DEVELOPMENT OF ENTREPRENEURSHIP OPPORTUNITY IDENTIFICATION COURSE IN ENTREPRENEURSHIP EDUCATION PROGRAM FOR ENGINEERING STUDENTS AT JIAXING UNIVERSITY

BY

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Abstract

The research objective was to explore the influence of EOI course on the EOI ability of engineering students, and to develop and validate the EOI course on the EOI ability of engineering students at Jiaxing University. In Phase 1, a posttest quasi-experimental group and control group design were conducted. The experimental group took compulsory and elective EEP courses, while the control group only took the compulsory EEP courses. The researcher administered a questionnaire to both groups on the effect of EEP on EOI. In Phase 2, a pretest-posttest quasi-experimental design was used to conduct the developed course intervention experiment with the experimental group. A pretest-posttest questionnaire and a structured interview survey on EOI abilities were administered. The research results showed that the result in Phase 1 confirmed that EEP and EOI were positively correlated; however, the current EEP is not significant in improving the EOI ability of engineering students. The result in Phase 2 confirmed that the EOI training course developed with the combination of research results and theoretical basis could effectively improve the EOI ability of students. This research provided multiple avenues for future research, such as the survey methodology that could be used to develop the curriculum. It would be beneficial to conduct further empirical testing on how the developed curriculum influences students' EOI in more specific aspects for future research.

(Total 184 pages)

Keywords: Entrepreneurship Education Program (EEP), Entrepreneurial Opportunity Identification (EOI) course, EOI ability, Engineering Students

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ABBREVIATIONS

Abbreviations	Meaning
EEP	Entrepreneurship education program
EOI	Entrepreneurial opportunity identification
CC	Compulsory courses in entrepreneurship education program
CE	Compulsory and elective courses in entrepreneurship education program

CHAPTER 1

INTRODUCTION

Chapter 1 introduces the background of the research and explains its importance. It shows the research objectives, problems, and hypotheses, as well as discusses the status of Entrepreneurship Education Programs (EEP), Entrepreneurship Opportunity Identification (EOI), and engineering in Chinese universities. It emphasizes critical issues in the research, establishes a theoretical foundation, and proposes the hypothesis that an EOI course can enhance the EOI abilities of Chinese engineering students. In addition, chapter 1 also briefly explains the terms of research.

1.1 Background and Significance of the Problem

1.1.1 Background of the Study

In the past few decades, entrepreneurship has become essential for economic and social development (Klofsten et al., 2019). Entrepreneurship is a special kind of planned and purposeful behavior that improves economic efficiency by creating new employment opportunities, fostering innovation, and promoting economic growth (Milana & Ashta, 2020). With China becoming one of the most entrepreneurial countries in the world (Shan, Jia, Zheng, & Xu, 2018), the requirements of enterprise employers for undergraduates have been upgraded from professional ability to necessary entrepreneurial knowledge and skills to cope with the rapidly changing and uncertain economic environment of the 21st century (Boyles, 2012). The European Commission (2020) has stated that there is a need to foster entrepreneurship and provide businesses with the skills needed to adapt to the new work environment. Students need to develop their entrepreneurial skills, which can open up more possibilities for their social survival. EEP can stimulate entrepreneurship and is a crucial way to improve entrepreneurial attitudes, abilities, and intentions.

The reasons for the low entrepreneurial ability of Chinese engineering students (Cheng, Wang, & Lee, 2018) are as follows. Firstly, EEP in China is immature. Although more than 90% of Chinese universities have entrepreneurship education programs (EEP), it is still in its infancy compared to the 80-year history of EEP in the United States, which is only 20 years old. Secondly, EEP is not sound, and its teaching objectives need to be clarified; it lacks faculty (Hua, 2017), has limited interdisciplinary coverage, and lacks theoretical and practical training in entrepreneurial skills. These lead to a lack of applied entrepreneurial knowledge and experience dealing with markets for engineering students with technical backgrounds. Engineering students need help to learn and utilize their entrepreneurial skills fully.

Engineering majors have technical thresholds and are qualified to carry out entrepreneurial and innovative activities in technologies such as patented products, core technologies, and technical services. They have great entrepreneurial potential and markets. However, Chinese engineering education emphasizes technology and needs more comprehensive ability cultivation. The EEP needs to be fully integrated with professional guidance. Disciplines and professions have lost strong support from EEP. Low conditions for technological entrepreneurship education lead to a need for more awareness and practice of entrepreneurial opportunities in technological innovation among engineering students. Engineering students need the ability and conditions to find suitable entrepreneurial opportunities in their majors, and they consequently need more motivation and action to carry out entrepreneurial practice. EOI is crucial to EEP (Karimi, Biemans, Lans, Aazami, & Mulder, 2016), especially for engineering students with technical backgrounds, as it is the starting and critical point for improving a good combination of professional competencies and entrepreneurial activities.

The basic assumption of the EEP is that it enhances individual skills and creativity for successful entrepreneurship (Fayolle, Doucet, Gillet, Bourland, & Lejeune, 2013), helps students understand what entrepreneurship is, and learn how to apply theories and concepts in practice. Students are likelier to develop interest and confidence in entrepreneurship through planned education. There still needs to be

more research in China; it is essential to study whether and how EEP can improve EOI ability.

The world's EEP curriculum system of American universities has matured (Yu, 2018), which has four kinds of courses: Entrepreneurial Awareness, Entrepreneurial Knowledge, Entrepreneurial Ability and Quality, Entrepreneurial Practice and Operation. EEP compulsory courses are usually arranged in the lower grades, while EEP elective courses are generally in the higher grades (Bergmann, Geissler, Hundt, & Grave, 2018). In addition, universities develop students' practical skills and improve their entrepreneurial practice by holding competitions and setting up business incubators.

Chinese universities still need to develop a complete and mature EEP. However, they only have basic EEP course module, specialized course module, and practical course module (Yao, 2019). The introductory module aims to stimulate students' entrepreneurial awareness, broaden their knowledge structure, and improve their entrepreneurial quality. Generally, these are compulsory courses, including Internet + Undergraduates' Innovation and Entrepreneurship, Fundamentals of Entrepreneurship, Undergraduates' Entrepreneurship, and Career Guidance. The specialized course module includes business management, new venture financing, and other course types, generally for business college-related majors.

Practice courses are conducted through entrepreneurship competitions, field trips, and entrepreneurial experiences to enhance students' innovative and practical skills (Huang, 2015).

Although most Chinese universities have launched EEP courses, they are primarily offered in business, management, or entrepreneurship colleges, with few entrepreneurial practice courses (Yu, 2018). The EEP courses demonstrate simplification, fragmentation, and a lack of systematization. More importantly, only a few universities offer EEP courses and majors, which makes it difficult for students to

integrate them into their professional studies effectively. There are gaps in the universities' understanding of EEP.

In this research, the entrepreneurship rate was 2.5% for Liberal Arts (mainly business colleges), 1.8% for science majors, and 0.9% for engineering majors at Jiaxing University. Among these three disciplines, engineering majors have the lowest entrepreneurial rate. The researcher obtained some information about EEP by interviewing five engineering students. These students are usually interested in entrepreneurship but are still bystanders rather than practitioners. They have three problems: the first is that there is still no clear entrepreneurial opportunity after taking the EEP courses, which has become a gap in starting a business; Secondly, they do not know how to combine entrepreneurship with their majors in order to leverage their value; Third, although students took the EEP courses and did not have enough practical training, and they did not have confidence enough to practice entrepreneurship. Even if they have entrepreneurial opportunities, they must learn how to operate the business. EOI's ability in the training process of EEP at Jiaxing University shows its lack of EOI ability, ability to combine entrepreneurial opportunities with majors, and ability to implement entrepreneurial opportunities. Universities must improve students' EOI ability to increase their entrepreneurial success, which can be improved through training courses (Jena, 2020).

Jiaxing University has developed EEP courses for undergraduate students based on the "Basic Requirements for Teaching Entrepreneurship Education in General Undergraduate Schools (for Trial Implementation)" by the Chinese Ministry of Education (2012). The EEP curriculum has two systems: compulsory courses and elective courses. The pedagogical goal of EEP compulsory courses is to popularize students' knowledge of entrepreneurship and cultivate essential entrepreneurial qualities without teaching more about subdivision and depth of education. The pedagogical goal of EEP elective courses is the in-depth development of students' comprehensive entrepreneurial skills. However, EEP elective courses are scarce, students have limited options, and the prevalence of elective courses that can be taught in depth is meager. In addition, there are no teaching and practice courses to develop

specific entrepreneurial skills or courses to improve entrepreneurial skills for their majors.

Jiaxing University offers eight Environmental Engineering Program (EEP) courses, including three mandatory and five optional EEP courses. Compulsory EEP courses are "Internet + Undergraduates' Innovation and Entrepreneurship," "Fundamentals of Entrepreneurship," and "Undergraduates' Entrepreneurship and Career Guidance"; Elective EEP courses are "Cultivation Experimental Course," "Elite Cultivation Course," "Personalized Training Project," "Cultivation Lecture" and "SYB (start your business) Training." Table 1.1 shows the details.

Table 1.1 Compulsory and elective courses in EEP at Jiaxing University

Course type	Course name	Number of courses	Course attribute		Teaching stage	Enrollment scale
1.EEP compulsory courses	1.1 Internet + Undergraduates' Innovation and Entrepreneurship	16	8 class hours	Online theory	The first semester of Freshman	About 4,000
			8 class hours	Offline experiment		
	1.2 Fundamentals of Entrepreneurship	16	8 class hours	Online Theory	The second semester of Freshman	About 4,000
			8 class hours	Offline Experiment		

Table 1.1 Compulsory and elective courses in EEP at Jiaxing University (Cont.)

	1.3 Undergraduates' Entrepreneurship and Career Guidance	16	16 class hours	Online Theory	The second semester of Freshman	About 4,000
2.EEP Elective courses	2.1Experimental Cultivation Course	60	9 days	Offline Theory and Practice	The second semester of Freshman and Sophomore	About 80
			51 days	Online theory and guidance		
	2.2Elite Cultivation Course	1 semester		Practice class	The first semester of Senior	4 to 14
	2.3 Personalized Training Project	2 years		tutorial system	Third to fourth academic year	Less than 10
	2.4 Cultivation Lecture	4-7 times / year	3 hours / time	Online or offline lectures	academic year	About 150 people / time
	2.5 SYB training	8 days		Offline training	First semester of Senior	About 800 people / year

Source : Data Classification by the Researcher

Among the eight courses, only the "Fundamentals of Entrepreneurship" course has a section on EOI, and three class hours are dedicated to teaching EOI. Table 1.2 displays the contents of the system, with three questions included in this section.

Table 1.2 Contents of EOI in fundamentals of entrepreneurship courses

Entrepreneurial opportunities and risks		
General teaching objective: To enable students to understand entrepreneurial opportunities and their identification elements, types of entrepreneurial risks, how to prevent them, the process of developing business models from entrepreneurial opportunities, and mastering business model design strategies and skills.		
Chapter name	Teaching objectives	Course content
Entrepreneurial Opportunity Identification	Students will understand the concept, sources, and types of entrepreneurial opportunities, the links and differences between creativity and opportunities, EOI's general steps and influences, and the behavioral patterns that help identify entrepreneurial opportunities. Students will learn about entrepreneurial opportunities with business potential that suit them.	·Ideas and opportunities ·Entrepreneurship and business opportunities ·Characteristics and types of entrepreneurial opportunities ·Sources of entrepreneurial opportunities ·Key factors that influence the identification of opportunities ·General process of EOI ·Behavioral skills for EOI ·Basic characteristics of valuable entrepreneurial opportunities ·Matching individuals with

Table 1.2 Contents of EOI in fundamentals of entrepreneurship courses (Cont.)

	They will also understand the evaluation of social opportunities and master the evaluation methods of entrepreneurial opportunities.	entrepreneurial opportunities ·Particularity of evaluating entrepreneurial opportunities ·Skills and strategies for evaluating entrepreneurial opportunities
Entrepreneurial risk identification	Make students realize there are risks in entrepreneurship, but there are also ways to avoid and prevent them. To enhance students' rational understanding of opportunity risks and improve their risk prevention ability.	·Composition and classification of opportunity risks ·Possible approaches of systemic risk prevention ·Possible ways to prevent unsystematic risks ·Estimation of the risk-taking ability of entrepreneurs ·Venture income prediction based on risk estimation
Business model development	To enable students to understand the essence of business models, the relationship between strategy and business model, master business model design and development ideas, and clarify the key influencing factors of business model development.	·Definition and essence of a business model ·Relationship between business model and business strategy ·Decomposition of the business model's cause-and-effect chain ·Ideas and methods for designing business models ·Logic and methodology for business model innovation

Source: Ministry of education of China, 2012

1) Short teaching time: The course "Fundamentals of Entrepreneurship" has 32 class hours, and the EOI content is 3 class hours, including 1.5 hours of online video courses. The content of EOI is taught for a short period, is simple, and belongs to the teaching of general theoretical knowledge.

2) Not designed for engineering majors: This course is a general compulsory course that needs to teach students how to use EOI skills to start a business from their majors.

3) Lack of practice: The course does not have a practical component to aid students in solidifying their EOI knowledge and abilities.

1.1.2 Significance of the Problem

China's EEP focuses on cultivating undergraduate students' employability and entrepreneurship, but it also needs to emphasize the development of talent entrepreneurship, innovation ability, and creativity. EEP still needs improvement and should focus on developing students' entrepreneurial and innovative skills (Wang, Mundorf, & Salzarulo-McGuigan, 2022).

Entrepreneurial opportunity is a critical element of entrepreneurship (Milanesi, 2018). Previous studies have shown that EOI is critical in determining whether undergraduate students can succeed in entrepreneurship (Kim, ElTarabishy, & Bae, 2018). It is also the standard to test the quality of EEP for undergraduate students. EOI has antecedents that include developing personal skills, professional skills, and entrepreneurial knowledge. These will form a set of methods and technologies for each EOI. Individuals trained in specific entrepreneurial skills may have a higher EOI ability than those who have not studied (Laguna-Sánchez, de la Fuente-Cabrero, & Calero, 2020).

The context of EEP in China illustrates the apparent importance of EEP in developing the EOI ability of engineering students. EEP can increase social value

creation through the EOI ability of undergraduate students (Kim, ElTarabishy, & Bae, 2018). However, the empirical research on whether EEP improves the EOI ability is insufficient, and more research is needed to test it (Iwu et al., 2021).

The development of EEP should be based on the requirements of the national or even local economy as well as the current context. China's EEP still faces many issues and obstacles. Developing specific EEP courses in the "professional background" should be prioritized (Mei & Symaco, 2022). Therefore, it is necessary to develop a training course to improve the EOI abilities of undergraduate students (Ho & Man, 2021).

Another problem in China is that there needs to be more research on EOI for engineering students, especially regarding the impact of EEP (Mason, Carter, & Tagg, 2011). Most existing studies have focused on EEP engineering students, including research on the status of EEP, training modes, and the quality of student entrepreneurship. Regarding EOI, most research applies to undergraduate students regardless of their academic backgrounds, including the impact of entrepreneurial education on EOI, factors affecting EOI, and the impact of EOI on entrepreneurial intention. Worldwide, research in this field has been conducted in the same manner as in China. There are many studies on EEP for engineering students and EOI for undergraduate students, but few combined studies on EEP and EOI for engineering students. With the development of China's engineering economy, it is necessary to research how EEP can improve the EOI of engineering students (Turner & Gianiodis, 2018).

1.2 Research Objectives

1.2.1 To explore the influence of EEP courses on the EOI ability of engineering students at Jiaxing University.

1.2.2 To experiment the EOI course on the EOI ability of engineering students in EEP at Jiaxing University.

1.2.3 To validate the EOI course on the EOI ability of engineering students in EEP at Jiaxing University.

The independent variable of the first research objective is EEP courses and the dependent variable is EOI ability. The independent variable of the second and third research objectives is EOI course, and the dependent variable is EOI ability.

1.3 Research Questions

1.3.1 What factors of EEP courses significantly impact the EOI ability of engineering students?

1.3.2 Can EOI course effectively improve the EOI ability of engineering students?
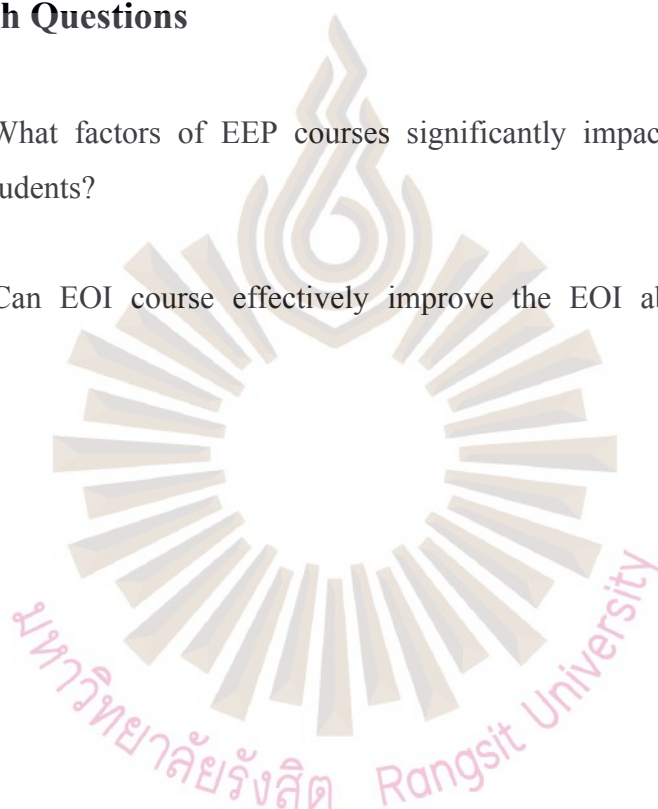
1.4 Research Framework
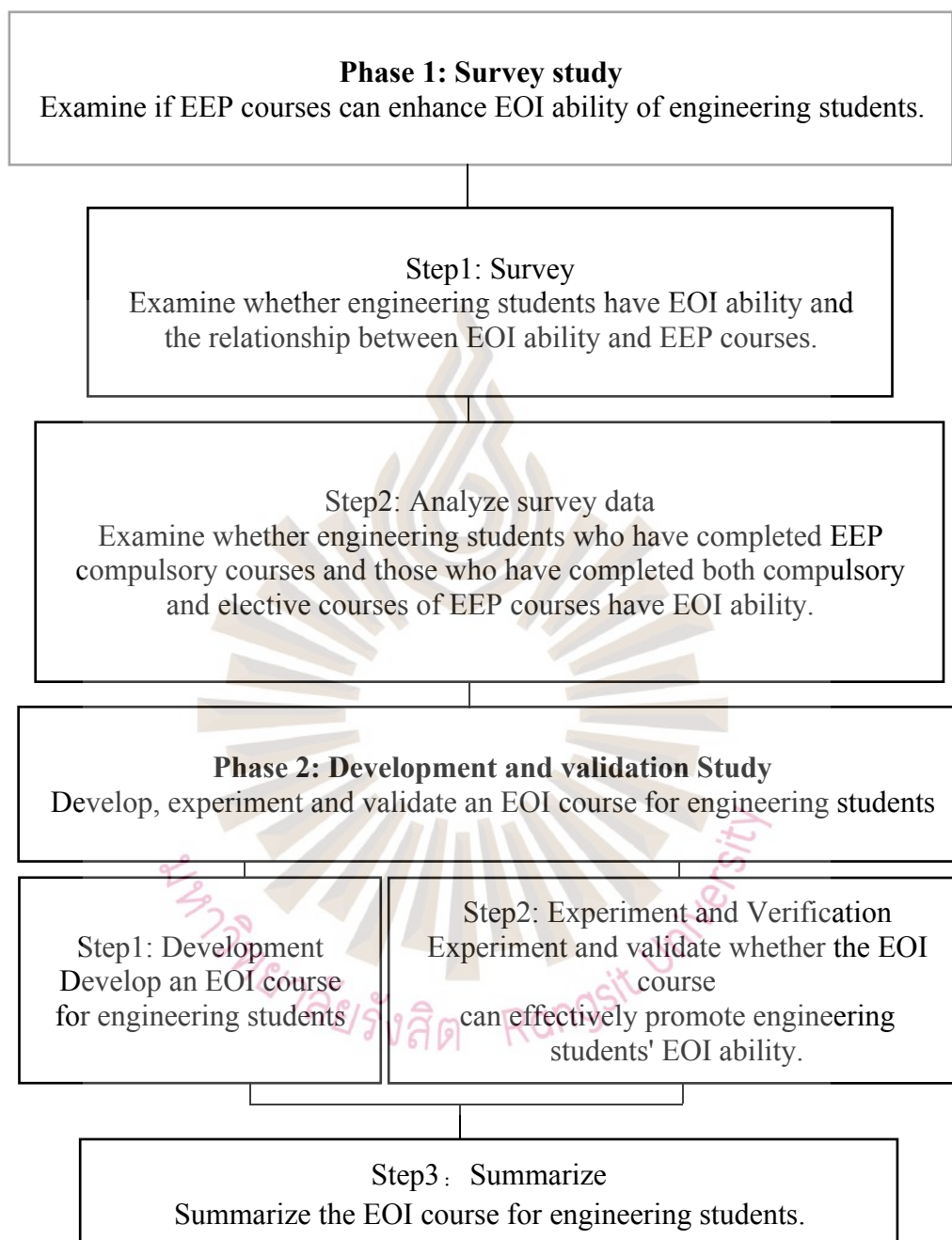
Figure 1.1 Conceptual Framework

This research aims to investigate whether EEP courses at Jiaxing University can improve the EOI ability of engineering students, develop and validate the EOI course for engineering students. Figures 1.1 show the conceptual framework.

1.4.1 Research Hypotheses

There are two hypotheses in this research:

1) The engineering students who had completed the EEP compulsory courses and those who had completed both EEP compulsory and elective courses have low EOI ability.

2) The EOI course can effectively improve the EOI ability of engineering students.

