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Assessing engineering students' perspectives of entrepreneurship education within higher education: a comparative study in Hong Kong

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ABSTRACT

With the increasing interest in entrepreneurship education within engineering education, there are questions on what engineering entrepreneurship education should include. As engineering entrepreneurship education aims to foster entrepreneurial individuals who will contribute to knowledge-based societies and economic growth, student perspectives are crucial. This study assessed first and final year engineering students' perceptions on entrepreneurship education in a university in Hong Kong, identifying important competencies as learning outcomes and motivating and deterring factors for students to pursue entrepreneurship as a career. Findings offer implications for curriculum design and educational practices, particularly on formally offering entrepreneurship education in the engineering discipline, involving competencies development in educational practices and developing opportunities addressing students' factors of motivation and deterrence.

KEYWORDS

Entrepreneurship education; entrepreneurial competencies; higher education; learning outcomes

Introduction

Over the years, more and more educational institutions have sought to engage in entrepreneurship education (Cheung 2008). With entrepreneurship contributing to innovation, creating opportunities and encouraging economic growth, higher education institutions have responded to the need by offering entrepreneurship education to students in various ways. The discipline of engineering has increasingly incorporated entrepreneurship education into its curriculum, as engineers are considered 'well placed to act upon new opportunities and solve technical problems' (Pettersen et al. 2019, 1138). With the fourth industrial revolution, engineers are contributing greatly to knowledge-based societies and economic growth, and there is growing emphasis to develop entrepreneurial mindsets in engineering students. The purpose of this study is to assess engineering students' perceptions towards entrepreneurship education, comparing first and final year students. This study also evaluates factors that motivate and stop engineering students from becoming entrepreneurs, along with competencies students perceived as important for becoming a successful entrepreneur. The findings offer implications for engineering entrepreneurship education curriculum and practices.

Literature review

Engineering entrepreneurship education

Over the past two decades, there has been significant attention given to entrepreneurship education, especially within higher education, to provide opportunities for students to engage in entrepreneurship-related practices outside of business schools (Morris, Kuratko, and Pryor 2013). Along with the rise of entrepreneurship education, entrepreneurship programmes and courses in engineering education have steadily increased (Zappe et al. 2013; Besterfield-Sacre et al. 2016). There has been increasing awareness of the value of entrepreneurship education for students in engineering, believing that it would bridge technology with market and commercialisation (Kleine, Giones, and Tegtmeier 2019). Dabbagh and Menascé (2006) claimed that engineering graduates need entrepreneurial skills that are beyond that of technical engineering, and Huang-Saad, Bodnar, and Carberry (2020) believed that engineers need to be entrepreneurial in thinking and actions to contribute to technological advancements. Entrepreneurship education for students in engineering would connect technology innovation to the market, where students learn to develop and create technology in their higher education studies in preparation for starting entrepreneurship after graduation.

Studies of entrepreneurship education in engineering have focussed on various outcomes, such as developing students' entrepreneurial mindsets (João and Silva 2020), entrepreneurial self-efficacy and intent (Shekhar and Huang-Saad 2021), and improving students' creativity while extending their engineering knowledge (Pettersen et al. 2019). Entrepreneurship education was also found to support students in self-directed learning, preparing students for work life or self-employment (Täks et al. 2014). Questions remain on what engineering entrepreneurship education should include, and what the aims and learning outcomes should be. Engineering entrepreneurship is still evolving (Huang-Saad, Bodnar, and Carberry 2020), so research in this field should contribute to developments in understanding and practices.

Competencies as learning outcomes

Competencies comprise of skills, positive values and attitudes (Chan et al. 2017), and in entrepreneurship education an abundance of competencies are learning outcomes (Wong and Chan 2021). Sánchez (2013) believed that entrepreneurship education is a vital means of developing competencies essential to create businesses. The combination of entrepreneurial skills, values and attitudes would produce entrepreneurs competent to create businesses. However, there is no defined set of competencies for entrepreneurship education. Okolie et al. (2021) reported a set of thirteen competencies related to entrepreneurship education identified from a Delphi study, such as opportunity recognition, resilience, self-efficacy and resource leveraging. Ernest, Matthew, and Samuel (2015) reported a different set of entrepreneurial competencies, for example creativity, networking, self-efficacy and sense of initiative. Wong and Chan (2021, 12) found other categories of competencies as learning outcomes of entrepreneurship education, including generic competencies and professional competencies, 'but entrepreneurial competencies often overlapped with generic and professional competencies'. Despite a considerable amount of research in entrepreneurial competencies, there is a lack of definition of what competencies students should develop from entrepreneurship education experiences. Ferreras-Garcia, Hernández-Lara, and Serradell-López (2021, 2357) highlighted the ongoing debate on 'the question of equivalence between entrepreneurial competencies and the skills needed by entrepreneurs'. Questions remain on what competencies are truly important within entrepreneurship education, and whether these competencies enable students to become entrepreneurs after graduation.

