to examine whether engineering students' self-efficacy and opportunity recognition improve after they were taught 'about' (case study immersion) and 'through' (experiential learning) entrepreneurship. The results indicate that teaching 'about' entrepreneurship can develop students' opportunity recognition and self-efficacy. In contrast, the evidence shows that teaching 'through' entrepreneurship cannot develop students' opportunity recognition. Nonetheless, it is teaching 'through' entrepreneurship that the impact on students' self-efficacy development is greater, compared to the other approaches.

A possible explanation for this might be that engineering students were exposed through case study immersion to the knowledge of how to develop an entrepreneurial project, the processes, and practical details needed to start a business generally. However, it was through experiential learning that engineering students developed stronger self-belief in their readiness and capability to start a viable business. This evidence in the context of engineering (non-business) students corroborates earlier findings of undergraduate business students (Mukesh et al., 2020). Our findings are also in line with the works of Piperopoulos and Dimov (2015), who discovered that self-efficacy was associated with lower entrepreneurial intention in a theoretically oriented course, compared to a practically oriented course. The experience of performing actions as an entrepreneur in a mini pre-launch venture enhances the perception of feasibility of becoming an entrepreneur. This finding supports previous observations that entrepreneurial project execution in the experiential learning method constitutes an action-embedded pedagogy that is excellent in developing actionable outcomes (Ho, Uy, Kang, & Chan, 2018; Järvi, 2015; Neck et al., 2014).

Taken together, these findings have implications for the understanding of how learning 'through' entrepreneurship is in line with the self-determination theory (Deci & Ryan, 2012). The originality and relevance (Evans et al., 2021) of this study is the adaptation of experiential learning idea into the entrepreneurship context, specifically by examining the outcomes of pedagogical practice that demands students to define their own learning. As shown in this study, students were free to choose viable business ideas, pre-launch new venture, and gain income. It was in such authentic environment that students build confidence in their ability to apply entrepreneurship knowledge and skills. The evidence further strengthens the idea for curriculum and pedagogy modification to provide students the freedom to internalise and align learning with own experience that will develop their self-efficacies more effectively (Mitchell, Nyamapfene, Roach, & Tilley, 2019).

One unanticipated finding was that the student group who were taught 'about' entrepreneurship through case study immersion showed improvement in their opportunity recognition, compared to those who were taught 'through' entrepreneurship. Even though few studies have attested that teaching 'about' entrepreneurship is traditional and ineffective to develop the desirable outcomes (Higgins & Elliott, 2011) such as entrepreneurial intention (Bae et al., 2014; Nabi et al., 2017); however, we discovered the significance of teaching 'about' entrepreneurship to engineering students in developing one of their key entrepreneurial skills. Despite these students were enrolled in a non-business education program, instructor managed to develop students' capability to recognize entrepreneurial opportunity better, after they were assigned to gain deeper understanding through document review/observation/interview of how sustainable entrepreneurship can be put in place and performed SWOT comparative analysis of business model canvas of established ventures in Malaysia.

It seems possible that these results are due to what Gregoire, Barr, and Shepherd (2010) described about the cognitive underpinning of opportunity recognition, which results from the mental connection process of various sources such as prototypes and prior knowledge (Shane, 2000). In the context of this study, the case study immersion approach provides exposure to real businesses exemplars that form sufficient prerequisite knowledge. The assimilation of this new information into students' existing knowledge enhances their capability to think of new business ideas, creative ways to do things, and ideas that are translatable to products or services.

In the longer term, we hope the relevance of this pedagogical research will inform and change ways of thinking and practice (Evans et al., 2021) that previously deemed teaching 'about' entrepreneurship as traditional and ineffective. Although the current study is based on a small sample of engineering students, the findings suggest a potential of transferability beyond the immediate discipline. Case study immersion presented in this study could complement interdisciplinary team-based learning (Bailey, Read, Linder, & Neeley, 2021; Lüthje & Prügl, 2006) in other pedagogical framework that brings together business, engineering, and design students to develop their opportunity recognition.

6. Conclusion

This study set out to examine the effectiveness of teaching 'about' and 'through' entrepreneurship to develop entrepreneurial self-efficacy and opportunity recognition among engineering students. The results of the longitudinal research proved that engineering students' opportunity recognitions were enhanced when they were taught 'about' entrepreneurship through case study immersion. In contrast, their self-efficacies were improved when they were taught 'through' entrepreneurship or experiential learning. These findings make several contributions to the current literature. Firstly, this study strengthens the idea that the 'how' of teaching method will vary its effectiveness with 'what' learning outcome it intends to achieve, and for 'whom' the course is targeted. While a few scholars encourage theoretical teaching 'about' entrepreneurship (Fiet, 2001; Morris, 2017), there are others who perceive teaching 'through' entrepreneurship as an inherently transformational approach (Kakouris & Liargovas, 2021; Mukesh et al., 2020). Our findings offered another point of view that neither is better than the other. Entrepreneurship educators should adopt an approach that is constructively aligned based on the specific learning outcome, whether to develop affective (entrepreneurial self-efficacy) or cognitive (opportunity recognition). Secondly, this longitudinal study addressed the concern on methodological flaws stressed in most impact assessment studies that lack the experimental design to establish the causal claims (Carpenter & Wilson, 2021; Longva & Foss, 2018; Nabi et al., 2017). The findings will be of interest to the engineering entrepreneurship education community as we provided details of the effective instructional strategy to develop opportunity recognition, which has been highlighted as among the understudied cognitive outcomes by many scholars (Aamir et al., 2019; Huang-Saad et al., 2018; Nabi et al., 2017). To conclude, we recommend the following suggestions for future research: Firstly, we envisage that the impact of self-efficacy on entrepreneurial intention could be enhanced if students develop better opportunity recognition skills after taking entrepreneurship education courses designed with effective pedagogy. Therefore, future study could examine the moderating effect of opportunity recognition on the relationship between self-efficacy and entrepreneurial intention. Furthermore, future research could also explore the effectiveness of the hybrid mode that augments both theoretical and experiential teaching. Finally, the scope of this study was limited as the surveys collected information on students' perception on opportunity recognition. Hence, it is strongly recommended that future study apply the T&L activities described for each instructional methods in this study to other contexts with a more precise outcome measure to gauge the actual business opportunity identified at the end of the course. The limitation of this study is that the sample was drawn from two cohorts of undergraduate students from one engineering program of one tertiary institution, which may influence the responses and therefore generalisability of the findings. Although samples of similar abilities

profiles were ensured for both groups, the study did not repeat the other way round to observe if the same results would have been achieved. Future research could examine the generality of the results through a bigger sample, and a longitudinal study could also compare between business and non-business to explore how the thought culture and field of study specific (Kakouris, 2016) play a role in changing entrepreneurial self-efficacy and opportunity recognition over time.

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