1.4.2 Scope of The Study

1.4.2.1 Location of the Study

This research is conducted at Jiaxing University, a comprehensive university in Zhejiang Province, on the eastern coast of China. The geographical significance of the study sites is as follows:

(1) Good entrepreneurial environment: Since the beginning of the 21st century, entrepreneurial activity in the Yangtze River Delta has become increasingly intense (Zhang, Chen, & Liu, 2022). Zhejiang Province is the center of this economic region and has been the first experimental area for advanced systems in China. China's Ministry of Education had statistically concluded that The Entrepreneurial Success Rate of undergraduates in Zhejiang Province is higher than the average of other regions of China.

(2) Jiaxing University is a regular comprehensive university with a representative sample of personnel and disciplinary backgrounds. The nature of a comprehensive university determines the equality of disciplinary education without being influenced by any biases in specific fields.

1.4.2.2 Research Population

This research was conducted across four engineering majors of (1) Civil Engineering, (2) Engineering Management, (3) Building Environment, and (4) Energy Application Engineering and Architecture in the College of Architecture Engineering. The total student population is 457, with the majority between 1998 and 2001. They completed their sophomore or junior year in June 2023.

This research selected all of the 82 students who had both studied EEP compulsory and elective courses as the experiment group and randomly selected 138 students who had only studied EEP compulsory courses as the control group in Phase 1. A sample of 26 was recruited to participate in Phase 2.

The researcher chose engineering students who had completed their sophomore and junior years of study based on the following criteria:

(1) They had taken the required EEP courses, and some of them had also studied EEP elective courses, which provided a learning basis for improving EOI ability.

(2) They have also studied two or three years of professional courses, master and apply professional skills.

(3) The population can be used as a good source of samples for research objectives.

1.4.2.3 Duration of the Study

The duration was one semester during the 2022 academic year. This research data collection lasted two months, and Phase 1 was conducted in the second semester of the 2022 academic year. It lasted about two weeks. Phase 2 was completed afterwards. The researcher participated in the teaching experiment as a teacher and an observer. Phase 1 has completed the data collection of questionnaire, while Phase 2 has completed the data collection of both a questionnaire and an interview.

1.5 Definition of Terms

1.5.1 Entrepreneurship Education Program

The Entrepreneurship Education Program (EEP) implemented at Jiaxing University is based on entrepreneurship education, which aims to cultivate engineering students' entrepreneurial spirit, entrepreneurial skills, and entrepreneurial ability to adapt to the requirements of the new work environment and bring more possibilities for students' social survival. The EEP of Jiaxing University is divided into two categories: EEP compulsory courses and EEP elective courses. The teaching objective of compulsory courses is to popularize entrepreneurship knowledge and cultivate the essential entrepreneurial quality of students. The teaching objective of EEP elective courses is to develop students' comprehensive entrepreneurial skills in depth.

1.5.2 Entrepreneurial Opportunity Identification Ability

In this research, entrepreneurial opportunity identification (EOI) is the process of identifying new and potentially successful ideas, a core for engineering students in the early stages of entrepreneurship. In this process, undergraduate students can understand and judge the market demand correctly, continuously process the relevant resources acquired in entrepreneurial learning, and shape their innovative abilities and personalities.

EOI ability of this research is based on the definition of EOI. It refers to the ability of engineering students to identify new and potentially successful ideas, to correctly understand and judge market needs, to process the relevant resources acquired in entrepreneurial learning continuously, and to shape their creative abilities and personality.

1.5.3 EOI Course

In this research, the main teaching objective of the EOI course is to enhance the EOI ability of engineering students. The researcher uses ADDIE model to guide systematic course development, from analysis, design, development, and implementation to evaluations, and uses Bloom's taxonomy of educational objectives for systematic instruction and instructional assessment. The teaching contents include engineering EOI, engineering EOI case analysis, and engineering EOI practice. The teaching forms include theoretical teaching, case analysis, and practical experience. The teaching assessment was achieved by comparing quantitative data on the pretest and post-test EOI ability of the group 3, as well as conducting one interview.

1.5.4 Engineering Students at Jiaxing University

In this research, engineering students refers to the research population which were from Jiaxing University in Eastern China. They were sophomores and juniors from four majors at the College of Architectural and Engineering. All students at this stage had completed the EEP compulsory courses, some of them had completed both compulsory and elective courses, which are good sources of samples.

CHAPTER 2

LITERTURE REVIEW

Chapter 2 discusses the key theoretical elements of EOI formation guided by social cognitive theory, including environmental factors of EOI (EOI course), individual factors (students learning), and behavioral outcomes (EOI). The developmental theory of the EOI course is introduced. The EOI course is developed based on the theory and EEP status, and the course's evaluation system is discussed.

2.1 Social Cognitive Theory

Social cognitive theory is one of the fundamental theories in psychology (Beauchamp, Crawford, & Jackson, 2019) that explains the social learning process and focuses on cognitive factors such as human beliefs, memories, expectations, motivations, and self-reinforcement. Unlike the two-sided behavioral theory, which has external factors, this theory treats a person's behavior as a tripartite "environmental input, personal factor, and behavioral outcome." Environmental inputs, personal characteristics, and behavioral outcomes explain human behavior and functioning. Specifically, individual cognition influences the choice and intensity of behavior and an individual's cognitive behavior changes in response to environmental inputs. Personal motivation is positive and includes positive choices and adjustments. Actors include tripartite reciprocity, cognition, individual factors, behaviors, and environmental events. The process refers to the construction process.

Bandura put forward a viewpoint of human functioning in social cognitive theory and believed that the processes of cognition, substitution, self-regulation, and self-reflection played a central role in human adaptation to change (Efklides & Misailidi, 2019). The traditional behaviorist theory holds that human behavior is a causal relationship formed by the interaction between an individual's personality and

environment (Sussman & Gifford, 2019). However, human personalities and behaviors are dynamic and not static. The view of stability limits the understanding of the interaction between developing individuals and changing environments (Siew, Wulff, Beckage, & Kenett, 2019). People mainly affect specific situations, cognitive styles, and subsequent behaviors through their personal and external environmental behaviors. At the same time, it is essential to identify methods that can change individual behavior. This study attempts to create an environment in which individuals can be exposed to specific knowledge, technology, and resources through the intervention of practical courses and improve the EOI ability by adjusting students' cognition, behavior, and environment to start entrepreneurial activities. Figure 2.1 shows them.
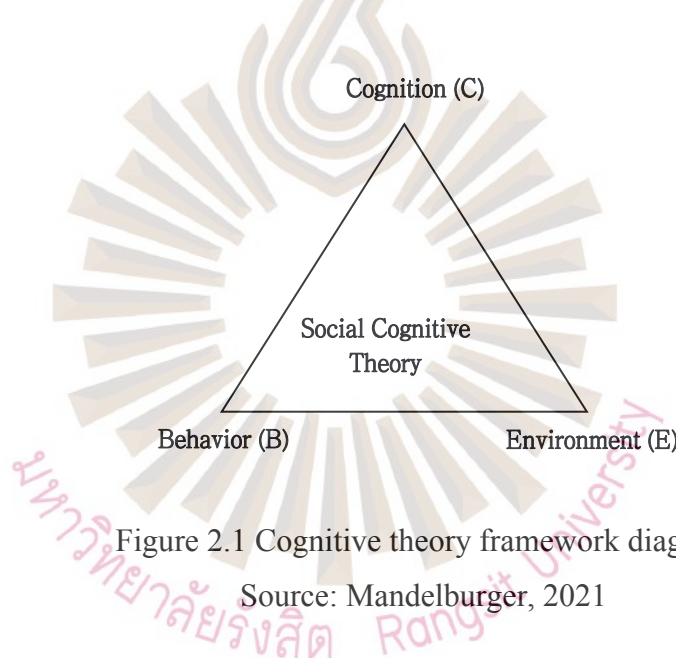
Figure 2.1 Cognitive theory framework diagram

Source: Mandelburger, 2021

For entrepreneurial learners, purposeful learning intervention can enable individuals to generate awareness of specific knowledge, skills, and resources, thus changing individuals and generating entrepreneurial ideas, behaviors, and even new enterprises (Goje, 2017). For the learning process, the social cognitive theory holds that the learning effect and significance are actively constructed by students' will and are composed of the student's interest points, what they focus on learning, and what they finally get. According to the theory of social cognition, this study argues that the individual is the dominant factor in education, particularly for adult learners who possess judgment and autonomy. The social cognitive theory also claims that individual learning motivation in the learning process is self-driven, and learners

possess complex self-regulation. The social cognitive theory explains that when students learn the same course, different expectations lead to varying influences among individuals and different preferences for different knowledge points. For the intervention course in this research, students can consciously or unconsciously choose the parts they are interested in for active learning to improve their knowledge and mastery of skills in that part, depending on their needs and interests in certain aspects of knowledge. Table 2.1 shows them.

Table 2.1 The occurrence process of individual "social cognition" in the learning process

	Occurrence process			
	Step1: Individuals are aware of the learning and development requirements (Active consciousness based on curriculum stimulation)	Step2: Students are aware of differences (Complete initiative)		Step3: Generate motivation and expect a reduction of the gap	Step4: Based on individual expectations, set and actively manage the performance standards for those expectations.
course		disparity	Known standards		
			Expected standard		
external environment	Consciousness stage			Motivational stage interaction Behavioral phase	

Source : Data Classification by the Researcher

In addition, the Social Cognitive Theory can alter an individual's cognition through personal research. EEP courses allow individuals to explain specific knowledge, skills, and resources, as well as improve or change individuals through motivation (Schunk & DiBenedetto, 2020).

2.1.1 Environmental Factors

There are three primary directions for research on entrepreneurial opportunities: the development process of entrepreneurial opportunities, the influencing factors of entrepreneurial opportunities, and the relationship between entrepreneurial opportunities and the environment and entrepreneurial outcomes. This study takes the development process of entrepreneurial opportunities as the research basis and the influencing factors as the basis of research variables to study the correlation and influence differences between entrepreneurial courses and EOI. The environmental factors of university students may come from the institutional, educational, and unique environment, which provides the development conditions and foundation for entrepreneurial activities. EEP may affect an individual's view of themselves and the environment. At the same time, an individual's cognition may also affect their view of the environment or behavior. Therefore, EEP is necessary to pay attention to the complex interrelationship between individual cognition, behavior, and environment (Wei, Liu, & Sha, 2019). The research shows that the formation of EOI is related to individual environmental factors (policy environment, educational environment), individual factors, and behavioral outcomes (EOI).

Policy Environment

The institutional environment is a factor in external macro-governance. It is the political, social, and legal basic rules a country uses to establish the basis of production, exchange, and distribution. It is a public and private structure established by a government to develop knowledge and skills that bring substantial economic and social advantages to individuals (Bergmann, Hundt, & Sternberg, 2016). Political policies are implemented from top to bottom, from the state to individuals. Their impact may not be felt in the short term, and it will take several years or decades to affect individuals (Malebana, Swanepoel, 2015; Yousafzai, Saeed, & Muffatto, 2015). The change in individual entrepreneurial mentality may be determined by a solid social framework composed of supervision, regulation, and cultural cognition. The general office of the State Council, the Ministry of Education, the People's Bank of China, and other state departments have provided policy support for undergraduate

students' Entrepreneurship in terms of venture funds, venture loans, infrastructure support, and technical support. These institutions may take some time to support undergraduate students' entrepreneurs. However, they provide essential support and a growth environment for entrepreneurship education to cultivate engineering students' entrepreneurs and provide favorable long-term conditions for students' entrepreneurial activities. This study belongs to the micro-level of EEP research, and it will take several years or even decades to consider the direct impact of the institutional environment on entrepreneurs. Therefore, the effect of the institutional environment is no longer considered in the study.

Educational Environment

The EEP environment can be regarded as external environmental factors at the micro-level. EEP can provide theoretical teaching and practical support for undergraduate students. Through cognitive development, EEP provides individuals with opportunities to impart entrepreneurial knowledge and entrepreneurial skills training, improve their entrepreneurial ability and cognitive level (Ratten, Costa, & Bogers, 2019), cultivate their innovation awareness, entrepreneurial spirit, and entrepreneurial practice ability, and help students realize their values. The research on the classification of EEP is of great significance in evaluating EEP's effect and the improvement of the curriculum (Sirelkhatim & Gangi, 2015). According to different teaching methods and contents, EEP has two categories: theory-oriented EEP and practice-oriented EEP (Singh & Gibbs, 2013). Theory-oriented EEP focuses on acquiring theoretical knowledge and helps students understand the prospects and results of entrepreneurship. Practice-oriented EEP aims to influence, improve, and develop students' entrepreneurial action through practice. It pays attention to students' understanding of entrepreneurial theory, mastery of entrepreneurial skills, and cultivation of comprehensive ability in practice.

Participation in EEP may play an essential role in influencing the EOI of individuals (Cohen, Hsu, & Shinnar, 2021; Karimi et al., 2016). Entrepreneurial opportunity is the visible, objective construction of knowledge by entrepreneurs. Some researchers suggest that participating in the EEP can improve students' EOI abilities.

Baručić and Umihanić (2016) believed that the students who passed the EEP courses had a higher cognitive ability and EOI than those who did not (Gedeon, 2017). They support EEP to improve students' entrepreneurial cognition and entrepreneurial skills. Gielnik et al. (2015) also found that EEP improves students' ability to act on entrepreneurial goals and entrepreneurship. These studies show that EEP can improve students' overall entrepreneurial ability by guiding their choice of career roles in employment. Hassan, Saleem, Anwar, and Hussain (2020) found that some factors of EEP improve students' EOI, entrepreneurial opportunity cognition, and intention.

The EEP of Jiaxing university in this study includes EEP compulsory courses and elective courses, mainly carried out through theoretical teaching, practical activities, and lectures. According to the research literature, it can be concluded that EOI can be taught through entrepreneurial education. However, there is still little research on the effects of specific courses on EEP. At present, the role of compulsory and elective courses on EEP and their impact on EOI are still uncertain. Therefore, considering the low entrepreneurship rate of students from Jiaxing University, after preliminary interviews, the engineering students at the university have relatively low EOI ability after studying EEP compulsory courses and elective courses. In other words, EEP still cannot meet the learning needs of students' EOI abilities, and this is verified.

H1: The engineering students who had completed the EEP compulsory courses and those who had completed both EEP compulsory and elective courses have low EOI ability.

Individual Environment

The purpose of EEP is not to increase the number of start-ups or entrepreneurs but to improve the lifelong skills required by graduates to engage in business activities or find jobs in the future. Therefore, EEP aims to provide entrepreneurial knowledge, investigate entrepreneurial skills, and teach students how to start a business (Gibb, 2002). However, as entrepreneurial learning involves personal background, there are differences between teachers and students (Chen & Tseng, 2021), and the differences

among students are more complex. The differences in age, education, family background, and personality traits (Israr & Saleem, 2018) constitute complex differences. In this study, this aspect was considered in the scale selection. The data on gender, age, and background of EEP were investigated to improve the accuracy of the survey results.

2.1.2 Personal Factor

There are two main viewpoints in previous studies. One is that entrepreneurial opportunities exist objectively, which is an exogenous phenomenon of entrepreneurs and originates from the external environment, such as new technology and social change (Asante & Affum-Osei, 2019; Hu, 2018); The other believes opportunities are subjective perceptions, which originate from entrepreneurs' cognition. Through qualitative research, Renko, Shrader, and Simon (2012) show that the aim and perception aspects of opportunities have the same importance. The research process of opportunity identification may have subjective and objective attributes. After the analysis and research on the external environment in the previous section, considering that entrepreneurship is a complex process and the subjective perception of entrepreneurs is also dynamic, the impact on another period cannot be judged by the characteristics of one period, and the entrepreneurial behavior of entrepreneurs should be cross-sectionally studied by stages and changes.

2.1.3 Behavioral Outcome

Through learning entrepreneurial knowledge, the cognition and vigilance of personal perception, as well as cognitive processing, individuals make judgments and decisions on the development of self-behavior, make behavioral intentions to strengthen the identification of entrepreneurial opportunities, and generate actions. A feasible teaching framework for EOI can be established to improve students' identification of entrepreneurial opportunities. Therefore, the following assumptions are made in this study:

H2: The EOI course can effectively improve the EOI ability of engineering students.

2.1.3.1 Entrepreneurial Opportunity Identification

In EEP research, people have gradually changed from focusing on a research point to a research process, making entrepreneurship an internally connected organism. Therefore, the research focus has steadily expanded from entrepreneurial intention to the subdivision fields of EOI and entrepreneurial cognition and then to the research status of multi-directional development.

2.1.3.2 Entrepreneurial Opportunity Identification Concept

EOI refers to the process by which entrepreneurs identify opportunities (Clark & Ramachandran, 2019). The entrepreneurial process always begins with potential business opportunities. Entrepreneurial opportunities are explored and developed into new products, services, or processes (Baggen et al., 2015). It is one of the critical elements and research cores in the entrepreneurial process (Karimi et al., 2016). It plays a crucial role and is the primary problem to be solved in entrepreneurial activities.

Identifying opportunities for new enterprises is one of the most critical abilities for successful entrepreneurs. For entrepreneurs and potential entrepreneurs to successfully create and operate new enterprises, they should not only have the intention to start a business but also create or find opportunities that others ignore or fail to make timely and effective use of (Dutta, Li, & Merenda, 2011). Developing EOI ability should be a key theme for cultivating future entrepreneurs. Therefore, EEP should equip students with the knowledge and skills needed to discover and create business opportunities (Neck & Greene, 2011).

The psychological method of entrepreneurship research has also developed from a single study of personality attributes to the study of behavior, motivation, and cognition. The elements involved are becoming increasingly complex, including perceptual and situational variables (Goje, 2017). With the increasing

influence of cognitive psychology on the research of EOI, many studies use the theory of cognitive psychology to explain opportunity recognition. From the perspective of entrepreneurs' cognition, they use pattern recognition theory, feature analysis theory, and the prototype concept to study how opportunity, as a specific stimulus combination pattern, is recognized by entrepreneurs or potential entrepreneurs.

Ardichvili et al. (2003) defined EOI as the new matching relationship between market demand and resources after individuals perceive market demand or unused resources. It is a cognitive process, including cognition, intuition, and evaluating whether an idea can become an entrepreneurial opportunity. The process results from the comprehensive action of internal and external factors, including knowledge reserve, social capital, cognitive and personal characteristics, and environmental factors (Parida, George, Lahti, & Wincent, 2016).

2.1.3.3 Entrepreneurial Opportunity Identification Process

Ardichvili et al. (2003) believed that the successful entrepreneurial process includes opportunity identification, evaluation, and development. Opportunity identification comprises three steps: awareness, discovery, and creation of entrepreneurial opportunities, which then enter the development stage. Opportunity evaluation runs through the processes of identification and development. The evaluation results significantly affect the success of entrepreneurship, and the evaluation results determine the success probability of entrepreneurship.

Research on EOI should focus on its process model (Gaglio & Dimov, 2018). EOI has the characteristics of the development process. Analyzing its function will help to understand the operating mechanism of opportunity identification. There were two views on how EOI was formed in academic circles: one thought that opportunity recognition was created, and the other believed it was discovered. After empirical and theoretical research, it was found that the formation process of EOI includes both creation and discovery. Regardless of the cause of any discovery, its process consists of the discovery/creation stage and the formation stage (Yasira et al., 2020). The discovery stage refers to the insight into the opportunities in the external

environment that can create value and business profits. The formation stage refers to the evaluation of opportunities in the discovery stage, and on this basis, it refines the path to realizing opportunities.

There are many studies on opportunity identification models (Kim et al., 2018). The earliest studies focused on the stage type of opportunity identification and believed that the formation process of opportunity could have several stages. Lindsay and Craig (2000) believe that opportunity identification can be divided into three stages: opportunity search, EOI, and evaluation. However, this view only summarizes the model of opportunity formation without taking opportunity discovery and assessment into account, which is not conducive to the general study of opportunity identification. Hills, Shrider and Lumpkin's (2004) multidimensional opportunity identification process model (creativity-based) has more detailed processes, emphasizes the role of innovation, and involves information at the cognitive level, but has not conducted more in-depth cognitive research.

Ardichvili et al. (2003) believed that opportunity identification has three stages: opportunity identification, opportunity evaluation, and opportunity development. He incorporated opportunity evaluation and development into the whole process of opportunity identification. Opportunity identification is not only the discovery of the opportunity itself but also the identification, evaluation, development, putting it into use, adjustment, reassessment, and other operations. These operations constitute the whole process of opportunity identification. The inclusion of assessment and development makes opportunity identification more accurate. This is the most widely recognized and used opportunity identification stage model. In developing an EOI course, this study takes Ardichvili's three opportunity identification stages as the overall EOI process. Table 2.2 shows them.

Table 2.2 Model of the opportunity identification stage

Model of Opportunity Identification Stage		
Phase I:	Perception	Entrepreneurs perceive or perceive market demand and underutilized resources.

Table 2.2 Model of the opportunity identification stage (Cont.)

Opportunity Identification	Discovery	Find a match between resources and requirements.
	Creativity	Entrepreneurs reposition and combine existing resources to meet market demand, create a match between resources and demand, and make resources play a more significant role on an existing basis.
Phase II: Opportunity Assessment		Throughout the opportunity identification and development process.
Stage III: Opportunity Development		After passing the assessment, carry out opportunity development.

Source: Ardichvili et al., 2003

Therefore, in the EOI course, this study brings the development process of EOI into the theoretical module to teach students the principles of the formation process.

1) Identification of Entrepreneurial Opportunity

There are two theories of EOI: the discovery theory and the creation theory (Schmitt et al., 2018). One believes opportunities exist objectively in the external environment and require entrepreneurs to search for them or accidentally discover them. People with high alertness and relevant prior knowledge can quickly identify opportunities (Murphy, 2011); The other believes that opportunity recognition is subjective and created, and even opportunity recognition is creative (Hansen et al., 2011).

With the deepening of research, researchers gradually realize that the two views are not contradictory, but both occur in the process of entrepreneurship and complement each other. Entrepreneurs will use algorithms and exploration to process information related to entrepreneurial opportunities. Entrepreneurial opportunities are found and created simultaneously (Vaghely & Julien, 2010). They do not show the development of either of these but the trend of coexistence (Bhave, 1994; Short et al.,

2010). Entrepreneurs can complete the identification using discovery, creation, or a combination of the two when identifying entrepreneurial opportunities.