The research gap

Mani (2015, 3) wrote on ‘gaps in the entrepreneurship education provided in the universities and colleges and the expectations of the students’. As students are one of the main stakeholders in higher education, student perspectives are crucial, in that student expectations, motivations and interests affect learning outcomes, assessments and classroom practices. Even more so in entrepreneurship education, which aims to create entrepreneurial individuals who will bring innovation and new opportunities to the society, students are the focus of the learning experiences. Student perceptions are thus crucial for entrepreneurship education. While comparative studies in entrepreneurship education have focused on comparing countries (e.g. Packham et al. 2010; Trivedi 2016), comparisons between different stages of higher education are lacking. Student perceptions may differ according to their stage of study, as their thoughts or needs would be influenced by their experiences and maturity.

Moreover, research in entrepreneurship education is relatively lacking in Asia. Wong and Chan (2021, 13) claimed that the current entrepreneurship education literature has ‘lack of representation from the East, with literature from the West dominating due to the databases being primarily Western’. Non-Western higher education contexts should be addressed to offer new insights to current curricula and practices. Universities in Hong Kong ‘have begun to shift their missions and paradigms towards academic entrepreneurialism and entrepreneurial university’ (Mok 2005, 538). The turn to academic entrepreneurialism has influenced academic and curriculum design within Hong Kong higher education, and research in Hong Kong should contribute to understandings of entrepreneurship education in an Asian context.

The current study aims to assess engineering students’ perceptions on entrepreneurship education in a university in Hong Kong. This study will identify important competencies as learning outcomes and motivating and deterring factors for students to pursue entrepreneurship as a career, offering understandings of entrepreneurship education within an Asian context. A comparative study among first and final years will be conducted to examine similarities and differences in student perceptions according to their year of study. Implications from this study will contribute to curriculum design and teaching and learning practices for engineering entrepreneurship education.

Research methodology

This research paper aims to assess student perceptions on entrepreneurship education with the following research questions:

- RQ1. What are engineering students’ perceptions on pursuing entrepreneurship as a career option?
- RQ2. What are engineering students’ perceptions on entrepreneurship education?
- RQ3. What motivates and deters engineering students to take entrepreneurship as a career option?
- RQ4. What competencies are important for engineering students to become entrepreneurs?
- RQ5. What are the similarities and differences of first and final year engineering students’ perceptions on entrepreneurship education?
- RQ6. What are the implications for engineering entrepreneurship education?

Research design

Questionnaires are a common research instrument in entrepreneurship education (e.g. Ibrahim, Devesh, and Ubaidullah 2017; Abualbasal and Badran 2019), assessing learning outcomes and

student perspectives on programmes. This study adopted a quantitative research method design, collecting numerical data in the form of numbers and statistics which 'can lead to the assumption that the findings are valid' (McCusker and Gunaydin 2015, 539). A questionnaire was adapted for the current study from the 'Entrepreneurship education survey' from Mani (2015), which was a validated 7-question instrument developed to understand higher education non-business discipline students' perspective about entrepreneurship education. In Mani's study, the survey instrument targeting engineering students was tested for validity through detailed discussion with experts and faculty members. After piloting, the reliability of the questionnaire was measured by Cronbach's alpha coefficient, where a value greater than 0.7 is considered acceptable, and the instrument was found reliable with a Cronbach's alpha of 0.801. This instrument was considered reliable and valid for the current study.

As Mani (2015) targeted higher education engineering students in India, a different context from the current study situated in Hong Kong, piloting was first conducted with 32 students in a university in Hong Kong. Feedback was obtained from the pilot regarding the format and clarity of the instrument, and after detailed discussion with two experts in teaching and learning within the university, wordings and items in the instrument were refined accordingly. The final questionnaire consisted of a first section collecting students' demographic information, and a second section consisting of seven questions which assessed students' perspectives towards entrepreneurship education, entrepreneurship as a career, and competencies relevant to a successful entrepreneur.