2) Evaluation of Entrepreneurial Opportunity

Enntrepreneurial Opportunity Assessment runs through the whole process of EOI and development. Not all entrepreneurial opportunities can enter the actual business of innovative enterprises, and accurate evaluation is an important consideration (Rastkhiz et al., 2018). There are many research results on opportunity evaluation, but many research methods and evaluation standards are fragmented. After comparing and screening various methods, this study selects the fuzzy screening system developed by Rastkhiz et al. (2018) to evaluate and select the best entrepreneurial opportunities (Figure 2.2). Yager (1993) introduced fuzzy screening as a multi-expert, multi-criteria decision-making (ME-MCDM) model.
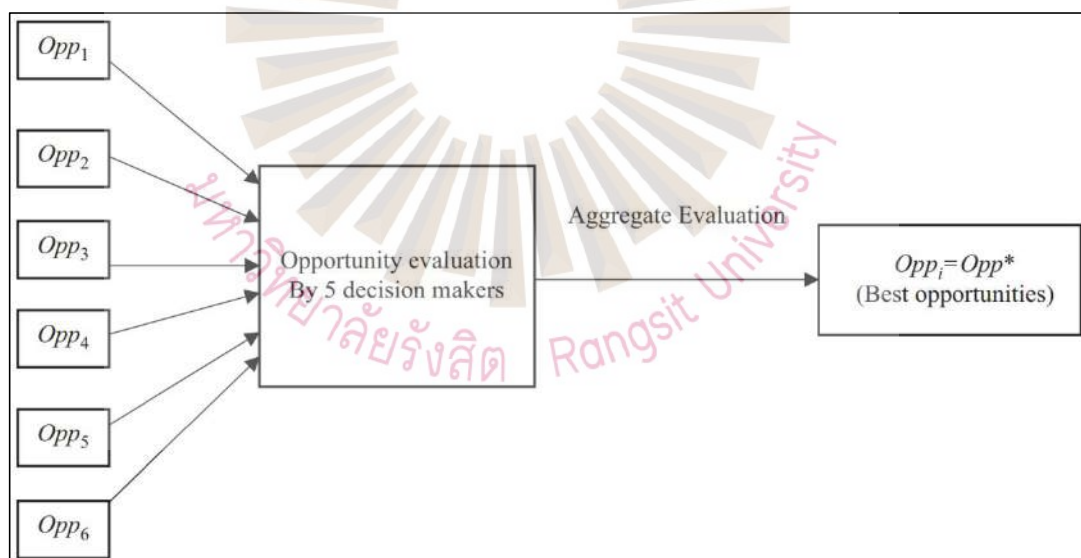
Figure 2.2 Fuzzy Screening Model Entrepreneurial opportunities form the set of decision alternatives: Opp

Source: Rastkhi et al., 2018

The fuzzy screening model relies on the fuzzy screening technology (ME-MCDM), which makes decisions on EOI by considering the evaluation and decision-making of multiple experts rather than depending on the evaluation and

decision-making of a single entrepreneur, reducing possible deviations. ME-MCDM can achieve reliable evaluation through collective decision-making and conflict resolution. Rastkhiz and others regard opportunity evaluation as a multi-expert decision-making process. In this process, the company's main decision-makers or key entrepreneurial team members responsible for the business participate in the evaluation. During EOI development in the developed EOI course, this study provides students with practical experience opportunities in teamwork, with 5 or 6 people in each group. As key entrepreneurial team members, members of each team evaluate and make decisions on the designed entrepreneurial opportunities.

Rastkhiz et al. (2018) gave seven types of evaluation criteria, including economic and financial factors, market and industry, products or services, aspirations, feasibility, human capital (term or individual), and environmental factors. Table 2.3 shows the scale comprising seven standard categories and 49 measurement items.

Table 2.3 Categorization of Opportunity Evaluation Criteria

Categories (Evaluation criteria)	Items	References
Economic and financial factors	Required capital, time to break-even point, net profit (per year), return on investment (ROI) potential, internal rate of return (IRR) potential, R&D expenditures, total cost	Murnieks et al. (2011), Douglas and Shepherd (2002), Smith et al. (2010), Spinelli and Adams (2012)

Table 2.3 Categorization of Opportunity Evaluation Criteria (Cont.)

Categories (Evaluation criteria)	Items	References
Market and industry	Target market, key customers, competitors, market structure, market size, market potential, market capacity, market share attainable (year 5), growth rate	Smith et al. (2010), Murnieks et al. (2011), Spinelli and Adams (2012)
Product or service issues	Novelty, rarity, substitutability, imitability, competitive advantage, product/service life, sustainability, value proposition	Shapherd et al. (2013), Williams and Wood (2015), Spinelli and Adams (2012)
Desirability	Income, risk, work effort, independence, net perquisites	Douglas and Shepherd (2002), Fitzsimmons and Douglas (2011), Haynie et al. (2009)
Feasibility	Financial feasibility, market, and industry feasibility, product/service feasibility, technical feasibility	Dimov (2010), Zahra et al. (2006)

Table 2.3 Categorization of Opportunity Evaluation Criteria (Cont.)

Human capital	Knowledge, skills, education, experience (industry or technical), entrepreneurial team, intellectual honesty, intellectual capital, learning, cognitive-metacognitive abilities, social networks, individual characteristics	Wood and Williams (2014), Barreto (2012), Grichnik et al. (2010), Dimov (2010), Murnieks et al. (2011) Mitchell and Shepherd (2010)
Environmental factors	Economic, political, social and cultural or technological environment, environmental uncertainty	Smith et al. (2010), Mitchell and Shepherd (2010), Autio et al. (2013)

Source: Rastkhi et al., 2018

Data were collected through a survey questionnaire on a seven-point S scale (Yager, 1993). It comprises 49 items that measure the seven criteria. The decision-making experts first evaluate each opportunity according to each standard and then summarize the evaluation of each expert to obtain the overall language value of each opportunity. This comprehensive assessment serves decision-makers well (Yager, 1993). The opportunity evaluation is formulated in the form of a fuzzy screening system. This part will be used as the teaching content for the Entrepreneurial Opportunity Assessment in the EOI course.

3) Development of Entrepreneurial Opportunity

Entrepreneurial opportunity opportunity development is a process in which entrepreneurs carry out effective large-scale operations on identified entrepreneurial opportunities (Choi, 2018). The development stage of entrepreneurial opportunities in this study occurs after the evaluation of entrepreneurial opportunities. However, it does not include the follow-up entrepreneurial activities and results of opportunity development, including whether the entrepreneur decides to develop entrepreneurial opportunities. It also determines this opportunity's trend and development status.

When entrepreneurs develop entrepreneurial opportunities, they often consider them from economic, psychological, and social network perspectives. From the standpoint of economics, mainly from the perspective of alternatives and differences in resources, entrepreneurs look for places where the supply and demand of products or services are unbalanced and rely on their perception and alertness to develop opportunities. In this process, entrepreneurs may weigh the economic benefits of opportunity cost, opportunity development, self-ambition, and labor cost before developing opportunities (Du, 2014). In this process, entrepreneurs will also judge whether their knowledge and ability, competitors' conditions, and opportunities have reached the expected or best point (Choi, 2018). From the perspective of psychology, it mainly refers to those entrepreneurs taking different ways to evaluate and use their knowledge because of different personal cognitive characteristics and developing entrepreneurial opportunities through the perceived feasibility of options, attitude towards behavior, and consideration of social norms. A social network is an essential factor in opportunity identification and development. However, some studies have shown that the strength of social networks and the impact of opportunity identification and development have limitations. The trust and standardization of interpersonal relationships can be further explored.

Feature Analysis Model (FAM)

Some studies have shown that EOI usually involves cognitive models. Pattern recognition can help individuals carry out meaningful opportunity cognition in a complex environment (Costa et al., 2018), connect the links between

seemingly unrelated independent events or trends such as market changes, policy changes, and technological progress, and find meaningful patterns hidden in them, playing a pivotal role.

Pattern recognition is a process in which individuals recognize meaningful patterns in complex events or trend arrays. It may be closely related to recognizing new business opportunities and the cognitive events and processes that lead to such recognition. Applying pattern recognition to identify business opportunities may help individuals identify new entrepreneurial opportunities (Lorenz et al., 2018). They may find the links between independent events (for example, technological progress, market changes, and changes in government policies) and detect new entrepreneurial opportunities in these connection patterns.

In recent years, the research on the opportunity recognition process model has mainly focused on cognition, including the feature analysis model, prototype model, and structure matching model based on pattern recognition theory. For the prototype model (Baron & Ensley, 2006), the business opportunity model of experienced entrepreneurs has more precise definitions and richer content than that of novices. The application of the prototype model requires entrepreneurs to have some entrepreneurial experience—the more experienced, the more precise the prototype model is. The prototype model is more suitable for mature entrepreneurs. For the structure matching model (Gregoire, Barr, & Shepherd, 2010), the structure models of entrepreneurs with unique experiences differ. The structure matching degree has different effects and has higher requirements for entrepreneurs' experience. For novice entrepreneurs, the experience reserve requirements are high, and the effectiveness of use is unstable.

The feature-analysis model (Baron, 2006) is this study's Cognitive Model of Opportunity Recognition. Entrepreneurs use the characteristics of opportunities to identify entrepreneurial opportunities with the help of a cognitive framework. Opportunities can be identified when the characteristics of events or stimuli match. Baron and Markman (2003) pointed out that the characteristics of

entrepreneurial opportunities have four dimensions: (1) newness novelty: judge whether the new stimulus differs from the existing psychological model; (2) practicality feasibility: analyze whether the opportunity is operable and feasible; (3) Novelty features: whether the new products and services contained in the opportunity have not appeared; (4) uniqueness independence: excavators have inherent unique factors so that others cannot easily imitate them.

Entrepreneurs with different experiences have different visions of opportunities. Novices' Visions of opportunities are based on novelty and uniqueness, while experienced entrepreneurs' visions are based on profitability and feasibility. Novelty, singularity, and independence depend more on personal creativity and have little correlation with experience. They are more suitable for novice entrepreneurs to learn, master, and use. Feature-analysis Model (Baron, 2006) has four characteristics: (1) Like the object pattern recognition process, (2) The opportunity itself has observable characteristics, and (3) In this process, cognitive frameworks (such as prototypes) that rely on experience acquisition play a crucial role. These frameworks can make individuals pay attention to the links between seemingly unrelated things or trends (such as technological progress, market transformation, and policy adjustment) and then detect meaningful patterns to identify entrepreneurial opportunities. (4) More attention is paid to scattered features.

This study attempts to take the feature analysis model based on pattern cognition theory as the core strategy to improve students' opportunity recognition. It carries out the experimental verification of the pretest and posttest. In developing the EOI course, this study attempts to teach students the verified feature analysis model through EEP elective courses. Students use and practice it in class to improve their EOI abilities.

The above is the basis for forming the theoretical teaching content of the EOI course, including the concept of EEP and the basic principles of the development process, which constitute the theoretical content framework.

2.2 The EOI Course

Although many studies have documented the improvement of students' entrepreneurial mentality and the cultivation of entrepreneurial skills in Higher Education (Gargouri & Naatus, 2019; Neck & Corbett, 2018), few studies have included EOI in the curriculum of EEP alone. The identification of entrepreneurial opportunities is critical. It can lay a foundation for undergraduates to start a business, improve students' entrepreneurial mentality, talents, and skills before choosing a career path, and make it possible for them to become entrepreneurs (Sarasvathy et al., 2014; Zupan et al., 2018). This study will verify the relationship between the EOI course and EOI ability.

2.2.1 ADDIE Model

As a systematic development teaching method for EOI course, the ADDIE model (Branson et al., 1975; Dick et al., 2009; van Merriënboer, 1997) systematically guides the entire process of analysis, design, development, implementation, and evaluation of the course. This part will be discussed in detail in Chapters 3 and 4. The basic overview is as follows:

Analysis: The EOI course conducted learner analysis and task analysis. In learner analysis, the learners are engineering students at Jiaxing University with more than one year study experience. After studying three introductory entrepreneurship education courses, it has a specific foundation in entrepreneurship cognition. The primary learning skills of this course are to train students to have the ability to identify entrepreneurial opportunities in combination with their professional skills. The task analysis aims to hope students can identify entrepreneurial opportunities, plan them according to their professional expertise and design, and verify entrepreneurial opportunity plans through team cooperation. To do this, they must use the learned model methods to identify entrepreneurial opportunities and judge and select good entrepreneurial options. The course is conducted through classroom theory teaching, discussion and practice, and teacher guidance.

Design: Learning goals, learning objectives, teaching strategies, and learning activities are designed. There are two learning goals: one is to identify potential entrepreneurial opportunities, and the other is to analyze and plan entrepreneurial opportunities. Learning objectives include the concept and principle of EOI, mastering the enterprise opportunity model, enterprise opportunity cases, and EOI practice. Teaching strategies are a plan for students to participate in classroom activities and help them establish entrepreneurial opportunities. Students will study handouts and cases of the EOI course. Students will participate in learning EOI activity so that they can get guidance from EOI, elaborate on and analyze the process of EOI in their own words, and have the skills of teamwork, communication, and execution.

Develop: Develop a PowerPoint with rich content and clear logic; develop handouts with guided dialogue; and develop a brochure with learning strategies in the guidance manual.

Implement: Students study, discuss, and implement the course, determine how the entrepreneurial opportunity plan is going, and adjust the entrepreneurial opportunity identification if necessary.

Evaluate: It includes formative evaluation and summative evaluation. The teacher gives a formative evaluation, and the teacher will check all the standards provided to the students during the learning period. According to the teacher's feedback, the students can make changes to future guidance. Students will conduct self-assessments and prepare separate documents during the learning process.

2.2.2 Cognitive Instructional Design Theory

Learning in cognition has always been a hot topic in educational research, especially in instructional design theory and practice. Learning can be divided into cognitive, emotional, and motor skills. Cognition includes metacognition, memory, and identification of cognition, building understanding, developing wisdom, and forming skills (Tomporowski & Pesce, 2019). The course design of this study selects

cognitive design theory as the teaching method theory. In essence, education is the transmission of information. It can design a good learning experience for students and effectively and smoothly transmit information or knowledge to them, which is very important for both traditional offline education and online learning.

Compared with the industrial age, higher-level learning in the information age is more important than memory and processing skills. The primary quality of learners has also changed a lot. Learners have more ways to acquire knowledge and skills. Their existing learning experience needs to be considered in the teaching design (Gallagher & Savage, 2020). Therefore, various learning resources and information technology can be used in the instructional design process to improve the learning effect.

Cognitive design theory is especially instructive in the face of groups from different majors and different cognitions. Different from the traditional teacher-centered teaching process, cognitive design theory is student-centered. Learners in this teaching environment have more dominant power over learning effects and methods (Balasubramani, Aamer, & Sonawane, 2022).

Cognitive learning is divided into four categories: memorizing information, understanding relationships, applying skills, and applying rules (Reigeluth & Julie, 2004). Reigeluth et al. put forward the framework of the cognitive teaching model, including six comparative elements: learning type, learning control, learning focus, learning to a group, learning interaction, and learning support. Table 2.4 shows the specific description of each element. Reigeluth and Julie pointed out that this framework is only for better comparison and analysis of instructional design theories. This does not mean that each instructional theory must reflect these elements.

Table 2.4 Comparison framework of the cognitive teaching model

Model Names	Learning Categories	Teaching Focus
Cognitive teaching model (Reigeluth.C.M.)	1.Type of learning	What type of learning in the cognitive domain is supported by this instructional design theory and model?
	2.Control of learning	Who controls the learning process: teachers, students, instructional design experts?
	3.Focus on learning	Is the learning activity centered on a topic, a problem or something else?
	4.Grouping for learning	How are learners grouped? Do they study independently or as a team?
	5.Learning interaction	What is the main interaction mode? Teachers and students, students and students, students and textbooks?
	6.Learning support	What types and levels of learning support can learners receive? What types of cognitive support do teachers and textbooks provide? What teaching resources and emotional support can learners get?

Source: Reigeluth & Julie, 2004

2.2.3 Bloom's Taxonomy of Educational Objectives

Bloom et al. (1956) believed that three domains applied to educational outcomes. Each domain has severe levels, from easy to difficult. They are the

cognitive domain, knowledge of and ability to work with information and ideas; the affective domain, the ability to organize, articulate, live, and work by a coherent value system relevant to the capabilities achieved through education; and the psychomotor domain, skills, and ability to do acts pertinent to the field of study. They represent and identify knowledge, beliefs, and abilities through which learning occurs. The Cognitive domain is related to the thinking process; the affective domain relates to feelings and attitudes; and the psychomotor domain includes motor skills.

The three domains are not mutually exclusive. Students think, experience feelings, and move in specific ways all at the same time. Psychomotor behaviors specifically contain elements of cognitive and affective behaviors within them. Psychomotor behaviors, or " doing" movements, are connected to and affect cognitive student learning and performance (Abedi & O'Neil, 2005; Adkins, 2004; Beane et al., 1986; Gage & Berliner, 1988; Haladyna, 1997). Each domain serves as a valuable reference point for the development and achievement of balance in the range and scope of educational objectives within the course to accent different areas of learning.

2.2.3.1 Cognitive Domain

The revised Bloom's taxonomy of educational objectives points out that the dimension of cognitive process is the stage that students experience in the process of learning knowledge, from simple to complex, including six levels of memory, understanding, application, analysis, evaluation, and creation (Bloom et al., 2001). This is a scientific learning model, and teachers can use these six stages to design teaching content (Adams, 2015; Ormrod et al., 2017). In the curriculum development process, this study uses Bloom's taxonomy of educational objectives to guide the consistency theory of teaching objectives, teaching strategies, teaching models, and teaching evaluation. In the evaluation's design system, attention should be paid to proving that students can remember teaching knowledge, accurately understand the theory learned, and use entrepreneurial skills through learning. The primary cognitive level has six levels, from the lowest to the highest: (1) Knowledge: Recognize and memorize certain kinds of information; (2) Comprehension: Shallow understanding of things; (3) Application: Be able to apply the learned knowledge to the appropriate

situation correctly; (4) Analysis: Be able to elaborate on internal principles; (5) Evaluation: Reprocess the learned knowledge and form a new cognition based on analysis; (6) Innovation: The highest level of educational objectives in the field of cognition emphasizes the rational judgment of the essence of things and the formation of creative achievements.

2.2.3.2 Affective Domain

The affective domain is part of Bloom's taxonomy, and its involvement in education is essential for holistic learning. It consists of five major stages: attending, receiving, valuing, organizing, and characterization. Every stage has its action verb and meaning (Syaiful et al., 2019). Affective is vague, hard to predict, and uncertain, as it is more towards attitude, emotion, and behavior. In this research, fuzzy logic, the most commonly used technique to measure affective domains, measures uncertainties and vague values.

The entrepreneurship courses cover the needs of learners of various backgrounds and interests. Bloom's taxonomy suggests that a well-designed course should include learning objectives in the cognitive, affective, and psychomotor domains (Bloom et al., 1956). However, Sitzman et al. (2010) pointed out that course design focuses mainly on knowledge transfer, emphasizing cognitive and psychomotor functions but neglecting the affective domain. Moreover, it is not easy to measure the achievement of practical goals through traditional evaluation methods. Taber (1989) argued that focusing on cognitive development may leave students unable to adapt to real-world challenges.

When entrepreneurs struggle to launch and sustain a new venture, the critical challenge is not a lack of relevant knowledge but the fortitude and attitude to face difficulties and challenges. Thus, entrepreneurs and business managers require development in the affective domain. Affection and cognition are complementary and cannot be developed independently during the learning process. Kraiger et al. (1993) pointed out that cognitive ability is foundational to affective learning, critical to behavioral performance, and practical skills. Therefore, affective teaching strategies

are essential in EEP (Fodor & Pintea, 2017). Effective teaching in the affective domain can help learners review their value choices, reflect on their value beliefs, revise their value systems, and then create their approaches to innovation and creativity. It is essential to ensure that students are emotionally involved in any teaching and learning session. It can also be described as a way of identifying, addressing, and understanding how people learn. It is a combination of learning objectives that highlight an emotion, tone of feeling, or level of rejection and acceptance. The psychomotor domain has five levels, from the lowest to the highest; they are: (1) Attending: Being attentive and willing to receive new information; (2) Receiving: Responding stage that describes the participation of the learner, whether actively or energetically involved with new information received from the first stage; (3) Valuing: The learner can form an opinion and commit to the valuing stage; (4) Organization: The learner can apply the knowledge to his life and be able to share the values with others in the organization stage; (5) Characterization: Characterization is the learner's ability to act consistently under the values that they received from the previous stage.

2.2.3.3 Psychomotor Domain

Performance Skill Test is mainly used for testing practical behavioral skills, such as sports and medicine. However, it is still rare to find skills related to EEP, which are highly demanding in practice. To ensure the success of EEP in training undergraduate students with entrepreneurial potential, there is a need for skill tests that incorporate students' abilities (Rasid et al., 2020). The performance skills test is designed to measure the basic skills used in the EOI process, and it helps students receive timely and quantitative feedback on their learning to increase their motivation and self-confidence in the learning process. It also helps instructors measure student performance and evaluate teaching procedures and programs (Begum, 2019).

Psychomotor outcomes must be included in instructional programs (Beane et al., 1986; Haladyna, 1997). The Psychomotor domain includes physical movement, coordination, and use of the motor-skill areas (Simpson, 1972). Developing these skills requires practice and is measured in terms of speed, precision,

distance, procedures, or techniques in execution. Simpson (1972) categorized the progressive levels of behavior from observation to mastery of a skill. Simpson (1972) built this taxonomy on the work of Bloom and others. The psychomotor domain has seven levels, from the lowest to the highest: (1) perception: Sensory cues guide motor activity; (2) set: Mental, physical, and emotional dispositions that make one respond in a certain way to a situation; (3) guided response: First attempts at a physical skill. Trial and error coupled with practice lead to better performance; (4) mechanism: The intermediate stage in learning a physical skill. Responses are habitual, with a medium level of assurance and proficiency; (5) complex overt response: Complex movements are possible with a minimum of wasted effort and a high level of assurance they will be successful; (6) adaptation: Movements can be changed for particular situations; (7) origination: New movements can be created for special situations.

2.2.4 Teaching Objectives Design

When formulating the learning objectives, considering that the target group is engineering students with technical backgrounds who have studied EEP compulsory courses and elective courses, the learning objectives focus on the in-depth understanding of theoretical knowledge and the study and practice of EOI in combination with majors. Four learning objectives are formulated under the cognitive domain's six ascending process stages, as shown in Table 2.5.