Participants

This study was a comparative study among first and final years. Participants were recruited through purposeful sampling, targeting undergraduate students in their first or final year of their engineering degree at a public university in Hong Kong in the academic year 2021-2022. Questionnaires were distributed in selected classes of the Faculty of Engineering in the university. This study collected 154 completed questionnaires, including 91 first years and 63 final years.

Participants in their first year were aged between 17 and 21, with an average age of 18.45, and among the 91 participants, 23 were female and 68 were male. Participants in their final year were aged between 18 and 24, with an average age of 21.11. Among the final year sample group, 48 were male, 10 were female and five preferred not to disclose their gender. Considering the entire sample of 154 engineering students, this study consisted of 33 females, 116 males and five undisclosed. When the questionnaire was distributed, first year participants had all experienced an entrepreneurship education course in the Faculty of Engineering, whereas only 5 final years reported experience in entrepreneurship education at the university. However, the study aimed to investigate first and final year students' perceptions on entrepreneurship education without referring to any particular educational background. Informed written consent was obtained from all participants and ethical approval was obtained from the Human Research Ethics Committee (HREC) at the University of Hong Kong (HREC Reference No.: EA210144).

Data analysis

The data was analysed descriptively, 'using frequencies, percentages, averages, or other statistical analyses to determine relationships' (Nassaji 2015, 129). Percentages were rounded to the nearest unit. The analysis allowed for comparison between the two groups of participants to indicate similarities and differences in student perspectives. Only Questions 5 and six had an option of 'Other' for participants to reveal what deterred and motivated them to become an entrepreneur, but few chose this option.

Findings

Entrepreneurship as a future career

Students were given five options regarding their plans to start their own business in the future, as in [Table 1](#). Responses revealed that 63 first year participants out of 91 would like to start their own business after graduation. Among those who wished to start their own business, students wished to do this mainly 5 to 10 years after graduation, or 1 to 5 years after graduation; 31% of first year participants never planned to start their own business. For final year participants, 35 participants never planned to start their own business and none wished to start one immediately after graduation; 16 students indicated their wish to start their own business after 10 years.

From all the responses collected from 154 participants, almost 60% of participants planned to start a business, but most of the responses indicated preferences to start a business 1 to 10 years after graduation. A higher percentage of the final years never planned to start a business (55%), as compared to the first years (31%). Both sample groups were similar in that the majority of both groups indicated plans to start a business in the future, but while 8 first years planned to start their business immediately after graduation, none of the final years planned to do so.

Entrepreneurship education

Students were asked about their perceptions on entrepreneurship education, as shown in [Table 2](#). For the question 'To what extent do you agree that entrepreneurship should be taught in universities?', 67 first years agreed that entrepreneurship education should be taught in universities, with 36 strongly agreeing; 39 final year participants agreed that entrepreneurship should be taught in universities, with seven students strongly agreeing. Overall, 106 participants agreed that entrepreneurship should be taught in universities. 33 participants expressed neutrality and 15 disagreed. The first-year sample group agreed more strongly with the question compared to the final years.

When asked to what extent they agreed that entrepreneurship education is useful even if they never plan to start their own business ([Table 3](#)), 67 first year participants agreed. Responses from final year participants revealed that 38 students agreed that entrepreneurship education is useful even if they never plan to start their own business, with 11 disagreeing and one student strongly disagreeing.

Table 1. Do you plan to start your own business in the future?

Options	No. of first year responses	No. of final year responses	Total no. of responses
Never	28 (31%)	35 (55%)	63 (41%)
Immediately after graduation	8 (9%)	0 (0%)	8 (5%)
1 to 5 years after graduation	20 (22%)	6 (10%)	26 (17%)
5 to 10 years after graduation	32 (35%)	6 (10%)	38 (25%)
After 10 years	3 (3%)	16 (25%)	19 (12%)
Total	91 (100%)	63 (100%)	154 (100%)

Table 2. To what extent do you agree that entrepreneurship should be taught in universities?