Table 2.5 Learning objective of the EOI course

General Learning Objectives	Behavioral Objectives	Bloom's Three Domains
Chapter I: Engineering EOI	Students can explain the concept of EOI	Cognitive Domain Level1:knowledge
	Students can give examples of Engineering EOI	Cognitive Domain Level3:application
	Students can explain the feature analysis	Cognitive Domain

Table 2.5 Learning objective of the EOI course (Cont.)

	model Students can explain the fuzzy screening model	Level4: analysis Cognitive Domain Level5: evaluation
Chapter II: Case analysis of engineering entrepreneurship	Students can analyze the EOI in the case	Psychomotor Domain Level1: perception
	Students can analyze the evaluation of entrepreneurial opportunities in the case	Psychomotor Domain Level2: set
	Students can analyze the development of entrepreneurial opportunities in cases	Psychomotor Domain Level3: guided response
Chapter III: Practice of engineering EOI	Students can form teams and make them work well	Psychomotor Domain Level4: mechanism
	Students can use two models to design entrepreneurial opportunities	Cognitive Domain Level6: innovation Psychomotor Domain Level5: complex overt response
	Students can skillfully introduce the EOI plan	Psychomotor Domain Level6:adaptation
	Students can skillfully evaluate the entrepreneurial opportunities of other teams	Psychomotor Domain Level7: origination
General Learning Objectives	Behavioral Objectives	Bloom's Three Domains
	What did the students learn in this course?	Affective Domain Level1: attending
	What difficulties have the students encountered?	Affective Domain Level2: receiving

Table 2.5 Learning objective of the EOI course (Cont.)

Students' satisfaction	Evaluate the strengths and weaknesses of the course content. What is the student's opinion on this issue and other ideas?	Affective Domain Level3: valuing Level4: organization Level5: characterization

Source : Data Classification by the Researcher

2.2.5 Teaching Strategy and Teaching Mode

A three-pronged pedagogic approach was used in teaching and learning (Asamoah et al., 2017). The components of the three-pronged approach are sensitization, theory or principles, and practice. The course starts with reviewing the concept of EOI in the compulsory course of the first year, triggering the linkage of students' previous knowledge and preparing for the connection with new knowledge. Next, it introduces the occurrence process of EOI, the concept and understanding of Engineering EOI, and the principles and application of the two models. The practice part is mainly reflected in the exercise of comprehensive ability and the experience of EOI design. Learning, understanding, teamwork, communication, and other abilities are integrated into this part.

The strong practicality of EEP determines the importance of the practical experience of the knowledge learned, and effective entrepreneurship activities depend on understanding relevant knowledge. Therefore, the EOI course needs to include theoretical and practical content (Asamoah, 2022). In addition, EEP involves interactive learning related to business and community initiatives (Boon, van der Klink, & Janssen, 2013). Experience-based knowledge is also needed, and case studies are usually part of the entrepreneurial education experience (Chawinga, 2017). Therefore, case teaching can integrate interactive learning and experiential learning. The experimental course of this study takes theory, case analysis, and practice as the framework to guide the teaching content. It organizes and designs the teaching content of the experimental course.

The course is ten days long, with a total length of 60 hours. The teaching content starts with a review of the concept of EOI and then introduces the occurrence process of EOI in depth. The theories and application methods of the two models are explained with examples. Select three cases of Engineering entrepreneurship, each of which has a different focus, focusing on EOI, entrepreneurial opportunity evaluation, and entrepreneurial opportunity development. Students comprehensively use the knowledge and ability learned in the course to design, discuss, revise, and show the EOI plan in the form of team cooperation and require teams to evaluate each term. This step pays special attention to the role played by practice. Through practice, students can practice their professional technology, the knowledge learned in previous entrepreneurship courses, and this course of exercising comprehensive ability through cooperation. These activities are demonstrated to students through lectures and implemented through student discussion and teamwork. Table 2.6 shows the course structure.

Table 2.6 Structure of the EOI course

The course structure of the EOI course					
Days	Chapter	Section	Teaching Form	Variables	Results
1	Chapter I: Engineering EOI	1.1 Basic theory 1.1.1 what is EOI? 1.2.2 the process of EOI.	Theory teaching	EOI course	Class discussion
2		1.2 EOI in engineering, Concepts, examples			
3		1.3 EOI model 1.3.1feature analysis model (Baron, 2004b) 1.3.2fuzzy screening system (Rastkhiz et al., 2018)			

Table 2.6 Structure of the EOI course (Cont.)

4	Chapter II: Case analysis of engineering entrepreneurship	2.1 Case 1: focus on the analysis of opportunity identification.	Case analysis		
5		2.2 Case 2: focus on the analysis of opportunity evaluation. 2.3 Case 3: focus on the development of opportunities.			
6	Chapter III: Practice of engineering EOI	3.1 Using the EOI model, find a creative opportunity in your specialty and experience.	Practical exercises	EOI ability	Identification analysis, evaluation analysis, opportunity development analysis, report EOI plan
7		3.2 Student grouping and cooperation Students discuss the deepening and implementation of entrepreneurial opportunities and the plan for EOI.			
8					
9		3.3 EOI design and report Students' self-evaluation, revision, and report on the works of this group.			
10					

Source : Data Classification by the Researcher

2.2.6 The EOI course Quality Assessment

Delphi Technique is used to check the quality of the EOI course. Invite five entrepreneurship education experts to form a Delphi technology expert group and invite experts to complete at least two rounds of the Delphi questionnaire survey through e-mail, which will be used as a reference for prediction and decision-making. The implementation steps are as follows:

1) Determine the research topic: according to EOI course design principles and EEP courses' status at Jiaxing University, prepare the first draft of the "EOI course" Delphi technology structured questionnaire. 2) Selected experts: request assistance. 3) Send the questionnaire to the experts and ask them to express their opinions. 4) Sort out and collect the questionnaires. Make a comprehensive summary and send the overall results to the selected experts. Ask them to consider the overall results and express their opinions again. Repeat this two times to summarize the conclusion.

The course is designed in seven aspects: teaching methods, teaching objectives, teaching contents, teaching methods and activities, teaching evaluation, teaching resources, and teachers. See Appendix E, Teaching Plan, for design contents. The teaching method of the EOI course is optional. See Appendix E for the teaching methods and activities. The teaching evaluation is conducted in the three fields of Bloom's taxonomy of educational objectives: the cognitive domain, the affective domain, and the psychomotor domain. Teaching resources include "the principle of selecting teaching reference materials" and "the types of teaching resources." Teachers' design in the cognitive, affective, and psychomotor domains.

2.2.7 Teaching Development Evaluation

Researchers have found problems with the validity and reliability of student opinion of teaching survey results over the past few decades. This has led many researchers and faculty members to conclude that a comprehensive, meaningful assessment of teaching requires using multiple measures to collect and triangulate data

from students, faculty peers, administrators, and others (AAUP, 1975; Benton & Cashin, 2014; Onufer, 2022; Vasey & Carroll, 2016). Experts have recommended that teaching surveys serve as one, ideally formative, assessment of teaching amongst several measures, including peer review, self-assessment, and review of teaching and student learning artifacts (Gormally et al., 2014; Linse, 2017; Miller & Follmer Greenhoot, 2018). The teaching design of the EOI course includes teaching objectives, teaching strategies, and teaching modes, as well as teaching evaluation. It was designed and written by researchers. Three Chinese EEP experts and two Thai education experts were invited to comment on the course content.

Student Assessment

Assessment of learning in higher education, including EEP, serves three primary purposes. First, the educator knows if learning goals have been achieved; second, students receive feedback about their learning; and third, students receive a mark and accreditation for benchmarking (Gibb & Price, 2014). Assessment should be designed to encourage continued learning. Students must be taught how to make an informed judgment about their capabilities to prepare them for the world after university (Boud & Soler, 2016). Practical evaluation of students in EEP is a powerful tool to motivate and encourage students to participate in and experiment with entrepreneurial activities (Wenninger, 2019). More innovative evaluation formats are needed because they are most suitable for action-based, experiential, and learning-by-doing (ABELD) entrepreneurship courses. Here, a rich pool of evaluators, peer feedback, reflective self-assessment, and the transformation to formative and process-oriented assessment are promising student assessment methods because they better explain the vague real-life situation of entrepreneurship.

Assessment is an essential motivational factor in students' learning in higher education courses and should be closely aligned with the course's intended learning outcomes (Biggs, 1999). Rooted in assessing students' progress (formative assessment) and performance (summative assessment) as the foundation to provide certified qualifications, student assessment is crucial for students, educators, society, and business. Building on experiential learning theory (Kolb, 1984) as a theoretical lens,

the research defines learning as a process of making sense of experience in a transformative way, emphasizing the creation and recreation of knowledge. This view highlights the importance of supporting learners in learning how to learn (Kolb, A., & Kolb, D., 2009). A formative type fits this perspective in student assessment, which intends to improve student performance by providing feedback that helps them learn from mistakes. Thus, formative assessment focuses on the process of learning. It is distinct from summative assessment, which indicates how much a student has learned (Rust, 2002), emphasizing the learning outcome instead of the process.

In most cases, the educator is the assessor in higher education. However, students can and should be integrated into the assessment process through self-and peer assessment. This has educational benefits (Rust, 2002) and enriches the pool of assessors for somewhat subjective tasks. Assessment types can further be divided based on whether they assess students individually or as a group.

Student Achievement Assessment

The assessment system is designed hierarchically and quantitatively. The standards of the six levels of memory, understanding, application, analysis, evaluation, and creation are described in detail, and the educational objectives are clear. Four deliverables reflect student knowledge and ability to understand the course content: two class discussions, an EOI process analysis report, and an EOI plan. The course provides students with "student-centered" classroom time to discuss, ask questions, and summarize practice daily. Students should integrate the previous learning content for learning and training. Ask students about the formation process of phased achievements to test their understanding and mastery. EOI allows students to apply their theoretical knowledge and practical experience as individuals and teams and encourages them to form groups. Among team members, they can use their peers' technology and experience to analyze problems and find appropriate solutions. Creating teams with different disciplines has improved creative diversity and innovation (Domik, 2011).

2.2.8 Tests Design

This section studies and elaborates on the evaluation items, standards, and evaluation scores for the formative assessment of students. There are three tests: the EOI Achievement Test, the EOI Affective Questionnaire, and the EOI Psychomotor Test. The three tests correspond to the three domains of Bloom's taxonomy of educational objectives: cognitive domain, affective domain, and psychomotor domain. Table 2.7 shows the theoretical sources of tests.

Table 2.7 The testing framework of the EOI course

	Name	Target domains	Theoretical Basis
1	EOI Achievement Test	Cognitive domain: Knowledge, innovation, etc.	Anderson and Krathwohl (2001)
2	EOI Affective Questionnaire	Affective domain: Opinion and attitude on the EOI course	Wu et al. (2019)
3	EOI Psychomotor Test	Psychomotor domain: Skill performance	Anderson and Krathwohl (2001)

Source : Data Classification by the Researcher

2.2.8.1 EOI Achievement Test (Cognitive Domain)

Based on the revised version of Bloom's taxonomy of educational objectives (Anderson & Krathwohl, 2001), this study created a summative assessment test based on six levels of the cognitive domain, as shown in Table 2.8. The test questions were designed from low to high levels in conjunction with the course content in a simple to complex test design, with 12 test questions scoring 100 points, each assigned a score based on its complexity in the cognitive domain of Bloom's taxonomy. The scores of the students after the test were measured using IRT.

Table 2.8 EOI achievement test (cognitive domain)

EOI Achievement Test			
Level		Test design	Scores
Lowest level ⬇ Highest level	1.Knowledge	1.1 what is the definition of EOI?	0-2
		1.2 what are the three main stages of EOI?	0-3
	2.Comprehension	2.1 please give an EOI case related to your major.	0-5
		2.2 explain the feature analysis model and analysis steps in your own language.	0-5
		2.3 explain the fuzzy screening model and analysis steps in your own language.	0-5
	3.Application	3.1 please choose a case given in the class. If it is you, how will you determine the entrepreneurial opportunity.	10
		3.2 Analyze and calculate a case using feature analysis and fuzzy screening models.	10
	4.Analysis	4.1 Please select a case given in the class and conduct an overall analysis according to the whole process of EOI.	7
		4.2 What is the main stage in the whole process of analysis?	6
		4.3 What can be optimized in this case?	7
	5.Evaluation	5.1 Which of the three cases given in the course do you think is the best? Why?	20
	6.Innovation	6.1 Starting with this major, please use the feature analysis and fuzzy screening models to design an entrepreneurial opportunity.	20

Source : Data Classification by the Researcher

2.2.8.2 EOI Affective Questionnaire (Affective Domain)

Entrepreneurship courses cover the needs of learners of various backgrounds and interests. Bloom's taxonomy suggests that a well-designed course

should objectives in the cognitive, affective, and psychomotor domains (Bloom et al., 1956). However, Sitzmann et al. (2010) pointed out that course design focuses mainly on knowledge transfer, emphasizing cognitive and psychomotor functions but neglecting the affective domain. It is difficult to measure the achievement of practical goals through traditional evaluation methods. Taber (1989) argued that focusing on cognitive development may leave students unable to adapt to real-world challenges. When entrepreneurs struggle to launch and sustain a new venture, the critical challenge is not a lack of relevant knowledge but the necessary fortitude and attitude to face difficulties and challenges. Thus, entrepreneurs and business managers require development in the affective domain. Affection and cognition are complementary and cannot be developed independently during the learning process. Kraiger et al. (1993) pointed out that cognitive ability is foundational to effective learning, critical to behavioral performance and practical skills. Therefore, affective teaching strategies are essential in EEP (Fodor & Pintea, 2017). Effective teaching in the affective domain can help learners review their value choices, reflect on their value beliefs, revise their value systems, and then create their approaches to innovation and creativity.

Bloom et al. (1984) viewed affective development as exploring and adapting human interests, attitudes, values, and appreciation. Emotional learning outcomes cannot be readily quantified through traditional tests but rely on qualitative self-reflection. This study used the Affective Test developed by Wu et al. (2019). The test was administered four times and was divided according to the stages of Bloom's categorized affective domains in the course design, measuring whether students were at different levels for each stage of Bloom's affective curriculum. Each time, the learners provided written feedback on slips of paper after each class, and these comments served as the basis for further content analysis (Wu et al., 2019). Specifically, specific lesson design and content analysis of the affective domain of the EOI were combined to develop and assess the EOI. Information was collected through the EOI Affective Test; written student feedback and follow-up interviews were analyzed and compared; and reports collected after each lesson of the learning experience were analyzed to assess whether pre-determined instructional goals were met. This test determines whether students' affective domains have improved by

investigating how the course design affects students' Bloom's Taxonomy-based affective development.

There is a lack of standardized assessment skills tests to assess competencies, score students, and predict student performance in EOI. EOI is the process of opportunity identification, opportunity development, and opportunity assessment, where learners need to identify entrepreneurial opportunities, develop entrepreneurial opportunities, and assess entrepreneurial opportunities in the context of expertise, entrepreneurial resource integration, and teamwork (Ardichvili & Cardozo, 2000). This test is based on Ardichvili et al.'s (2003) behavioral definition of the process of EOI, combined with the overall behavior of the entrepreneurial process, based on Simpson's (1972) classification of the psychomotor domain into seven levels based on the behavior of students from observation to mastery of skills, based on Bloom's taxonomy. Skills are often a combination of abilities, each involving several levels. Instead of designing test questions individually, this research combined the course content and selected their basic and core skills to form four test questions, as shown in Table 2.9.

Table 2.9 EOI affective questionnaire (affective domain)

EOI Affective Questionnaire			
Level	Test design		Assessment
Lowest level	Attending	1.What did you learn in this course?	
	Receiving	2.What difficulties have you encountered?	
	Valuing	3.Evaluate the strengths and weaknesses of the course content?	
Highest level	Organization Characterization	4.What is your own opinion on this issue and other ideas.	

Source : Data Classification by the Researcher

2.2.8.3 EOI Psychomotor Test (psychomotor domain)

Table 2.10 EOI Psychomotor Test (Psychomotor domain)

EOI Psychomotor Test			
Level	Test design		Assessment
	Perception	1. Please analyze the EOI in the case.	
Lowest level ↓ Highest level	Set	2. Please analyze the evaluation of entrepreneurial opportunities in the case.	
	guided response	3. Please analyze the development of entrepreneurial opportunities in these cases.	
	Mechanism	4. Please form teams and make them work well.	
	complex overt response	5. Please use two models to design entrepreneurial opportunities.	
	Adaptation	6. Please skillfully introduce the EOI plan.	
	origination	7. Please skillfully evaluate the entrepreneurial opportunities of other teams.	
	origination	8. Please skillfully evaluate the entrepreneurial opportunities of other teams.	

Source : Data Classification by the Researcher

Based on the revised version of Bloom's taxonomy of educational objectives (Anderson & Krathwohl, 2001), this study created a summative assessment test based on seven levels of the psychomotor domain, as shown in Table 2.10. The test questions were designed from low to high levels in conjunction with the course

content in a simple to complex test design, with 7 test questions scoring 100 points, each of which was assigned a score based on its complexity in the cognitive domain of Bloom's taxonomy. The scores of the students after the test were measured using IRT.

Chapter 2 outlines the overall research framework and basis, covering the relevant variables determining EOI, including independent variables (EOI course) and dependent variables (EOI ability). The research discusses whether the EEP had played a role in improving the EOI ability of engineering students at Jiaxing University and developing the EOI course. The core proposition within this study's conceptual framework is that engineering students have significantly improved their EOI abilities after learning the EOI course.
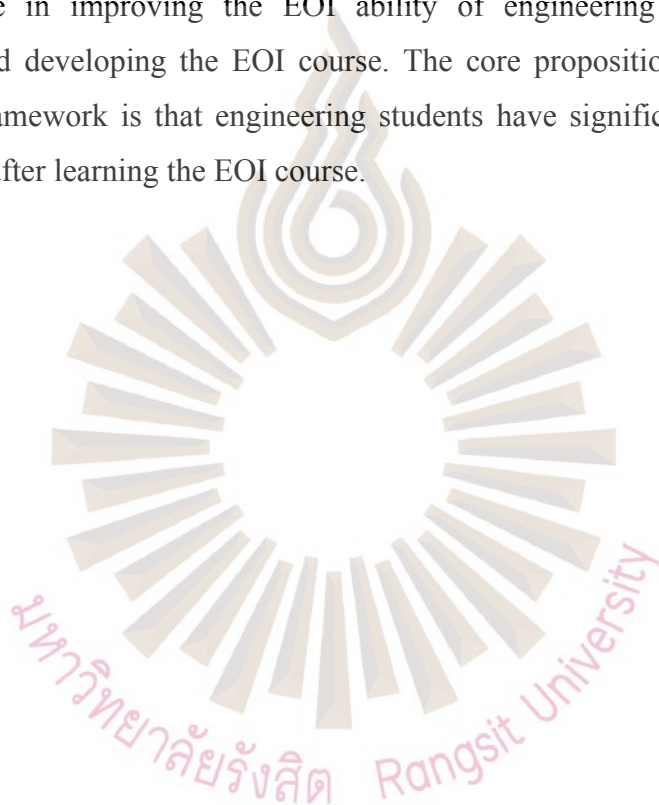
CHAPTER 3

RESEARCH METHODOLOGY

Chapter 3 describes the research methods used to achieve the study objectives, including study participants and research instruments, study design, data collection procedures, data analysis, and validity and reliability of the data.

3.1 Research Methodology and Research Design

The purpose of this research is to develop a course that can effectively improve the EOI abilities of engineering students. The research begins with a better understanding of the existing problems, followed by an exploratory development study.

There are two phases to this research. Phase 1 uses a questionnaire to collect EEP and EOI data from engineering students and uses the data to analyze the relationship between EEP and EOI. This survey study uses post-test to compare experiment and control groups participating in different levels of EEP courses to conclude whether students' EOI abilities have improved. Phase 2 develops and verifies the EOI course in literature and status support. A quasi-experimental pretest and post-test were used for measurement. The experiment group was subjected to the instructional intervention experiment of the EOI course, and quantitative and qualitative data collection and analysis were conducted to test whether the intervention course could effectively improve students' EOI abilities. Table 3.1 shows the detail.

Table 3.1 Data collection and survey purpose

	Phase 1 Survey Study		Phase 2 Development and validation Study	
Data Collection	Questionnaire 1 [Post-test]	Group1 [experiment group] Group2 [control group]	Questionnaire 2 [Prettest and Post-test] Interview	Group3
Objectives	To explore the influence of EOI course on the EOI ability of engineering students in EEP at Jiaxing University.		To experiment and validate the EOI course on the EOI ability of engineering students in EEP at Jiaxing University.	
Time	Aug 2022		Aug-Sep 2022	

The research used quantitative research-based and qualitative research-supported methods. The quantitative instrument was a questionnaire, and the qualitative instrument was an interview. The questionnaire used the social science system software package (SPSS) to make statistics and analyses of quantitative research data. Pearson correlation was used to calculate the relationship between EEP and EOI. The quantitative survey uses random sampling to distribute questionnaires to students and collect them online. Interview data was analyzed by NVIVO software. The target group of the study is sophomore and junior engineering students at Jiaxing University in eastern China. Based on the needs of the experimental objectives, they were grouped according to students who had only studied EEP compulsory courses and students who had studied both EEP compulsory courses and elective courses. The specific plan of the study was as follows:

Phase 1: Survey Study

1) Design Questionnaires and interview

Questionnaire 1 for Phase1

Questionnaire 1 was used in Phase 1 and had four parts: demographics, EEP courses, EOI ability, and opinions on the EOI course. Personal information is the collection of primary information from samples. The questionnaire measures the experiment and control groups, which received different levels of EEP courses. Data analysis was conducted to study the EEP courses on the EOI ability of engineering students.

questionnaire 2 and Interview for Phase 2

Questionnaire 2 and the interview were used in Phase 2: the EOI ability questionnaire and the EOI achievement interview. Twenty-six sophomore and junior engineering students were recruited for group 3, some of whom had only studied EEP compulsory courses, while others had studied EEP compulsory and elective courses. Questionnaire 2 was used for the pretest and post-test of group 3, and the interview was used for the post-test of group 3. They were used to obtain the EOI ability data of group 3 and analyze whether the EOI course effectively improved the EOI ability of engineering students of Jiaxing University.

2) Validity of the questionnaires and test Interview

Five experts were invited to evaluate the rationality, reliability, and validity of the questionnaires and interview, and 30 students were randomly selected to participate in the pretest of the questionnaires and interview, revised by the researcher based on the feedback.

3) Data Collection

The population size was 457, with 82 engineering students who had taken both the compulsory and elective EEP courses and 375 engineering students who had taken only the compulsory EEP course. All 82 engineering students as the

experiment group   and random sampling method was used to select 138 samples from 375 engineering students as the control group (Krejcie & Morgan, 1970).

Phase 2: Development and validation Study

1) Experimental Design

The EOI course was designed based on the findings of Phase1. Group 3 consists of 26 recruited sophomore and junior students, some of whom had only studied EEP compulsory courses, while others had studied EEP compulsory and elective courses. Questionnaire 2 and interview were used for the pretest and post-test of group 3.

Then, a ten-day course experiment was conducted for group 3, and the researcher of this study served as the trainer for this course. At the end of the course, post-test was administered to group 3. Data were collected and analyzed to determine if the EOI course was effective in improving the EOI ability of group 3. The key messages of the research design are presented in Figure 3.1.

Phase 1: Survey Study

To explore the influence of EEP courses on the EOI ability of engineering students at Jiaxing University.

Research Design

    Post-test for the experiment and control group
3. Population size: 457 sophomores and junior engineering undergraduates from four engineering majors
3.1 Experiment group: Group 1, 82 students who had studied both EEP compulsory and elective courses. Control group: Group 2,138 students who had only studied EEP compulsory courses
3.2 Control group: Group 2,138 students who had only studied EEP compulsory courses

Data collection: Questionnaire

Independent variable：EEP Courses
Dependent variable：EOI ability

Phase 2: Development and validation Study

To experiment and validate the EOI course on the EOI ability of engineering students in EEP at Jiaxing University.

Research Design
1. Quantitative research and qualitative research
2. Pretest and post-test
3. 26 recruited sophomores and junior engineering undergraduates, some of whom have only studied EEP compulsory courses, while others have studied EEP compulsory and elective courses
3.1 Group 3
4. Recruiting Sampling

Data collection: Questionnaire and Interview
5.Variables：
Independent variable：EOI course
Dependent variable：EOI ability

Figure 3.1 Main information about the research design

3.2 Population and Samples

In the research, samples should be selected for a specific purpose (Malebana, 2014). Samples for this research were drawn from Jiaxing University, a public university in the eastern coastal region of China (a more economically developed area). As of April 2023, this university has over 5,400 engineering students and will have over 50,000 engineering students in the next 10 years. The results of this study have applicability to this university. In addition, the EEP of Jiaxing University has been implemented for ten years, from 2013 to 2023. The university has essential management and teaching experience in EEP. It has four Engineering Colleges with 22 majors, including four in the College of Materials and Textile Engineering, nine in the College of Information Science and Engineering, five in the College of Biological and Chemical Engineering, and four in the College of Architectural Engineering.

The four engineering colleges have similar entrance grades, learning ability, social cognitive ability, entrepreneurial learning environment, and entrepreneurial conditions, as well as the proportion of students taking EEP courses, and each college has no less than four majors with rich sample sources. Secondly, the College of Architecture and Engineering can provide research support staff in collecting and distributing the questionnaire and interview, organizing students' participation in the experiment, and data collection, which can be helpful in the experiment's implementation to provide an adequate guarantee. Therefore, sophomores and juniors of the four engineering majors (civil engineering, engineering management, building environment, energy application engineering, and architecture) in the College of Architecture Engineering were selected as samples for this research.

3.2.1 Sample Size

All the samples had completed the compulsory EEP courses when they were freshmen and were the primary recipients of the EEP elective courses at the undergraduate level. The population is 457, of which 375 students have taken only the compulsory EEP courses, and 82 have taken both the compulsory and elective courses.

3.2.2 Experiment and Control Groups

Phase 1 has two groups, Group 1 and Group 2, while Phase 2 has one group, Group 3. The researcher worked at the university and had access to the student list, including the student's learning ability, social perception, and entrepreneurial learning environment.

In Phase 1, Group 1 was the engineering students who had taken EEP compulsory and elective courses; with a population size of 82, they were all used as samples. Group 2 was the engineering students who had only taken the EEP compulsory courses; 138 students were randomly selected from 375. In Phase 2, group 3 has 26 recruited sophomore and junior students, some of whom had only studied EEP compulsory courses, while others had studied EEP compulsory and elective courses. The sample sizes of Group 1, 2, and 3 are presented in Table 3.2, and 3.3 were used to determine the sample size (Krejcie & Morgan, 1970).

Table 3.2 Sample size and method

	Group	Population Size	Sample Size	Sampling Method	Sample Characteristics
Population 457	Group1	82	82	Cluster	CE
	Group2	375	138	Random	CC
	Group3	26	26	Recruitment	CE+CC

CE: Engineering undergraduates Who Had Learned the compulsory and elective EEP courses

CC: Engineering undergraduates Who Had Learned compulsory EEP courses

Table 3.3 Table for determining the sample size of the known population

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	1000000	384

Source: Krejcie & Morgan, 1970

<u>Note</u> N is Population Size; S: S is Sample Size.

3.3 Research Instruments

This study has two Phases. A post-test was administered to Groups 1 and 2 in Phase 1 using Questionnaire 1 to collect data on their EEP learning levels, EOI competency levels, and opinions on the EOI course to be developed. The two data sets of data were compared and analyzed to determine the relationship between EEP and EOI ability. The design basis of the questionnaire is detailed in 3.4, and the specific content of the questionnaire is shown in Appendix A.

In Phase 2, questionnaire 2 was used to pretest and post-test the EOI ability of the group 3. The questionnaire design basis is detailed in 3.4, and the content of questionnaire 2 is shown in Appendix B. A Structured interview was conducted with the students of the group 3 for qualitative data analysis. The interview questionnaire is shown in Appendix C.

3.3.1 Questionnaire 1

Questionnaire 1 has four parts. 1) The demographic characteristics collect data on students' personal information and entrepreneurship-related experiences. 2) The "EEP scale" part is to collect data on students' entrepreneurial motivation, entrepreneurial preparation, entrepreneurial skills, and entrepreneurial interpersonal networks to measure the corresponding effects on students after studying EEP courses. 3) The "EOI scale" part is to collect data on whether students have the EOI ability after learning EEP courses at different levels, and the EOI ability is measured. Through the collection and analysis of the groups of data, data measurement, and correlation analysis are carried out to determine whether the research samples have EOI ability, whether there are differences in EOI ability, whether EOI was improved, and the relationship between the two variables of EEP and EOI. 4) The"EOI course Cognition" part was used to collect students' opinions on the EOI course that will be developed. Table 3.4 shows the theoretical sources of Questionnaire 1.

Table 3.4 Theoretical sources of questionnaires

1	Demographics	Goje (2017)
2	EEP	Souitaris et al. (2007)
3	EOI Ability	Chandler and Hanks (1994) Cai et al. (2014)
4	the EOI course on Cognition	Taylor (2002)

1) Demographics

The data considered in this study include gender, major, grade, whether they have taken more entrepreneurship education courses, and whether they have entrepreneurial experience. These variables are common influencing factors in the entrepreneurial process, which are also supported in the literature. Gender (male=1, female=2), major (Civil Engineering=1, project management=2, building environment, and energy application engineering=3, architecture=4), grade (Sophomore=1, Junior=2), how many EEP elective courses did you study? (0 course=1, 1 course=2, 2 courses=3, 3 courses=4, 4 courses=5). Do you have any entrepreneurial experience?(NO=0, Running a family business=1, Start a new company=2, Personal business activities=3, Follow Entrepreneurship=4).

2) Entrepreneurship Education Program

In this study, EEP refers to the education that can provide students with entrepreneurial knowledge and skills. This study adopts the EEP concept learning measurement method of Souitaris et al. (2007), based on the concept classification of five levels of entrepreneurial learning indicators by Johanison (1991). A person's perception of the environment may better predict entrepreneurial behavior than the actual situation (Zahra, 1993). Respondents were asked to use the 5-point Likert scale (1= not at all, 5= to a large extent) to measure the extent to which EEP has affected them. The following questions were investigated, including the understanding of entrepreneurs' motivation and values (why entrepreneurs should act), the actions they need to take (what they need to do), the actual management ability and skills of entrepreneurship (how to start a business), the ability to build interpersonal networks (whom you need to know), and the ability to identify opportunities (when to act). These five questions are to deal with the teaching content of EOI involved in EEP in this study, including the accurate measurement of entrepreneurial motivation, entrepreneurial preparation, entrepreneurial skills, entrepreneurial interpersonal networks, and opportunity recognition ability. Questions 1- 4 are data on the teaching effectiveness of EEP, while question 5 is about students' perceptions of their own EOI abilities. Therefore, question 5 is analyzed together with the seven questions of the EOI. They are shown in Table 3.5.

Table 3.5 EEP Scale

2.1	Increase students' understanding of the actions one needs to take in order to start a business	
2.2	Increase students' understanding of the attitudes, values, and motivations of an entrepreneur	
2.3	Increase students' practical management knowledge and skills on how to start a new venture	
2.4	Increase students' abilities to create networks	

[1] Not at all   [2] Little extent   [3] Not sure   [4] Great extent   [5] A very great extent

3) Entrepreneurial opportunity identification ability

EOI in this study refers to the ability of individuals to recognize good entrepreneurial ideas and translate them into business concepts (Karimi et al., 2016). In the third part of the questionnaire, the EOI scale draws on the measurement of EOI by Chandler and Hanks (1994) and the entrepreneurial opportunity utilization by Cai et al. (2014). EOI ability includes being able to accurately perceive the unmet market demand, being willing to spend more time and energy looking for products and services that can bring value to customers, being able to identify the products and services that consumers need effectively, and, with external support, being able to predict the prospects of the industry to be developed. Opportunity utilization capacity includes being able to make resource allocation decisions to maximize benefits, being able to organize and motivate employees to achieve corporate goals, and being able to manage resources and coordinate various work tasks effectively. Table 3.6 shows them.

Table 3.6 EOI scale

3.1	Increase your ability to exploit an opportunity	
3.2	Be able to perceive the unmet market demand accurately.	
3.3	Be able to predict the industry's prospects with external support.	
3.4	Be able to identify the products and services that consumers need effectively.	
3.5	Willing to spend more time and energy looking for products and services that can bring value to customers.	
3.6	Be able to make resource allocation decisions to maximize benefits.	
3.7	Be able to organize and motivate employees to achieve corporate goals.	
3.8	Be able to organize resources and coordinate various work tasks effectively.	

[1]Not at all   [2] Little extent   [3] Not sure   [4] Great extent   [5] A very great extent

4) EOI Course Cognition Questionnaire

The purpose of this part is to collect students' views on the EOI course to be developed. The Course Cognition Questionnaire contains ten questions in four areas: Course planning, Teaching content, Teaching objectives, and Teaching evaluation (Taylor, 2002). Part 4 of Appendix A shows the details of the ten questions.

3.3.2 Questionnaire 2 and Interview

Phase 2 used questionnaire and interview to collect quantitative and qualitative data on students' learning outcomes. Questionnaire 2 used the EOI scale developed by Chandler and Hanks (1994) and Cai et al. (2014), as shown in Table 3.4. The interview questions were conducted using the EOI achievement test designed in this study, which belongs to the cognitive domain. The questions can be found in Appendix C.

3.4 Data Collection

3.4.1 Data Collection Procedures

This study collected research data of four engineering majors in Phase 1 and Phase 2. The full versions of the questionnaires 1, 2 and the interview are showed Appendices A, B, and C.

3.4.2 Validity and Reliability of Instruments

To prevent the respondents from being unable to answer questions accurately due to vague questions, too concentrated answers, tricky questions caused by question sequencing, conflicts with answers caused by sensitive vocabulary, or ignored or omitted questions, the pre-survey procedure shall be carried out before the formal questionnaire work. This procedure can improve the validity of the questionnaire and tests (Saunders et al., 2012). In this study, 30 engineering students were randomly selected to pretest the questionnaire prior to the survey, and some linguistic expressions that tend to cause uprisings were corrected.

3.4.2.1 Validity

Validity refers to how the tool measures what it wants to measure. The Index of Item- Objective Congruence (IOC), developed by Rovinelli and Hambleton (1977), is a procedure used in instrument development for evaluating content validity at the item development stage. In this study, IOC was used to assess classroom observations, a structured interview, and a questionnaire and was evaluated by five experts, including three Thai experts and two Chinese experts, who have a high level of English ability. The IOC points in calculations are provided on three scales of rating for the consistency and congruency of the items. Five experts will choose only one answer as the given mark from these three alternatives:

$+1$ = Congruent with clear understanding,

0 = Uncertain or not sure whether the item is related to the research objectives,

-1 = Not understanding, congruent, or unrelated to the research objectives.

Total points for each item must have the consistency value equal to or above 0.5; IOC marks were calculated by applying the following equation:

$$\text{IOC} = \frac{\sum r}{n} \qquad (3\text{-}1)$$

"r" is the individual expert's score, and "n" is the number of experts (using the IOC standard). The experts scored the questionnaire and interview questions, and 36 of the IOC Averages in the summary table scored 1, 3 scored 0.8, and 1 scored 0.6. The IOC results were above 0.6, and 90% were 1. The ICO of this study has high validity. The scoring results are shown in Appendix F.

3.4.2.2 Reliability

Cronbach's Alpha (Cronbach, 1951) was used to check the reliability of the questionnaire. The researcher invited a trial group of 30 engineering students to complete a questionnaire and calculated the value using the SPSS application. According to Table 3.7, the higher the Cronbach's Alpha coefficient is, the more reliable the instrument will be. To be regarded as acceptable in this study, reliability must be above 0.7, which is considered strong dependability.

Table 3.7 Description of internal consistency using Cronbach's Alpha

Cronbach's α	Internal consistency
α≥0.9	Excellent
0.9＞α≥0.8	Good
0.8＞α≥0.7	Acceptable
0.7＞α≥0.6	Questionable

Table 3.7 Description of internal consistency using Cronbach's Alpha (Cont.)

Cronbach's α	Internal consistency
0.6＞α≥0.5	Poor
0.5＞α	Unacceptable

The details of the Cronbach's Alpha coefficient (α) scores and interpretation are shown in Table 3.8. Cronbach's Alpha of the Entrepreneurship Education Program is 0.954, and Cronbach's Alpha of the Entrepreneurial Opportunity Identification is 0.954. Their internal consistency is excellent. Cronbach's Alpha of the EOI course Cognition Questionnaire is 0.648. Its internal consistency is acceptable.

Table 3.8 The Cronbach's Alpha Values

Variables	Cronbach's Alpha	Sum of Items	Internal consistency
Entrepreneurship Education Program	.954	4	Excellent
Entrepreneurial Opportunity Identification	.961	8	Excellent
EOI Course Cognition Questionnaire	.648	10	Questionable

3.4.3 Survey Procedure

Survey Background

The background of EEP courses in Phase 1 and Phase 2 surveys is the same. EEP compulsory courses and elective courses are suitable courses for the whole university. Entrepreneurship instructors have received unified training, and the course content, teaching methods, and course are the same. The same teacher teaches the experimental course, and the teaching conditions and contents are the same. This

research has been approved by the teaching management department of the University and carried out under the guidance of morality and specialty. The researcher ensured that all necessary ethical measures were taken before, during, and after the investigation. Students' participation in the survey was voluntary, confidential, and anonymous. Participants agree to participate in the survey voluntarily and may withdraw from the survey at any time. Any third party will not track their responses, and the questionnaire will be destroyed after data analysis.

Survey Arrangement

After reliability and validity checks by five experts, 30 sophomores and juniors who were not selected as a sample were randomly assigned to participate in the pretest in August 2022, these students will not participate in the formal survey. The main purpose is to test the comprehensibility and effectiveness of survey questionnaires and interview. For the formal survey in Phase 1, Questionnaire 1 was scheduled for two weeks, and it was distributed and recycled online. In Phase 2, the process of the pretest and post-test survey was the same as above, with the pretest scheduled in August and the post-test in September 2022. The interview follows closely after the post-test. Phase 1 used Questionnaire 1 to collect data of Group 1 and Group 2. Phase 2 used Questionnaire 2 and the interview to collect data of Group 3.

3.5 Data Analysis

In this study, SPSS 26.0 was used for data analysis to reveal the statistical significance of the results and test the research objectives and hypotheses of this research. The reliability and normality tests were carried out to test the validity of the data and analyze the test hypothesis. (Karimi et al., 2016; Sanchez, 2013).

3.5.1 Statistics Overview

Based on the research hypotheses, Phase 1 is planned to use different analysis methods for the data collected in the four sections of Questionnaire 1. Specifically, in the data analysis of the demographic information (gender, major, grade level), "How

many EEP courses did you study?" and "Do you have any entrepreneurial experience?" Cross-analysis and one-way ANOVA will be used to verify whether EEP has a significant effect on EOI. The data analysis of the EEP courses and EOI ability are analyzed for reliability, including frequency analysis, reliability analysis, and validity analysis. The mean difference and standard deviation of the critical instruments, EEP and EOI, will be discussed. Data are analyzed for EEP and EOI using a one-way ANOVA and a Pearson correlation matrix to measure the relationship between the correlation coefficient variables, which would provide further evidence for research hypothesis 1. Multiple regression analysis will be used to confirm the relationship between EEP and EOI. In order to effectively improve students' EOI abilities, an "EOI for Engineering Students" course should be developed. Therefore, descriptive analysis will be used to compare the data on the perceptions of the EOI course between the experimental and control groups and to statistically analyze the students' perceptions of the EOI course to help accurately adjust the course development.

In Phase 2, a comparison of the pretest and post-test means will be used to analyze the EOI data collected from Questionnaire 2, which can provide data to support whether the EOI has improved significantly. At the same time, an interview questionnaire (EOI Achievement Test) will be used to interview 26 students participating in the course of the intervention experiment, and the qualitative analysis software NVIVO will be used to encode and analyze the data using keywords. These findings can be used to argue whether Hypothesis 2 is valid.

CHAPTER 4

DATA ANALYSIS

This chapter presents data analysis and the quasi-experimental results discussed in previous chapter by testing the hypotheses. The researcher discussed demographic information, and the results were consistent with expectations by using statistical analysis software SPSS 26.0 to reveal the statistical significance of the results to test the research objectives and hypotheses.

There were two phases in the research. Phase 1 was to verify by questionnaire 1 that the EEP had a positive correlation on improving engineering undergraduate students' EOI ability to provide evidence support for the necessity of developing a course that can enhance students' EOI; Phase 2 was to verify the effectiveness of the developed EOI course. By comparing EOI levels of group 3 before and after learning the course with a scale, it concluded that the practice had a better role in improving EOI ability. This chapter had two sections including a summary of survey results, analysis, the relationship between EEP and EOI, and a discussion on the effectiveness of the developed EOI courses.

4.1 The outline of Data Analysis

This research had two Phases. The fundamental proposition of Phase 1 was that engineering students participating in EEP studies at Jiaxing University may have a particular impact on improving their EOI ability. This part had a specific research questions: What factors of EEP courses significantly impact the EOI ability of engineering students? On this basis, Phase 2 will develop an EOI course for engineering students that will effectively improve students' EOI competencies, which will be validated and discussed.

These data were collected from engineering students at Jiaxing University in a developed region of eastern China before and after studying different levels of EEP. The 220 engineering undergraduates (82 in the experiment group and 138 in the control group) participated in the first and 26 in the second phases. Phase 2, the researcher used the pre-test and post-test experiment group design. The study compared the experiment and control groups using a post-test, and the results showed that:

1) EEP and EOI are positively correlated: Engineering students who had participated in EEP had the EOI ability but low. Students who had participated in studying more EEP courses had slightly higher EOI ability than those who only participated in EEP compulsory courses. Therefore, EEP had a positive correlation with the improvement of EOI ability.

2) Among the factors that affect students' EOI, "attributes, values, and motivations of an entrepreneur" and "management knowledge and skills" are the most significant influencing factors: Therefore, when forming the EOI abilities, students must focus on learning and mastering these two abilities, as they have a relatively practical effect on improving students' EOI ability.

3) Except for the EEP course, other control factors are insignificant: Specifically, gender had no significant effect on improving the EOI ability, while majors have some influence, which is because the different entrepreneurial characteristics of majors determine the convenience of professional innovation and entrepreneurship. Therefore, when planning to start a business, it is necessary to guide students in entrepreneurship by teaching courses in their majors. On a broader level, this research provides empirical evidence for specialized ability education in EEP by revealing the factors that affect students' EOI in EEP courses.

Phase 2 used a pretest and post-test to the 26 recruited students. It used a questionnaire and interview to investigate the EOI data of engineering students before and after learning the developed EOI course. The results showed that these students'

EOI abilities improved significantly after learning compared to Phase 1. Overall, this research supports the development of methods that can effectively enhance the EOI of Chinese engineering students by revealing the most important factors affecting their EOI and providing empirical evidence and relevant literature on EOI.

4.2 Demographic Information

This research collected demographic data, including gender, major, grade, and whether they had taken more entrepreneurship education courses and entrepreneurial experience. A cross-analysis was used on the above aspects between the experiment group (students who had studied EEP compulsory and elective courses) and the control group (students who had only taken EEP compulsory courses) to provide background data for determining the impact of EEP on EOI. Gender, Major, Grade, "How many EEP courses?", "Do you have any introductory experience?" and "Have you studied any other EEP courses?" were cross analyzed, respectively. This analysis may or may not significantly impact EOI; it used one-way ANOVA to verify whether these factors and EEP significantly impact EOI. This analysis is helpful for the effectiveness of EEP.

4.2.1 Gender

This research used cross-analysis to study the differential relationship between gender and 'Have you studied any other EEP courses?'. The proportion of males and females who had only studied EEP compulsory courses is 62.81% and 62.63%. The balance of males and females who have studied EEP compulsory and elective courses is 37.19% and 37.37%. It seems that gender does not impact whether students choose to explore more EEP courses. Table 4.1 shows the above.