Options	No. of first year responses	No. of final year responses	Total no. of responses
Strongly agree	36 (40%)	7 (11 %)	43 (28%)
Agree	31 (34 %)	32 (51%)	63 (41%)
Neutral	19 (21%)	14 (22%)	33 (21%)
Disagree	4 (4%)	9 (14%)	13 (9%)
Strongly disagree	1 (1%)	1 (2%)	2 (1 %)
Total	91 (100%)	63 (100%)	154 (100%)

Table 3. To what extent do you agree that entrepreneurship education is useful for students even if they never plan to start their own business?

Options	No. of first year responses	No. of final year responses	Total no. of responses
Strongly agree	30 (33%)	7 (11%)	37 (24%)
Agree	37 (41%)	31 (49%)	68 (44%)
Neutral	18 (20%)	14 (22%)	32 (21%)
Disagree	5 (5 %)	10 (16%)	15 (10%)
Strongly disagree	1 (1%)	1 (2%)	2 (1%)
Total	91 (100%)	63 (100%)	154 (100%)

Table 4. To what extent do you agree that entrepreneurs are born, and entrepreneurship can't be taught in classroom?

Options	No. of first year responses	No. of final year responses	Total no. of responses
Strongly agree	9 (10%)	3 (5%)	12 (8%)
Agree	16 (18%)	13 (21%)	29 (19%)
Neutral	24 (26%)	21 (33%)	45 (29%)
Disagree	31 (34%)	20 (32%)	51 (33%)
Strongly disagree	11 (12%)	6 (9%)	17 (11%)
Total	91 (100%)	63 (100%)	154 (100%)

105 participants out of 154 agreed that entrepreneurship education is useful for students even if they never plan to start their own business. Out of the total responses, approximately 11% disagreed. The main similarities between both sample groups were that over 60% of students from each agreed with the question. First year students showed a larger extent of agreement to the question, and final years showed a relatively higher percentage of disagreement.

Responses to whether entrepreneurs are born and entrepreneurship cannot be taught in the classroom (Table 4) revealed that 42 first year students disagreed. Among the final year participants, 26 disagreed, with six among these indicating strong disagreement. In total, students showed more disagreement towards these questions. There were 68 responses indicating disagreement, whereas 41 responses indicated agreement. Responses from both sample groups in this study were largely similar.

Motivating and deterring factors

Students were asked to choose one of 11 options to indicate what factors would stop them from taking entrepreneurship as a career option immediately after university, with the final option allowing for open answers. Results are shown in Table 5. None of the first-year students stated having started an entrepreneurship as a factor that deterred them. The most important factor stopping first year students from taking entrepreneurship as a career option immediately after university was too much risk (33%), followed by lack of experience (26%). Two first-year students identified other factors: 'Hard to compete with big company... like Weibo or Tencent or Alibaba will suppress the small company in any kind of form to make sure they are the only one of the market' and 'Nothing stops me'.

Responses from final year students showed none stating having started an entrepreneurship as a factor that deterred them. The most important factor stopping final year students was too much risk (33%), followed by lack of funds with 13 responses and other factors at 10 responses. Eight of the latter were because participants could not choose one factor from the list of options as the most important. Thus, three of the participants indicated too much risk, lack of experience combined with lack of funds and lack of knowledge were factors that deterred them from taking entrepreneurship as a career option immediately after university.

As for overall perspectives from participants, too much risk was the biggest factor stopping students from taking entrepreneurship as a career immediately after university, with 51 responses.

Table 5. What stops you to take entrepreneurship as your career option immediately after university?

Options	No. of first year responses	No. of final year responses	Total no. of responses
Too much risk	30 (33%)	21 (33%)	51 (33%)
Lack of experience	24 (26%)	7 (11%)	31 (20%)
Parents don't want	1 (1 %)	0 (0%)	1 (1%)
High-paying job offers	2 (2 %)	1 (2%)	3 (2%)
Lack of funds	14 (16%)	13 (21%)	27 (18%)
Lack of knowledge	4 (4%)	2 (3%)	6 (4%)
Family responsibilities	1 (1%)	1 (2%)	2 (1 %)
Other objectives in life	6 (7%)	2 (3 %)	8 (5 %)
Not interested	7 (8%)	6 (9 %)	13 (8%)
Already started one	0 (0%)	0 (0%)	0 (0%)
Other	2 (2%)	10 (16%)	12 (8%)
Total	91 (100%)	63 (100%)	154 (100%)

Table 6. What motivates you to become an entrepreneur?