From the total sample size perspective, the difference between the experiment and control groups is 25%, 1/4 of the sample size. There are several possible reasons for this result:

Table 4.1 Gender analysis of the samples

Cross Analysis				
Items	Categories	Have you studied any other EEP courses?(%)		Total
		Learned [experiment group]	Did not Learn [control group]	
Gender	Male	45(37.19)	76(62.81)	121(55)
	Female	37(37.37)	62(62.63)	99(45)
Total		82	138	220

Source: Survey results, 2022

1) Entrepreneurship Education Environment: Insufficient publicity efforts and low popularization rate at Jiaxing University and society, resulting in intense attention from students to studying entrepreneurship education.

2) EEP courses: The curriculum system needs to be sound, which may lead to insufficient attractiveness of the courses. Students need a better learning experience during their first year of studying EEP compulsory courses and must fully experience the magnificence and continuity of the classes.

3) Course arrangement issues for students: Engineering students have many professional courses and need more time and energy to study systems with non-mandatory credits. Therefore, teachers must design these exercises carefully and compactly to achieve good results within the limited class time.

4) Employment culture issue: Most students are still concerned about their future employment direction, such as finding a job in a company or becoming a civil servant. They do not want more pressure. Therefore, in entrepreneurship education, it is necessary to strengthen practical entrepreneurship education publicity work, enhance the fun of existing courses, strengthen the continuity among systems, and make students willing to continue studying.

4.2.2 Major

The researcher used cross-analysis to analyze the differences in willingness among majors to learn more EEP courses. Building environment and energy application engineering and architecture had the highest proportion, accounting for nearly half of the professionals. The civil engineering sample and the engineering management sample each accounted for more than a quarter of the total. From Table 4.2, different majors have specific differences in whether to study more EEP courses.

Table 4.2 Major analysis of the samples				
Cross Analysis				
Items	Categories	Have you studied any other EEP courses?(%)		Total
		Learned [experiment group]	Did not Learn [control group]	
Major	Engineering management	17(26.98)	46(73.02)	63(28.64)
	Building environment and energy application engineering	28(44.44)	35(55.56)	63(28.64)
	Architecture	30(41.67)	42(30.43)	72(32.72)
	Civil engineering	7(31.82)	15(68.18)	22(10.00)
Total		82	138	220

Source: Survey results, 2022

From the perspective of professional characteristics, Building Environment and Energy Application Engineering and Architecture had a high degree of professional technical flexibility. Building Environment and Energy Application Engineering could apply for patented technology and inventions with the characteristic of independent entrepreneurship. Architecture provided products to customers through design consulting services, requiring only architects to provide intellectual output, making it easy for independent practice. The job nature of Civil Engineering was generally to supervise construction sites or cooperate with architecture majors in design, with weak

characteristics of independent practice. Engineering management relied on enterprises for engineering management, which was not conducive to personal entrepreneurship. Overall, students from different majors had varying demands for entrepreneurship during the learning process of their professional courses. For majors with poor unique entrepreneurship conditions, course teachers and entrepreneurship education teachers must effectively guide and develop students' innovative abilities, laying a solid foundation for their future "internal entrepreneurship." For majors with good personal entrepreneurship conditions, students are encouraged to accumulate more entrepreneurial knowledge and practical experience and participate more in entrepreneurial activities, laying a solid foundation for future entrepreneurial activities.

4.2.3 Grade

Table 4.3 Grade analysis of the samples

Cross Analysis				
Items	Categories	Have you studied any other EEP courses?(%)		Total
		Learned [experiment group]	Did not Learn [control group]	
Grade	Sophomore	24(27.59)	63(72.41)	87(39.55)
	Junior	58(43.61)	75(56.39)	133(60.45)
Total		82	138	220

Source: Survey results, 2022

This study used cross-analysis to analyze the differences in the willingness of different grades to learn more EEP courses. Table 4.3 showed that Sophomore accounted for 27.59% and Junior accounted for 43.61% of the experiment group. The proportion of students choosing to study EEP courses increased as the grade increased. More students took elective courses in their junior year than in their sophomore year. However, although Juniors learned one more year than Sophomores, it still was at most 50%, which indicates that offering a more attractive EEP course was necessary to make students happy to learn. In addition to natural growth reasons, as grades rise,

some students had their own needs, such as employment needed and professional practice needs. Compared to Sophomore, Junior placed more emphasis on learning entrepreneurship education and hoped to acquire more entrepreneurial knowledge and skills. When designing EEP courses, customized course content could be developed according to student's needs, providing more targeted lessons for specific students. After 20 years of implementing popular EEP education in China, precise alignment was also an inevitable trend for future EEP courses.

4.2.4 Do you have any entrepreneurial experience?

Table 4.4 "Do you have any entrepreneurial experience?" analysis of the samples

Cross Analysis				
Items	Categories	Have you studied any other EEP courses?(%)		Total
		Learned [experiment group]	Did not Learn [control group]	
Do you have any entrepreneurial experience?	NO	67(34.36)	128(65.64)	195(88.64)
	Running a family business	8(72.73)	3(27.27)	11(5.00)
	Start a new company	1(100)	0(0.00)	1(0.45)
	Personal business activities	3(37.50)	5(62.50)	8(3.64)
	Follow Entrepreneurship	3(60.00)	2(40.00)	5(2.27)
Total		82	138	220

Source: Survey results, 2022

The researcher used cross-analysis to analyze the differences in whether students with different entrepreneurial experiences are willing to learn more EEP courses. From Table 4.4, the proportion of students with entrepreneurial experience

was low, with 11.36% reflecting the limited entrepreneurial experience of Chinese engineering students, which may be related to China's exam-oriented education. Students needed to learn through practical EEP courses and consciously start their businesses. Specifically, 100% of students from Start a new company, 72.73% of students with family and business backgrounds chose to study more EEP courses, 60% of students with Follow Entrepreneurship experience, 37.5% of students with Personal Business activities experience, and 34.36% of students without any entrepreneurial venture. Students with more and more exposure to entrepreneurial activities had a higher probability of choosing to study more EEP courses, indicating that There might be a positive correlation between entrepreneurial experience and whether one had taken more EEP courses. The students with entrepreneurial ventures were willing to take more EEP courses, and learning more EEP courses might be more helpful in promoting entrepreneurship. It is necessary to offer EEP courses more tailored to students' needs.

Summarize

From the perspective of whether students were willing to learn more entrepreneurship courses, there is no significant relationship with gender. Still, there was a varying degree of substantial impact on majors, grades, and whether they have entrepreneurial experience. From the perspective of their impact on EOI, Figure 4.3 (P111) showed that these factors did not have a significant impact on the process of EEP's impact on EOI. Therefore, in EEP course development, personalized training was suitable for students of different majors, grades, and whether they have entrepreneurial experience, as they significantly impacted the overall teaching effectiveness of EEP. However, teachers did not need to consider these factors in improving EOI ability.

The data showed that students with family business backgrounds had more important entrepreneurial consciousness. Since starting a new company requires a higher overall quality and self-awareness, fostering student entrepreneurship is a long-term and challenging task for university entrepreneurship education. Students engaging in personal business activities or following others to start a business was a

lower threshold for college students, easier to achieve, and had the potential to help increase the rate of entrepreneurship. More emphasis can be placed on these two aspects of entrepreneurial awareness in entrepreneurship education by providing more guidance, encouragement, and support.

4.3 Reliability Tests

This research examines the relationship between EEP courses and engineering students' EOI ability. It measures the EOI ability level values of experiment and control groups who studied EEP courses at different levels. On this basis, develop a system to improve engineering students' EOI ability and verify the course's effectiveness.

Phase 1 is to collect the EOI abilities of engineering students and the differences in the impact of two levels of EEP courses on EOI abilities through a survey questionnaire. Use a post-test to measure the level of the experiment and control groups after learning different levels of EEP courses. Phase 2 develops and validates the EOI course through literature and evaluation support. Conduct teaching intervention experiment on the EOI course for the experiment group, using pretest and post-test quantitative data collection and analysis to test whether the intervention course can effectively improve the EOI ability of engineering students.

In Phase 1, the researcher collected 220 survey questionnaires with 220 valid questionnaires. It contained Eighty-two experiment group data and 138 control group data. The four scales of independent variables EEP are "start a business," "attributes, values, and motivations of an enrollment," "management knowledge and skills," and "create networks." The Entrepreneurship Education Program uses the weighted average method to generate total variables. The eight scales of dependent variable EOI are "explore an opportunity," "perceive the unmet market demand," "predict the prospects of the industry," "identify the products and services," "spend more time and energy looking for, "make resource allocation decisions," "organize and motivate employees," "organize resources and coordinate variable work," Generate the total

variable Entrepreneurial Opportunity Identification using a weighted average method. Perform reliability analysis on these data, including frequency analysis (Table 4.5), reliability analysis and validity analysis (Table 4.6).

Table 4.5 Frequency Analysis

Frequency Analysis					
Items	Categories	Experiment Group		Control Group	
		n	Percent (%)	n	Percent (%)
Entrepreneurship Education Program	[1]Not at all	2	2.44	5	3.62
	[2] Little extent	5	6.10	7	5.07
	[3] Not sure	34	41.46	83	60.14
	[4] Great extent	30	36.59	36	26.09
	[5] A very great extent	11	13.41	7	5.07
Entrepreneurial Opportunity Identification	[1]Not at all	2	2.44	6	4.35
	[2] Little extent	3	3.66	3	2.17
	[3] Not sure	34	41.46	72	52.17
	[4] Great extent	34	41.46	44	31.88
	[5] A very great extent	9	10.98	13	9.42
Total		82	100.0	138	100.0

Table 4.5 shows that the frequency of the Entrepreneurial Education Program and Entrepreneurial Opportunity Identification and the "Great Extent" and "A Very Great Extent options in the experiment group are higher than those in the control group. This data indicates that after studying EEP courses, the experiment group has a higher affirmation and self-awareness of entrepreneurial and EOI abilities and a higher level of entrepreneurial and EOI abilities. At the same time, the proportion of "Not Sure" and "Not at All" options in the experiment group was lower than that in the control group, indicating that more EEP courses were studied, and the experiment group had a more determined self-awareness of entrepreneurial and EOI abilities than

the control group. At the same time, most of the options in both groups were low, which may be consistent with the hypothesis that "after learning more EEP courses, the EOI ability improves, but the score is lower."

Table 4.6 Cronbach's alpha and KMO Test of EEP and EOI

Cronbach's alpha			
Variable	No. of Items	Cronbach α (experiment group, n=82)	Cronbach α (control group, n=138)
EEP	4	0.917	0.887
EOI	8	0.955	0.958
KMO			
Variable	No. of Items	KMO (experiment group, n=82)	KMO (control group, n=138)
EEP	4	0.834	0.815
EOI	8	0.922	0.923

Overall, Cronbach's Alpha and KMO values are more significant than 0.8, indicating the high reliability and validity of the collected data. All items have stable and consistent results (Pallant, 2010), making them suitable for extracting information.

Descriptive Statistics of Main Instruments

One-way ANOVA was used to analyze data on the impact of EEP on EOI. Each instrument's average, standard deviation and range discuss to verify that "engineering students who had completed EEP compulsory & elective courses and engineering students who had completed compulsory courses have EOI ability, but their level is relatively low. The study confirmed three aspects: whether EEP impacts EOI improvement, the EOI level of the two groups of students, and whether the EOI of the experiment group is higher than that of the control group. After data analysis, the researcher found that the overall level of EOI is low. Still, students receiving more EEP courses have a higher EOI than those studying fewer EEP courses. Therefore, it inferred that EOI still needs to be improved. The researcher developed an EOI course for Engineering Students and recruited 26 students to participate in the teaching

activities of the course. A comparative experiment was conducted on group 3 using a survey questionnaire before and after the test. The data was analyzed using average values, and the EOI level had significantly improved, indicating that the course was practical.

Research Hypothesis

Phase 1 of the research empirically tested the experiment and control groups using the following assumptions:

H1: The engineering students who had completed EEP compulsory courses and those who had completed both compulsory and elective courses have low EOI ability.

A survey questionnaire measured EOI levels in the experiment and control groups. The test showed that the average of the experiment group (n=138) was slightly higher than that of the control group (n=82), and both showed a gradual upward trend, but the overall level was relatively low. Consistent with this assumption, the assumption is valid.

4.4 Analysis of the impact of EEP on EOI

4.4.1 Analysis of Means

Table 4.7 is the corresponding table for the full names and codes of EEP and EOI factors.

Table 4.7 Full Name and Code of Variables

Variables	Full Name	Code
EEP	Increase understanding of the action one needs to take to start a business	EEP1
	Increase knowledge of the attitudes, values, and motivations of an entrepreneur	EEP2

Table 4.7 Full Name and Code of Variables (Cont.)

	Increase practical management knowledge and skills of how to start a new venture	EEP3
	Increase ability to create networks	EEP4
EOI	Increase ability to exploit an opportunity	EOI1
	Be able to perceive the unmet market demand accurately	EOI2
	With external support, predict the industry's prospects to develop	EOI3
	Be able to identify the products and services that consumers need effectively	EOI4
	Willing to spend more time and energy looking for products and services that can bring value to customers	EOI5
	Be able to make resource allocation decisions to maximize benefits	EOI6
	Be able to organize and motivate employees to achieve corporate goals	EOI7
	Be able to manage resources and coordinate various work tasks effectively	EOI8

The followings are the exact values of the analysis of variance for the experiment and control groups, including F-values, P-values, mean ranges, and SD ranges.

Increase understanding of the action one needs to take to start a business

Table 4.8 listed the summary statistical analysis of the experiment group and the data analysis of each EOI factor corresponding to EEP1. Use one-way ANOVA to study the differences in the impact of "start a business" on 8 EOI factors in the experiment group, it seems from the above table that all showed significant ($p<0.05$) differences, but F-values of EEP1 is much lower than EEP2、EEP、EEP4, it requires to use multiple regression analysis to determine whether EEP1 has a significant positive impact on the eight factors and whether EEP1 has a considerable effect on the overall mean of EOI.

Table 4.8 One-way ANOVA for 'Experiment Group' EOI (start a business)

	EEP1 (Mean±Std. Deviation)					F	p
	[1]Not at all (n=6)	[2] Little extent (n=8)	[3] Not sure (n=32)	[4] Great extent (n=24)	[5] A very great extent (n=12)		
EOI1	2.67±1.37	2.75±0.46	3.47±0.80	3.96±0.36	4.92±0.29	19.263	0.000**
EOI2	2.00±0.89	2.88±0.64	3.47±0.72	3.79±0.59	4.42±1.24	11.566	0.000**
EOI3	2.00±1.26	2.63±0.52	3.22±0.66	3.79±0.59	4.42±1.08	14.664	0.000**
EOI4	2.17±0.98	2.88±0.64	3.34±0.70	3.75±0.68	4.67±0.65	16.351	0.000**
EOI5	2.83±1.72	2.88±0.64	3.41±0.76	3.88±0.54	4.67±0.65	10.015	0.000**
EOI6	2.50±1.38	2.63±0.52	3.47±0.62	3.79±0.51	4.75±0.45	19.625	0.000**
EOI7	2.50±1.22	2.50±0.53	3.41±0.71	3.79±0.51	4.50±0.90	13.547	0.000**
EOI8	2.67±1.37	2.75±0.46	3.47±0.62	3.79±0.51	4.75±0.45	17.549	0.000**

The header "one-way ANOVA" spans the full table.

* p<0.05 ** p<0.01

One-way ANOVA was used to study the differences in the impact of "start a business" on 8 EOI factors in the control group, it seems from the above table that all showed significant (p<0.05) differences (Table 4.9), it requires to use of multiple regression analysis to determine whether EEP1 has a significant positive impact on the eight factors and whether EEP1 has a considerable effect on the overall mean of EOI. Table 4.10 is about the Comparison of mean values of all EOI options (start a business), it shows data of all the options and their mean values. Table 4.11 is about the comparison of the means of the 8 EOI factors (start a business); it is the summary result of Table 4.10.

Table 4.9 One-way ANOVA for 'Control Group' EOI (start a business)

one-way ANOVA							
	EEP1 (Mean±Std. Deviation)					F	p
	[1]Not at all (n=5)	[2] Little extent (n=19)	[3] Not sure (n=80)	[4] Great extent (n=28)	[5] A very great extent (n=6)		
EOI1	1.60±0.89	2.89±0.99	3.38±0.70	3.96±0.58	4.67±0.52	18.793	0.000**
EOI2	1.20±0.45	2.84±0.90	3.41±0.71	3.71±0.81	4.67±0.82	18.604	0.000**
EOI3	1.40±0.55	2.84±1.07	3.30±0.75	3.57±0.84	4.67±0.82	13.216	0.000**
EOI4	1.60±0.89	2.84±0.83	3.31±0.67	3.75±0.84	4.67±0.82	15.911	0.000**
EOI5	1.80±1.10	3.26±1.05	3.36±0.75	3.86±0.85	4.83±0.41	11.553	0.000**
EOI6	1.80±1.10	3.32±1.06	3.30±0.70	3.86±0.85	4.67±0.82	11.212	0.000**
EOI7	2.00±1.41	3.21±0.98	3.44±0.65	3.75±0.75	4.67±0.82	9.858	0.000**
EOI8	1.80±1.10	3.53±0.90	3.41±0.61	3.71±0.85	4.50±0.84	10.277	0.000**
* p<0.05 ** p<0.01							

Table 4.10 Comparison of mean values of all EOI options(start a business)

Items	Categories	Group 1		Group 2	
		n	Mean	n	Mean
EOI1	[1]Not at all	6	2.67	5	1.60
	[2] Little extent	8	2.75	19	2.89
	[3] Not sure	32	3.47	80	3.38
	[4] Great extent	24	3.96	28	3.96
	[5] A very great extent	12	4.92	6	4.67
	Total	82	3.70	138	3.42
EOI2	[1]Not at all	6	2.00	5	1.20
	[2] Little extent	8	2.88	19	2.84
	[3] Not sure	32	3.47	80	3.41
	[4] Great extent	24	3.79	28	3.71
	[5] A very great extent	12	4.42	6	4.67
	Total	82	3.54	138	3.37

Table 4.10 Comparison of mean values of all EOI options(start a business) (Cont.)

Items	Categories	Group 1		Group 2	
		n	Mean	*n*	Mean
EOI3	[1]Not at all	6	2.00	5	1.40
	[2] Little extent	8	2.63	19	2.84
	[3] Not sure	32	3.22	80	3.30
	[4] Great extent	24	3.79	28	3.57
	[5] A very great extent	12	4.42	6	4.67
	Total	82	3.41	138	3.28
EOI4	[1]Not at all	6	2.17	5	1.60
	[2] Little extent	8	2.88	19	2.84
	[3] Not sure	32	3.34	80	3.31
	[4] Great extent	24	3.75	28	3.75
	[5] A very great extent	12	4.67	6	4.67
	Total	82	3.52	138	3.33
EOI5	[1]Not at all	6	2.83	5	1.80
	[2] Little extent	8	2.88	19	3.26
	[3] Not sure	32	3.41	80	3.36
	[4] Great extent	24	3.88	28	3.86
	[5] A very great extent	12	4.67	6	4.83
	Total	82	3.63	138	3.46
EOI6	[1]Not at all	6	2.50	5	1.80
	[2] Little extent	8	2.63	19	3.32
	[3] Not sure	32	3.47	80	3.30
	[4] Great extent	24	3.79	28	3.86
	[5] A very great extent	12	4.75	6	4.67
	Total	82	3.60	138	3.42

Table 4.10 Comparison of mean values of all EOI options(start a business) (Cont.)

EOI7	[1]Not at all	6	2.50	5	2.00
	[2] Little extent	8	2.50	19	3.21
	[3] Not sure	32	3.41	80	3.44
	[4] Great extent	24	3.79	28	3.75
	[5] A very great extent	12	4.50	6	4.67
	Total	82	3.52	138	3.47
EOI8	[1]Not at all	6	2.67	5	1.80
	[2] Little extent	8	2.75	19	3.53
	[3] Not sure	32	3.47	80	3.41
	[4] Great extent	24	3.79	28	3.71
	[5] A very great extent	12	4.75	6	4.50
	Total	82	3.62	138	3.48

Table 4.11 Comparison of the means of the 8 EOI factors(start a business)

Items	Group 1		Group 2	
	Mean	Std. Deviation	Mean	Std. Deviation
EOI1	3.70	0.93	3.42	0.89
EOI2	3.54	0.97	3.37	0.93
EOI3	3.41	0.98	3.28	0.95
EOI4	3.52	0.93	3.33	0.89
EOI5	3.63	0.94	3.46	0.94
EOI6	3.60	0.89	3.42	0.92
EOI7	3.52	0.92	3.47	0.86
EOI8	3.62	0.86	3.48	0.83

Increase knowledge of the attitudes, values, and motivations of an entrepreneur

One-way ANOVA was used to study the differences in the effects of "attributes, values, and motivations of an entrepreneur" on 8 EOI factors in the experiment group, it can be seen from Table 4.12 that all showed significant ($p<0.05$) differences.

Table 4.12 One-way ANOVA for experiment group' EOI (attitudes, values, and

             motivations of an entrepreneur)

	one-way ANOVA						
	EEP2 (Mean±Std. Deviation)					F	p
	[1]Not at all (n=3)	[2] Little extent (n=4)	[3] Not sure (n=26)	[4] Great extent (n=35)	[5] A very great extent (n=14)		
EOI1	2.00±1.73	2.50±0.58	3.35±0.56	3.77±0.69	4.86±0.36	21.504	0.000**
EOI2	1.67±1.15	2.00±0.00	3.19±0.49	3.71±0.62	4.57±1.09	20.199	0.000**
EOI3	1.67±1.15	1.75±0.50	3.00±0.49	3.54±0.66	4.71±0.61	32.533	0.000**
EOI4	1.67±1.15	2.25±0.50	3.08±0.48	3.69±0.63	4.71±0.61	29.776	0.000**
EOI5	2.33±2.31	3.25±0.96	3.08±0.69	3.71±0.52	4.86±0.36	18.602	0.000**
EOI6	2.00±1.73	2.50±1.00	3.19±0.49	3.69±0.53	4.79±0.43	26.283	0.000**
EOI7	1.67±1.15	2.75±0.96	3.12±0.52	3.60±0.69	4.71±0.47	22.811	0.000**
EOI8	1.67±1.15	3.00±0.82	3.12±0.52	3.77±0.43	4.79±0.43	38.241	0.000**

* p<0.05 ** p<0.01

      One-way ANOVA was used to study the differences in the effects of "attributes, values, and motivations of an entrepreneur" in the control group on 8 EOI factors, table 4.16 showed that all showed significant (p<0.05) differences (Table 4.13). Table 4.14 was about the Comparison of mean values of all EOI options (attitudes, values, and motivations of an entrepreneur), it showed data of all the options and their mean values. Table 4.15 is about the comparison of the means of the 8 EOI factors (attitudes, values, and motivations of an entrepreneur); it was the summary result of Table 4.14.

Table 4.13 One-way ANOVA for Control Group ' EOI (attitudes, values, and
motivations of an entrepreneur)

Table 4.13 One-way ANOVA for Control Group' EOI (attitudes, values, and motivations of an entrepreneur)							
one-way ANOVA							
	EEP2 (Mean±Std. Deviation)					F	p
	[1]Not at all (n=5)	[2] Little extent (n=8)	[3] Not sure (n=62)	[4] Great extent (n=49)	[5] A very great extent (n=14)		
EOI1	1.00±0.00	3.00±1.31	3.19±0.57	3.69±0.58	4.57±0.65	34.862	0.000**
EOI2	1.00±0.00	3.50±0.93	3.10±0.62	3.61±0.70	4.50±0.94	27.609	0.000**
EOI3	1.00±0.00	3.00±1.20	3.00±0.63	3.55±0.68	4.57±0.85	29.637	0.000**
EOI4	1.00±0.00	3.50±0.93	3.03±0.44	3.59±0.64	4.50±1.09	34.575	0.000**
EOI5	1.00±0.00	3.38±1.30	3.19±0.57	3.76±0.63	4.50±1.09	27.221	0.000**
EOI6	1.00±0.00	3.63±0.74	3.21±0.63	3.61±0.67	4.43±1.16	23.951	0.000**
EOI7	1.00±0.00	3.50±0.76	3.32±0.54	3.63±0.60	4.43±1.09	28.146	0.000**
EOI8	1.00±0.00	3.63±0.74	3.32±0.50	3.65±0.52	4.36±1.15	29.878	0.000**
* p<0.05 ** p<0.01							

Table 4.14 Comparison of mean values of all EOI options (attitudes, values and
motivations of an entrepreneur)

Items	Categories	Group 1		Group 2	
		n	Mean	n	Mean
EOI1	[1]Not at all	3	2.00	5	1.00
	[2] Little extent	4	2.50	8	3.00
	[3] Not sure	26	3.35	62	3.19
	[4] Great extent	35	3.77	49	3.69
	[5] A very great extent	14	4.86	14	4.57
	Total	82	3.70	138	3.42
EOI2	[1]Not at all	3	1.67	5	1.00
	[2] Little extent	4	2.00	8	3.50

Table 4.14 Comparison of mean values of all EOI options (attitudes, values and
motivations of an entrepreneur) (Cont.)

Items	Categories	Group 1		Group 2	
		n	Mean	*n*	Mean
	[3] Not sure	26	3.19	62	3.10
	[4] Great extent	35	3.71	49	3.61
	[5] A very great extent	14	4.57	14	4.50
	Total	82	3.54	138	3.37
EOI3	[1]Not at all	3	1.67	5	1.00
	[2] Little extent	4	2.00	8	3.50
	[3] Not sure	26	3.19	62	3.10
	[4] Great extent	35	3.71	49	3.61
	[5] A very great extent	14	4.57	14	4.50
	Total	82	3.54	138	3.37
EOI3	[1]Not at all	3	1.67	5	1.00
	[2] Little extent	4	1.75	8	3.00
	[3] Not sure	26	3.00	62	3.00
	[4] Great extent	35	3.54	49	3.55
	[5] A very great extent	14	4.71	14	4.57
	Total	82	3.41	138	3.28
EOI4	[1]Not at all	3	1.67	5	1.00
	[2] Little extent	4	2.25	8	3.50
	[3] Not sure	26	3.08	62	3.03
	[4] Great extent	35	3.69	49	3.59
	[5] A very great extent	14	4.71	14	4.50
	Total	82	3.52	138	3.33
EOI5	[1]Not at all	3	2.33	5	1.00
	[2] Little extent	4	3.25	8	3.38
	[3] Not sure	26	3.08	62	3.19
	[4] Great extent	35	3.71	49	3.76
	[5] A very great extent	14	4.86	14	4.50

Table 4.14 Comparison of mean values of all EOI options (attitudes, values and
motivations of an entrepreneur) (Cont.)

	Total	82	3.63	138	3.46
EOI6	[1]Not at all	3	2.00	5	1.00
	[2] Little extent	4	2.50	8	3.63
	[3] Not sure	26	3.19	62	3.21
	[4] Great extent	35	3.69	49	3.61
	[5] A very great extent	14	4.79	14	4.43
	Total	82	3.60	138	3.42
EOI7	[1]Not at all	3	1.67	5	1.00
	[2] Little extent	4	2.75	8	3.50
	[3] Not sure	26	3.12	62	3.32
	[4] Great extent	35	3.60	49	3.63
	[5] A very great extent	14	4.71	14	4.43
	Total	82	3.52	138	3.47
EOI8	[1]Not at all	3	1.67	5	1.00
	[2] Little extent	4	3.00	8	3.63
	[3] Not sure	26	3.12	62	3.32
	[4] Great extent	35	3.77	49	3.65
	[5] A very great extent	14	4.79	14	4.36
	Total	82	3.62	138	3.48

Table 4.15 Comparison of the means of the 8 EOI factors (attitudes, values, and
motivations of an entrepreneur)

Items	Group 1		Group 2	
	Mean	Std. Deviation	Mean	Std. Deviation
EOI1	3.70	0.93	3.42	0.89
EOI2	3.54	0.97	3.37	0.93
EOI3	3.41	0.98	3.28	0.95
EOI4	3.52	0.93	3.33	0.89

Table 4.15 Comparison of the means of the 8 EOI factors (attitudes, values, and
　　　　motivations of an entrepreneur) (Cont.)

EOI5	3.63	0.94	3.46	0.94
EOI6	3.60	0.89	3.42	0.92
EOI7	3.52	0.92	3.47	0.86
EOI8	3.62	0.86	3.48	0.83

Increase practical management knowledge and skills of how to start a new venture

Table 4.16 One-way ANOVA for Experiment Group' EOI (management knowledge
　　　　and skills)

	One-Way ANOVA						
	EEP3 (Mean±Std. Deviation)					F	p
	[1]Not at all (n=2)	[2] Little extent (n=4)	[3] Not sure (n=27)	[4] Great extent (n=33)	[5] A very great extent (n=16)		
EOI1	1.00±0.00	2.50±0.58	3.26±0.53	3.82±0.64	4.81±0.40	37.504	0.000**
EOI2	1.00±0.00	2.50±0.58	3.15±0.60	3.73±0.63	4.38±1.15	15.186	0.000**
EOI3	1.00±0.00	2.25±0.50	2.93±0.62	3.58±0.61	4.50±0.89	24.014	0.000**
EOI4	1.00±0.00	2.50±0.58	3.15±0.53	3.61±0.70	4.56±0.73	22.837	0.000**
EOI5	1.00±0.00	2.50±0.58	3.33±0.73	3.73±0.52	4.56±0.89	19.282	0.000**
EOI6	1.00±0.00	2.50±0.58	3.19±0.48	3.73±0.57	4.63±0.62	33.237	0.000**
EOI7	1.00±0.00	2.25±0.50	3.30±0.54	3.58±0.66	4.44±0.89	19.080	0.000**
EOI8	1.00±0.00	2.75±0.50	3.15±0.53	3.76±0.44	4.69±0.48	45.384	0.000**
* p<0.05 ** p<0.01							

Using one-way ANOVA to study the differences in the impact of "management knowledge and skills" on 8 EOI factors in the experiment group, it can be seen from Table 4.16 that all showed significant (p<0.05) differences.

Using one-way ANOVA to study the differences in the impact of "management knowledge and skills" on 8 EOI factors in the control group, it can be seen from Table 4.17 that all showed significant (p<0.05) differences. Table 4.18 is about the Comparison of mean values of all EOI options (management knowledge and skills), it shows data of all the options and their mean values.

Table 4.17 One-way ANOVA for Control Group' EOI (management, knowledge, and skills)

	One-Way ANOVA						
	EEP3 (Mean±Std. Deviation)					F	p
	[1]Not at all (n=5)	[2] Little extent (n=4)	[3] Not sure (n=68)	[4] Great extent (n=48)	[5] A very great extent (n=13)		
EOI1	1.00±0.00	2.75±0.96	3.15±0.61	3.77±0.59	4.69±0.48	45.090	0.000**
EOI2	1.00±0.00	2.75±0.96	3.13±0.62	3.65±0.73	4.69±0.63	34.127	0.000**
EOI3	1.00±0.00	2.75±0.96	3.01±0.68	3.54±0.71	4.77±0.44	35.501	0.000**
EOI4	1.00±0.00	2.50±0.58	3.07±0.47	3.60±0.71	4.85±0.38	55.300	0.000**
EOI5	1.00±0.00	3.25±0.96	3.19±0.63	3.75±0.76	4.77±0.44	35.007	0.000**
EOI6	1.00±0.00	3.00±0.82	3.25±0.63	3.60±0.76	4.69±0.63	29.776	0.000**
EOI7	1.00±0.00	2.75±0.50	3.32±0.53	3.69±0.72	4.62±0.51	37.733	0.000**
EOI8	1.00±0.00	3.50±0.58	3.32±0.50	3.65±0.67	4.62±0.65	38.213	0.000**

* p<0.05 ** p<0.01

Table 4.18 Comparison of mean values of all EOI options (management, knowledge, and skills)

Items	Categories	Group 1		Group 2	
		n	Mean	n	Mean
EOI1	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	2.50	4	2.75
	[3] Not sure	27	3.26	68	3.15
	[4] Great extent	33	3.82	48	3.77

Table 4.18 Comparison of mean values of all EOI options (management, knowledge, and skills) (Cont.)

	[5] A very great extent	16	4.81	13	4.69
	Total	82	3.70	138	3.42
EOI2	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	2.50	4	2.75
	[3] Not sure	27	3.15	68	3.13
	[4] Great extent	33	3.73	48	3.65
	[5] A very great extent	16	4.38	13	4.69
	Total	82	3.54	138	3.37
EOI3	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	2.25	4	2.75
	[3] Not sure	27	2.93	68	3.01
	[4] Great extent	33	3.58	48	3.54
	[5] A very great extent	16	4.50	13	4.77
	Total	82	3.41	138	3.28
EOI4	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	2.50	4	2.50
	[3] Not sure	27	3.15	68	3.07
	[4] Great extent	33	3.61	48	3.60
	[5] A very great extent	16	4.56	13	4.85
	Total	82	3.52	138	3.33
EOI5	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	2.50	4	3.25
	[3] Not sure	27	3.33	68	3.19
	[4] Great extent	33	3.73	48	3.75
	[5] A very great extent	16	4.56	13	4.77
	Total	82	3.63	138	3.46
EOI6	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	2.50	4	3.00
	[3] Not sure	27	3.19	68	3.25

Table 4.18 Comparison of mean values of all EOI options (management, knowledge, and skills) (Cont.)

	[4] Great extent	33	3.73	48	3.60
	[5] A very great extent	16	4.63	13	4.69
	Total	82	3.60	138	3.42
EOI7	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	2.25	4	2.75
	[3] Not sure	27	3.30	68	3.32
	[4] Great extent	33	3.58	48	3.69
	[5] A very great extent	16	4.44	13	4.62
	Total	82	3.52	138	3.47
EOI8	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	2.75	4	3.50
	[3] Not sure	27	3.15	68	3.32
	[4] Great extent	33	3.76	48	3.65
	[5] A very great extent	16	4.69	13	4.62
	Total	82	3.62	138	3.48

Increase ability to create networks

This study used One-Way ANOVA to study the differences in the impact of "create networks" on 8 EOI factors in the experiment group; it could be seen from Table 4.19 that all showed significant ($p<0.05$) differences (Table 4.19).

Table 4.19 One-way ANOVA for Experiment Group; EOI (create networks)

One-Way ANOVA							
	EEP4 (Mean±Std. Deviation)					F	p
	[1]Not at all (n=2)	[2] Little extent (n=4)	[3] Not sure (n=27)	[4] Great extent (n=37)	[5] A very great extent (n=12)		
EOI1	1.00±0.00	2.75±0.50	3.30±0.54	3.84±0.73	4.92±0.29	27.903	0.000**

Table 4.19 One-way ANOVA for Experiment Group; EOI (create networks) (Cont.)

EOI2	1.00±0.00	2.50±0.58	3.15±0.60	3.73±0.65	4.58±1.16	16.950	0.000**
EOI3	1.00±0.00	2.75±0.50	2.96±0.65	3.51±0.77	4.75±0.62	21.056	0.000**
EOI4	1.00±0.00	3.00±1.15	3.11±0.58	3.62±0.68	4.75±0.62	21.089	0.000**
EOI5	1.00±0.00	2.75±0.96	3.30±0.72	3.73±0.65	4.83±0.39	21.754	0.000**
EOI6	1.00±0.00	3.00±0.82	3.19±0.56	3.73±0.65	4.75±0.45	25.158	0.000**
EOI7	1.00±0.00	3.00±0.82	3.15±0.46	3.59±0.80	4.75±0.45	21.199	0.000**
EOI8	1.00±0.00	3.00±0.82	3.19±0.56	3.78±0.53	4.75±0.45	31.256	0.000**
* $p<0.05$ ** $p<0.01$							

Table 4.20 One-way ANOVA for Control Group; EOI (create networks)

	one-way ANOVA						
	EEP4 (Mean±Std. Deviation)					F	p
	[1]Not at all (n=5)	[2] Little extent (n=15)	[3] Not sure (n=55)	[4] Great extent (n=48)	[5] A very great extent (n=15)		
EOI1	1.00±0.00	3.00±0.65	3.24±0.43	3.67±0.81	4.53±0.74	33.843	0.000**
EOI2	1.00±0.00	3.00±0.85	3.09±0.55	3.71±0.65	4.47±0.99	32.013	0.000**
EOI3	1.00±0.00	2.80±0.77	3.09±0.59	3.54±0.80	4.40±0.99	25.253	0.000**
EOI4	1.00±0.00	3.00±0.65	3.05±0.40	3.67±0.63	4.40±1.18	34.791	0.000**
EOI5	1.00±0.00	3.40±0.63	3.27±0.62	3.63±0.76	4.47±1.13	22.671	0.000**
EOI6	1.00±0.00	2.93±0.70	3.33±0.61	3.65±0.67	4.33±1.18	23.828	0.000**
EOI7	1.00±0.00	3.07±0.59	3.33±0.51	3.73±0.57	4.40±1.06	33.343	0.000**
EOI8	1.00±0.00	3.20±0.41	3.31±0.50	3.77±0.52	4.27±1.16	32.774	0.000**
* $p<0.05$ ** $p<0.01$							

Using one-way ANOVA to study the differences in the impact of "create networks" in the control group on 8 EOI factors; it could be seen from Table 4.20 that all showed significant ($p<0.05$) differences. Table 4.21 was about the Comparison of

mean values of all EOI options (create networks), it showed data of all the options and their mean values.

Table 4.21 Comparison of mean values of all EOI options (create networks)

Items	Categories	Group 1		Group 2	
		n	Mean	*n*	Mean
EOI1	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	2.75	15	3.00
	[3] Not sure	27	3.30	55	3.24
	[4] Great extent	37	3.84	48	3.67
	[5] A very great extent	12	4.92	15	4.53
	Total	82	3.70	138	3.42
EOI2	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	2.50	15	3.00
	[3] Not sure	27	3.15	55	3.09
	[4] Great extent	37	3.73	48	3.71
	[5] A very great extent	12	4.58	15	4.47
	Total	82	3.54	138	3.37
EOI3	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	2.75	15	2.80
	[3] Not sure	27	2.96	55	3.09
	[4] Great extent	37	3.51	48	3.54
	[5] A very great extent	12	4.75	15	4.40
	Total	82	3.41	138	3.28
EOI4	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	3.00	15	3.00
	[3] Not sure	27	3.11	55	3.05
	[4] Great extent	37	3.62	48	3.67
	[5] A very great extent	12	4.75	15	4.40
	Total	82	3.52	138	3.33

Table 4.21 Comparison of mean values of all EOI options (create networks) (Cont.)

EOI5	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	2.75	15	3.40
	[3] Not sure	27	3.30	55	3.27
	[4] Great extent	37	3.73	48	3.63
	[5] A very great extent	12	4.83	15	4.47
	Total	82	3.63	138	3.46
EOI6	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	3.00	15	2.93
	[3] Not sure	27	3.19	55	3.33
	[4] Great extent	37	3.73	48	3.65
	[5] A very great extent	12	4.75	15	4.33
	Total	82	3.60	138	3.42
EOI7	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	3.00	15	3.07
	[3] Not sure	27	3.15	55	3.33
	[4] Great extent	37	3.59	48	3.73
	[5] A very great extent	12	4.75	15	4.40
	Total	82	3.52	138	3.47
EOI8	[1]Not at all	2	1.00	5	1.00
	[2] Little extent	4	3.00	15	3.20
	[3] Not sure	27	3.19	55	3.31
	[4] Great extent	37	3.78	48	3.77
	[5] A very great extent	12	4.75	15	4.27
	Total	82	3.62	138	3.48

Table 4.22 listed each scale's mean and standard deviation in the experiment and control groups. Firstly, comparing the compromise of EEP and EOI between the experiment group and the control group, it showed that all standards were between 3-4 points (3 points indicate "uncertainty about ability improvement," 4 points indicate "improvement in ability"), which means that after receiving the EEP course, the

overall entrepreneurial and EOI abilities of the sample are low; Meanwhile, the average of each item in the experiment group was slightly higher than that in the control group, indicating that after learning more EEP courses, students' EOI ability improved. Still, the average improvement was 0.16, which was relatively small. Therefore, advancing technology and developing EOI course for engineering students must enhance EOI ability. From the perspective of standard deviation, the average standard deviation of EEP in the experiment group was slightly higher than that in the control group (EEP: SD1-SD2=0.08).

Table 4.22 Means and SD of EEP and EOI

Variables	Items	Group 1		Group 2		Mean1-Mean2	SD1-SD2
		Mean	Std. deviation	Mean	Std. deviation		
EEP	EEP1	3.34	1.08	3.08	0.81	+0.26	+0.27
	EEP2	3.65	0.95	3.43	0.89	+0.22	+0.06
	EEP3	3.70	0.93	3.44	0.85	+0.26	+0.08
	EEP4	3.65	0.88	3.38	0.95	+0.27	+0.07
	Average	3.59	0.96	3.33	0.88	+0.25	+0.08
EOI	EOI1	3.70	0.93	3.42	0.89	+0.28	+0.04
	EOI2	3.54	0.97	3.37	0.93	+0.17	+0.04
	EOI3	3.41	0.98	3.28	0.95	+0.13	+0.03
	EOI4	3.52	0.93	3.33	0.89	+0.19	+0.04
	EOI5	3.63	0.94	3.46	0.94	+0.17	+0.00
	EOI6	3.60	0.89	3.42	0.92	+0.18	-0.03
	EOI7	3.52	0.92	3.47	0.86	+0.05	+0.06
	EOI8	3.62	0.86	3.48	0.83	+0.14	+0.03
	Average	3.57	0.93	3.40	0.90	+0.16	+0.03

In comparison, the average standard deviation of EOI in the experiment group is somewhat higher than that in the control group (EOI: SD1-SD2=0.03), with a difference of 0.05 between the two values, which indicates that students' self-awareness of entrepreneurial ability is unstable after receiving different levels of

entrepreneurship education courses. However, the instability of self-awareness towards EOI ability is smaller than that towards entrepreneurial ability, so learning more in-depth EEP courses may be positively correlated with improving EOI ability.

The average of the eight factors of EOI in the experiment group, from high to low, is "EOI1(explore an opportunity) > EOI5 (spend more time and energy looking for) >EOI7(organize resources and coordinate variable work)>EOI6(make resource allocation decisions) > EOI2(perceive the unmet market demand) > EOI7 & EOI4 (organize and motivate, employees & identify the products and services) >EOI3 (predict the prospects of the industry)". The average of 'explore an opportunity' is the highest, while the standard of 'predict the industry prospects' is the lowest, which indicates that after studying the EEP course, the experiment group became more confident in "exploring an opportunity" and lacked confidence in the ability to "predict the prospects of the industry." The root cause may be that students are beginners in their field of study, "predicting industry prospects" is too grand for beginners, and their industry knowledge reserves are insufficient to support their predictive ability. Therefore, when developing EOI course, teachers can increase the teaching content of engineering industry prospects and accurately design other elements according to students' needs.

Table 4.23 compares the mean differences between the experiment and control groups for the five options corresponding to the four elements of EEP. There seems to be a significant fluctuation in the difference between the experiment and control groups regarding the "Not at all" option. The experiment group has a higher mean in "start a business" and "attributes, values, and motivations of an entrepreneur" than the control group. It has the same standard in "management knowledge and skills" and "create networks," The control group was more specific than the experiment group regarding cognition of having no entrepreneurial ability. After studying more EEP courses, the experiment group had fewer choices regarding "completely denying entrepreneurial ability," indicating that learning more EEP courses has a specific positive significance. In the "little context" option, the mean values of the four elements in the experiment group are all lower than those in the control group, which

fully indicates that the control group has a relatively straightforward disagreement about whether they have the entrepreneurial ability.

In contrast, the experiment group is more inclined to confirm their entrepreneurial ability, indicating that studying more EEP courses has a specific positive effect. From 'Not sure' to 'A very great extent,' most of the mean values in the experiment group were more significant than those in the control group, and students were increasingly sure about their entrepreneurial abilities. The difference in mean values between the experiment and control groups showed an increasing trend, indicating that the experiment group studied more EEP courses and became confident in possessing entrepreneurial abilities.