Options	No. of first year responses	No. of final year responses	Total no. of responses
Chasing your dreams	24 (26%)	6 (9%)	30 (20%)
Being your own boss	13 (14%)	15 (24%)	28 (18%)
Independent decision making	11 (12%)	2 (3%)	13 (8 %)
High returns	17 (20%)	14 (22%)	31 (20%)
Your own confidence and knowledge	4 (4 %)	3 (5%)	7 (5%)
To do things differently	6 (7%)	11 (17%)	17 (11%)
Family support	4 (4%)	1 (2%)	5 (3%)
To do something for society	5 (5%)	3 (5%)	8 (5%)
Other	7 (8%)	8 (13%)	15 (10%)
Total	91 (100%)	63 (100%)	154 (100%)

The factor with second highest responses was lack of experience which had 31 responses, and third was lack of funds with 27 responses. The two sample groups had similar responses on factors that deterred them from taking entrepreneurship as a career option, although almost twice as many first year students (26%) indicated 'lack of experience' as a deterring factor compared to final year students (11%). Familial factors, including 'parents don't want' and 'family responsibilities' were rated lowest among factors that stopped students from taking entrepreneurship as a career.

Asked to choose one option among nine factors that motivated them to become an entrepreneur (Table 6), first year participants' responses showed the most important factor was chasing their own dreams, which accounted for 26% of the responses. The next factor was having high returns from starting an entrepreneurship with 17 responses. As for the seven responses to the option of 'other', four first-years did not want to become entrepreneurs, two did not provide any reasons, whereas one indicated that chasing their dreams and being their own boss was perceived as a single motivating factor towards being an entrepreneur.

For final years, responses indicated that the most motivating factor for students to become an entrepreneur was being their own boss, which had 15 responses. The second most motivating factor was high returns, with 14 responses. Out of the eight responses which indicated other factors, five combined options as one single factor; e.g. 'high returns and to do something for society'. Another response indicated 'Make more money' as the most important factor. The least important factor motivating final year students to become an entrepreneur was 'family support', which only had one response.

Out of the total responses, 'high returns' received 31 responses, indicating it was the most motivating factor for students to become an entrepreneur. The factor of 'family support' had the lowest number of responses at five responses. First-year students had a much stronger motivation from the factor 'chasing your dreams' (26%), which was almost three times the final year responses (9%). First-years also considered independent decision making as a more

Table 7. First year responses – Which of the following competencies are important to becoming a successful entrepreneur?

Competencies	Highly important/Important	Not important/Not required at all	Mean	S.D.
Creativity	80 (88%)	0 (0%)	4.24	0.66
Risk-taking capacity	85 (93%)	0 (0%)	4.51	0.62
Ability to prepare business plan	84 (92%)	0 (0%)	4.37	0.63
Sales technique	78 (86%)	2 (2%)	4.21	0.78
Knowledge of finance	69 (76%)	5 (5%)	4.05	0.87
Communication skills	88 (97%)	0 (0%)	4.63	0.55
Decision making skills	87 (96%)	0 (0%)	4.65	0.56
Negotiation skills	82 (90%)	1 (1%)	4.40	0.70

Table 8. Final year responses – Which of the following competencies are important to becoming a successful entrepreneur?

Competencies	Highly important/Important	Not important/Not required at all	Mean	S.D.
Creativity	55 (87%)	1 (2%)	4.25	0.72
Risk-taking capacity	59 (94%)	0 (0%)	4.46	0.62
Ability to prepare business plan	49 (78%)	2 (3 %)	4.03	0.78
Sales technique	41 (65%)	2 (3%)	3.84	0.81
Knowledge of finance	48 (76%)	3 (5%)	3.97	0.80
Communication skills	57 (90%)	0 (0%)	4.44	0.67
Decision making skills	60 (95%)	0 (0%)	4.60	0.58
Negotiation skills	56 (89%)	1 (2%)	4.29	0.71

important motivating factor (12%) which was significantly higher than final years (3%). On the other hand, final years showed being their own boss as a more important factor (24%) compared to first years (14%). Final years were also more motivated by the need to do things differently (17%) than first years (7%).

Competencies important to becoming an entrepreneur

Students were asked to indicate the importance of eight competencies to becoming a successful entrepreneur on a 5-point Likert scale ('highly important = 5' to 'not required at all = 1'). Results for first-year participants are shown in Table 7. Communication skills and decision making skills were the most important competencies, receiving 97% and 96% respectively. Knowledge of finance was perceived as the least important among the competencies at 76%.

Table 8 shows results for final year participants. Decision making skills and risk-taking capacity were the most important competencies, recording at 95% and 94% respectively. Sales technique at 65% was perceived as the least important among the competencies.

All participants' perspectives on important competencies to becoming a successful entrepreneur are shown in Table 9. Responses indicated that most participants saw the competencies listed as important, as the mean of all responses were above four and importance ratings of all competencies were above 75%. Decision making skills were perceived as the most important, with 147 responses indicating importance and none indicating they were not important or not required at all. The second most important competence was communication skills, which received 145 responses agreeing it was important and none indicating it was not important or not required. Knowledge of finance came last, with eight responses indicating this was not important or not required at all to become a successful entrepreneur. Responses from both sample groups were largely similar, though first years perceived all competencies with slightly higher rates of importance. The competencies of ability to prepare business plan and sales technique were perceived by a higher percentage of first years as important, with 92% and 86% respectively, compared to that of final years at 78% and 65%.

Table 9. All responses – Which of the following competencies are important to becoming a successful entrepreneur?

Competencies	Highly important/Important	Not important/Not required at all	Mean	S.D.
Creativity	135 (88%)	1 (1%)	4.25	0.67
Risk-taking capacity	144 (94%)	0 (0%)	4.49	0.62
Ability to prepare business plan	133 (86%)	2 (1%)	4.23	0.71
Sales technique	119 (77%)	4 (3%)	4.05	0.81
Knowledge of finance	117 (76%)	8 (5%)	4.02	0.84
Communication skills	145 (94%)	0 (0%)	4.55	0.61
Decision making skills	147 (95%)	0 (0%)	4.63	0.57
Negotiation skills	138 (90%)	2 (1%)	4.35	0.70

Discussion

This study assessed engineering students' perceptions on entrepreneurship education, identifying important competencies along with motivating and deterring factors for students to pursue entrepreneurship. Results indicated that while a majority of engineering students would like to start their own business after graduation, approximately 40% never planned to. Over half of the participants agreed that entrepreneurship should be taught in universities and that entrepreneurship education is useful for students even if they never plan to start their own business. Only around 25% of participants agreed that entrepreneurs were born and entrepreneurship cannot be taught.

Storen (2014) argued that entrepreneurship education is now beyond starting up a business, helping to explain the current trend of Western perspectives on entrepreneurship education. The findings in this study confirmed that entrepreneurship education is not only for starting up entrepreneurs, but also for those who do not plan to be entrepreneurs. The engineering students in this study believed that entrepreneurship education should be taught and would be useful for those who would not become entrepreneurs.

Students were mostly neutral or agreed that entrepreneurship can be taught in the classroom. This highlights how entrepreneurship education should be offered to students in the engineering discipline, that this is valuable and useful for students. Students understood the importance of entrepreneurship education, implying that it is needed for engineering students in the current context, an echo of the increasing importance attached to it in the existing literature. The implications are that teaching should not only focus on creating entrepreneurs, so learning experiences would also be beneficial for students who do not plan to become entrepreneurs. Whether engineering entrepreneurship education should be compulsory remains open for discussion, but the results from this study imply that engineering entrepreneurship education is feasible and beneficial for students.

The findings in this study indicated that engineering students wished to start their own business mainly 1 to 10 years after graduation. More final year students reported to have never planned to start their own business. A reason may be that the majority of final years sampled in this study had never experienced entrepreneurship education. Entrepreneurial intentions are widely cited as a learning outcome of entrepreneurship education (Matlay et al. 2015; Nabi et al. 2017). All of the first years had experience in entrepreneurship education, which they may have developed entrepreneurial intentions from, so that more first years perceived entrepreneurship as a career option. On the other hand, while entrepreneurial intentions are widely cited in the research literature, the majority of which is from the West, this study revealed a distinct difference, that – in the context of Hong Kong – entrepreneurial intentions were not a crucial component within entrepreneurship education. The reason for such beliefs and differences could be investigated in future studies.

First and final year engineering students perceived entrepreneurship as too risky, which was the main factor stopping them from pursuing entrepreneurship. First years were also concerned

about the lack of experience whereas final years were concerned about the lack of funds. Such findings, similar to those of Mani (2015), suggest that engineering entrepreneurship education could offer opportunities and experiences such as allowing students to engage with entrepreneurs (Von Graevenitz, Harhoff, and Weber 2010) or pitching activities (Macht and Ball 2016; Murray 2019), helping to prepare students for entrepreneurship as a career. While current practices in entrepreneurship education do not support students in gaining funding for starting their own businesses, this may be considered for future engineering entrepreneurship opportunities, especially targeting final year students. Different practices may be offered for different years of study, so to address varying needs of students at a particular stage within higher education.

Decision making skills, communication skills and risk taking capacity were found most important to engineering students. While approximately 40% of the total number of participants in this study stated that they did not plan to start a business, the ability to prepare a business plan, knowledge of finance and sales techniques were still perceived as important with ratings over 75%.

Wong and Chan (2021), while acknowledging a majority of literature analysed in their literature review was from the West, revealed how learning outcomes in entrepreneurship education lean towards competencies development, and that, over the past two decades, an abundance of competencies have been included as outcomes of entrepreneurship education. This study confirmed eight competencies as crucial to students becoming entrepreneurs, demonstrating a similarity to the outcomes of entrepreneurship education from the West.

Current entrepreneurship education assessments are evidencing students' competencies development with practices such as portfolios (Frolova, Alwaely, and Nikishina 2021) and questionnaires (Baggen et al. 2018). However, competencies assessment is of concern within higher education. Competencies assessment literacy is still developing (Chan and Luk 2022; Chan and Luo 2021), with ongoing questions on how to grade competencies (Chan and Yeung 2021) and how to ensure the competencies developed are aligning with what is required by the industry (Chan and Chen 2022) and the curriculum (Chan and Lee 2021). Practices regarding competencies in engineering entrepreneurship education require further development and evaluation, but nonetheless, competencies as outcomes should first of all align with student needs, as students are the focus of entrepreneurship education as entrepreneurial individuals. Aligning with expectations of the market and of educational institutions should also be considered. This would enable engineering entrepreneurship education to be efficient and effective for all stakeholders, as well as increasing recognition for education quality and providing accreditation or credentials to recognise efforts made.

Limitations

A limitation of this study was that data was collected from one public university in Hong Kong. However, it is arguable that as the findings were to a large extent consistent with those of Mani (2015) in India, this study reflects, to a certain extent, Asian engineering student perceptions on entrepreneurship education.

Another limitation was that while all first-year participants in this study experienced entrepreneurship education, most of the final years did not. Comparing first and final year perspectives in the same academic year showed consistency of engineering student perspectives, but a longitudinal study would confirm if perspectives change, particularly with students experienced in entrepreneurship education during their studies. Change in student perceptions towards entrepreneurship may also be examined through work-integrated learning or internship experiences.

Nevertheless, the findings in this study offer implications for curriculum design and educational practices, particularly on formally offering entrepreneurship education in engineering,

involving competencies development in educational practices and considering creating opportunities for students to address their motivation and deterrence.

Conclusion

This study assessed students' perspectives on entrepreneurship education for engineering. Findings largely corresponded to the existing entrepreneurship education research literature, though a main difference was that students in this study perceived entrepreneurship education as important for those who did not want to become entrepreneurs, in contrast to existing literature which suggests entrepreneurial intention as an important outcome (e.g. Bae et al. 2014; Maresch et al. 2016).

A number of implications may be identified. Firstly, perspectives of first and final year engineering students were mostly similar, but differences do exist. Higher education institutions should understand and address such differences. Secondly, findings revealed that students are interested in starting their own business and consider entrepreneurship education as important, that entrepreneurship can be taught and that such education would be useful for students even if they were not interested in becoming entrepreneurs. This implies that engineering entrepreneurship education should not only target students interested in becoming entrepreneurs, and universities should recognise that entrepreneurial intention as an outcome is valid, but not definite.

Thirdly, lack of experience and funds were the most deterring factors for students to become entrepreneurs, whereas having high returns and chasing dreams were the most motivating factors. Deterrences and motivations should be supported through curriculum design, to encourage students in learning experiences. Finally, this study confirmed a set of eight competencies as important, so universities may consider designing entrepreneurship education with this set of competencies as outcomes, and provide various forms of support or opportunities for students to develop these crucial competencies.

Further research in engineering entrepreneurship education is encouraged, particularly on competencies assessment, designing and evaluating practices relevant to gaining funds for students who wish to be entrepreneurs, and exploring perspectives from other stakeholders such as educators and professionals with a more in-depth qualitative analysis.

Disclosure statement

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