Table 4.23 Mean difference between experiment group and control group

	EEP1	EEP2	EEP3	EEP4
Not at all	2.83-2.00=0.83	2.33-1.00=1.33	1-1=0	1-1=0
little extent	2.88-3.53= -0.65	3.25-3.63= -0.38	2.75-3.50= -0.75	3.00-3.40= -0.40
Not sure	3.47-3.44=0.03	3.35-3.32=0.03	3.33-3.32=0.01	3.30-3.33= -0.03
Great extent	3.96-3.96=0	3.77-3.76=0.01	3.82-3.77=0.05	3.84-3.77=0.07
A very great extent	4.92-4.83=0.09	4.86-4.57=0.29	4.81-4.85=-0.04	4.92-4.53=0.39

The following Figure 4.1 showed the data analysis graphs of EEP1 – EEP4, they analyzed the impact of EEP on EOI by one-way ANOVA. The eight graphs showed the mean line plots of the effects of each EEP factor on the 8 EOI factors between the experiment and control groups, respectively. From the graph, the impact of EEP on EOI is on the rise, and with the increase of EEP, EOI also increases accordingly, indicating a positive correlation between the two groups as follows:

1) Not at all: A significant difference in the mean values corresponding to the "Not at all" option exists between the two groups. Among the four factors in the experiment group, the mean values of two elements (regarding "Start a business" and "Attachments, values, and motivations of an entrepreneur") are unstable. In terms of "Not at all," students who have studied more EEP courses have shown instability in the eight factors of EOI ability corresponding to these two factors, Presenting a significantly different view of 'no improvement at all.' After studying more courses, there is an inevitable irregular fluctuation in the ability to disagree with one's own EOI completely, and it shows an upward trend, indicating that the learning of these courses has a positive impact. Among the four factors in the control group, one element ("Start a business") had a relatively uniform mean difference in the line graph. Students who only studied EEP compulsory courses had a regular fluctuation in "Start a business" and did not fully recognize their EOI ability, which showed an upward trend. The study of EEP courses may have an impact, but for students who choose this option, their feedback on "complete lack of EOI ability" is closely related to the factors of EOI. There is a consensus on the degree of impact, meaning they clearly understand their need for the 'Start a Business' ability.

2) Little Extent: The indicator corresponding to this option is the most abnormal. The experiment group has a lower average of their own EOI ability cognition than the control group. Among the experiment group students who choose this option, more students are still determining their EOI ability. Students have significant instability in their level of EOI ability, which means that there is a specific difference in students' evaluation of EEP courses and EOI ability, which is between "Not at all" and "little context" (slightly disagree).

3) Not sure, great extent, and a very great extent: The data for the three options are consistent and show an upward trend, indicating that the experiment and control group students who choose these three options are relatively sure about their EOI ability. In the experiment group, the highest mean values corresponding to the three EEP factors in the "a very great extent" option were higher than those in the control group, and only "Management knowledge and skills" were slightly lower than

those in the control group. Teachers can focus on cultivating "Management knowledge and skills" in future entrepreneurship education courses.

EEP1
(Increase understanding of the action one needs to take to start a business)

Experiment Group	
Control Group	

EEP2
(Increase knowledge of the attitudes, values, and motivations of an entrepreneur)

Figure. 4.1 Line plots of the effects of each EEP factor on the 8 EOI factors

EEP3

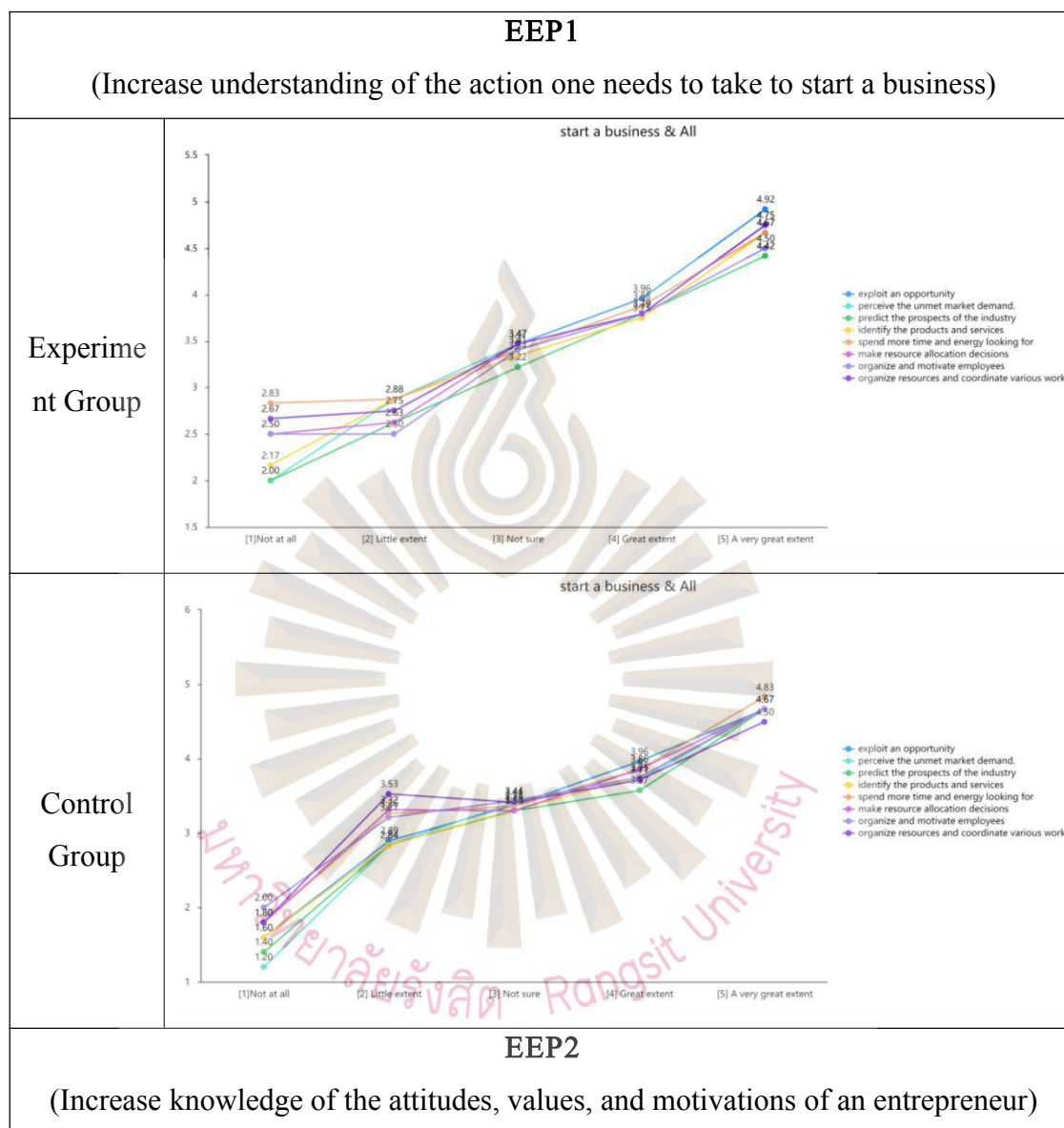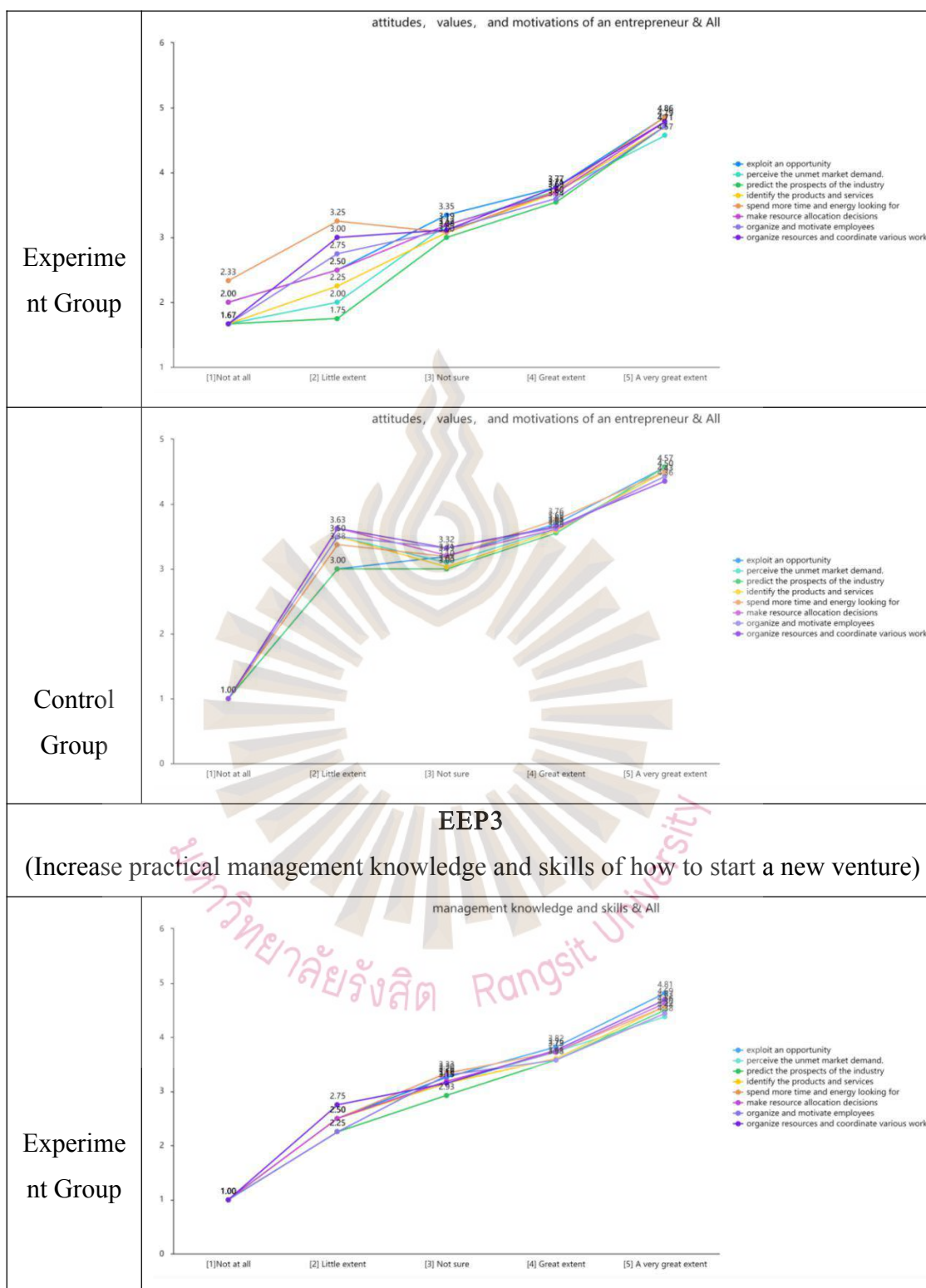(Increase practical management knowledge and skills of how to start a new venture)

Figure. 4.1 Line plots of the effects of each EEP factor on the 8 EOI factors (Cont.)

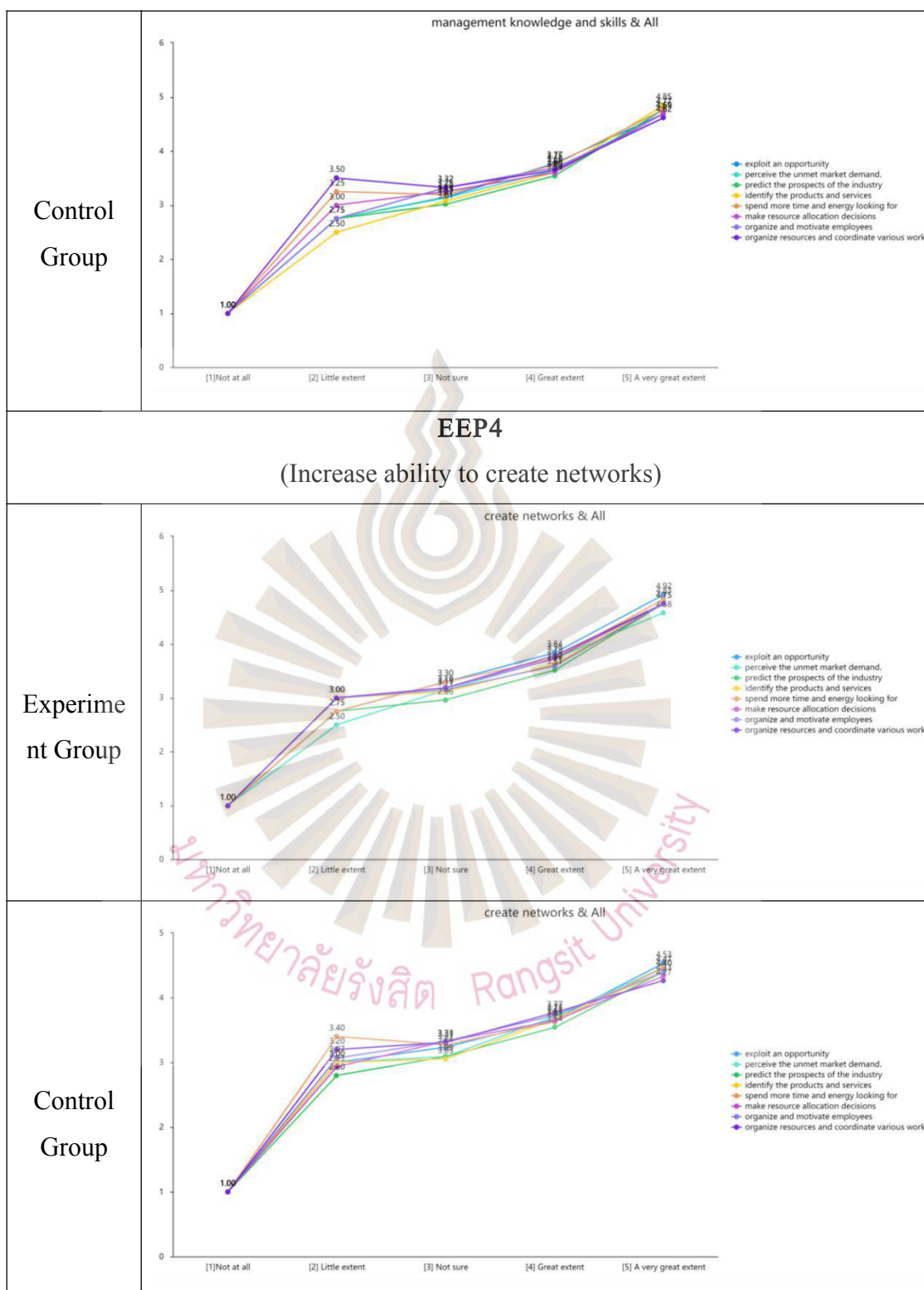Figure. 4.1 Line plots of the effects of each EEP factor on the 8 EOI factors (Cont.)

4.4.2 Analysis of Pearson Correlation Matrix

This study focuses on students (experiment group) participating in more EEP courses. Therefore, this section uses the Pearson correlation matrix to measure the relationship between correlation coefficient variables, which provides further evidence for the hypothesis.

Table 4.24 Pearson Correlation Matrix of EEP and EOI of the Experiment Group (n= 82)

Pearson Correlation Matrix								
Variable	EOI1	EOI2	EOI3	EOI4	EOI5	EOI6	EOI7	EOI8
EEP1	0.686**	0.600**	0.657**	0.666**	0.565**	0.687**	0.626**	0.663**
EEP2	0.706**	0.705**	0.771**	0.771**	0.645**	0.739**	0.712**	0.792**
EEP3	0.798**	0.651**	0.740**	0.717**	0.682**	0.781**	0.669**	0.819**
EEP4	0.745**	0.673**	0.687**	0.680**	0.695**	0.717**	0.675**	0.755**
** $p<0.01$								

Table 4.25 Pearson Correlation Matrix of EEP and EOI of the Control Group (n= 138)

Pearson Correlation Matrix								
Variable	EOI1	EOI2	EOI3	EOI4	EOI5	EOI6	EOI7	EOI8
EEP1	0.532**	0.491**	0.418**	0.482**	0.393**	0.370**	0.360**	0.285**
EEP2	0.640**	0.544**	0.605**	0.580**	0.569**	0.493**	0.524**	0.516**
EEP3	0.713**	0.653**	0.656**	0.739**	0.646**	0.599**	0.648**	0.608**
EEP4	0.619**	0.617**	0.577**	0.626**	0.482**	0.545**	0.604**	0.580**
** $p<0.01$								

Tables 4.24 and 4.25 showed that the Pearson correlation coefficient is strong, and the results show a significant and positive correlation between EEP and EOI in the experiment and control groups ($p<0.01$), which means that Chinese entrepreneurship education introduces students to "start a business," "attributes, values, and motivations of an entrepreneur," "management knowledge and skills," and "create networks," which Inspired students' interest in entrepreneurship. The Pearson correlation coefficients of the experiment group were mainly more significant than those of the control group, indicating that students had a particularly positive impact after studying more EEP courses. Furthermore, it is worth noting that only the coefficients of "Management knowledge and skills" for "Perceive the unmet market demand" and "Identify the products and services" are slightly lower than those of the control group, indicating that students have less effectiveness in these two aspects after studying more EEP courses, the courses developed can enhance the 'Perceive the unmet market demand' and 'Identify the products and services.'

4.4.3 Multiple Regression Analysis

Using multiple linear regression analysis, the eight factors of EOI were analyzed separately to verify whether the four factors of EEP significantly impact each facet of EOI. In the experiment group, "create networks" had a positive impact on six elements of EOI, "attributes, values, and motivations of an entrepreneur" and "management knowledge and skills" had a positive effect on five aspects of EOI, and "start a business" had a positive impact on one element of EOI; In the control group, "management knowledge and skills" has a positive effect on nine aspects of EEP, "create networks" has a positive impact on eight elements of EEP, "attributes, values, and motivations of an entrepreneur" has a positive effect on three aspects of EEP, and "start a business" only has a positive impact on one element of EOI.

Figure 4.2 calculates the average of 8 factors in EOI to generate a variable. The study conducted multiple regression analyses on the four variables in EEP and the criteria of this EOI. The regression coefficient value for EEP1 was invalid, while the other three factors positively impacted EOI. However, the positive impact relationship

for EEP3 showed a downward trend; EEP2 shows the most significant increase in the positive impact coefficient, while EEP4 shows an increase in the positive impact coefficient.
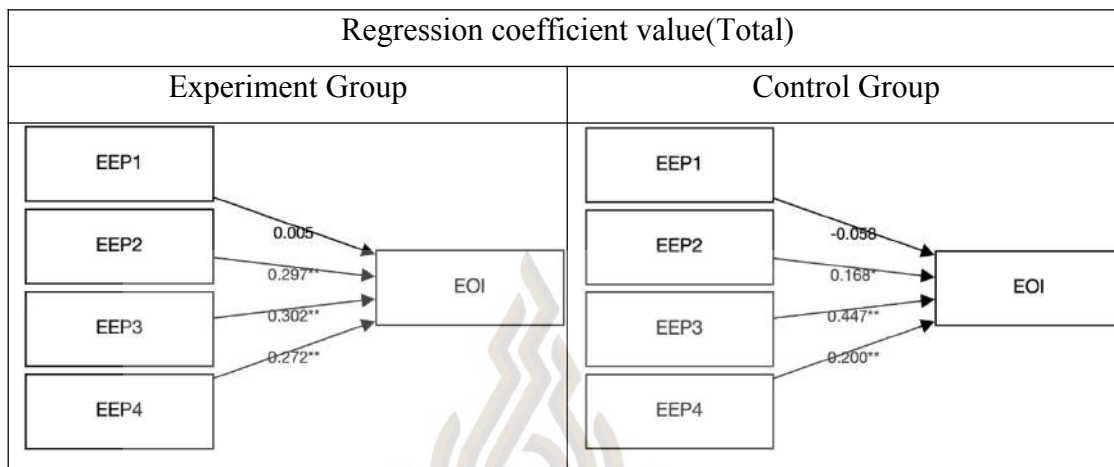
Regression coefficient value(Total)	
Experiment Group	Control Group

Figure. 4.2 Regression coefficient value(Total)

EEP1：Increase understanding of the action one needs to take to start a business

EEP2：Increase knowledge of the attitudes, values, and motivations of an entrepreneur

EEP3：Increase practical management knowledge and skills of how to start a new venture

EEP4：Increase ability to create networks

EOI1：Increase ability to exploit an opportunity

EOI2：Be able to perceive the unmet market demand accurately

EOI3：With external support, predict the industry's prospects to develop.

EOI4：Be able to identify the products and services that consumers need effectively.

EOI5：Willing to spend more time and energy looking for products and services that can bring value to customers.

EOI6：Be able to make resource allocation decisions to maximize benefits.

EOI7：Be able to organize and motivate employees to achieve corporate goals.

EOI8：Be able to manage resources and coordinate various work tasks effectively.

From Figure 4.3, it showed that EEP3 and EEP4 were still important factors that had a positive impact on EOI, and their influence was more concentrated, mainly

in the three aspects of EOI1, EOI6, and EOI8; The EEP2 primarily focused on the effects of EOI3 and were factors that expand the scope of positive influence, while EEP1 was independent of how many courses students have studied, only had a positive impact on EOI8. However, regardless of whether students learned more EEP courses, the impact value was 0.250, which once again confirmed that whether or not students had studied more EEP courses, EEP1 had no direct positive impact on the overall improvement of EOI.

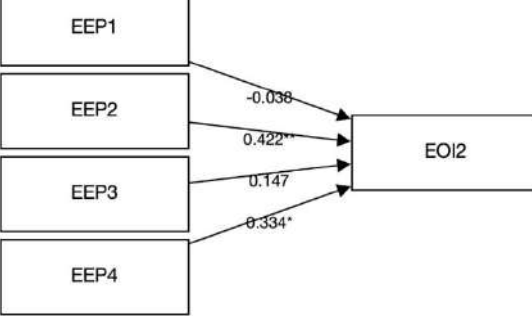| Regression Coefficient Value (EOI Sub Items)	
Experiment Group	Control Group
Significant influencing factors： EEP3： Increase practical management knowledge and skills of how to start a new venture EEP4: Increase ability to create networks	Significant influencing factors： EEP2： Increase knowledge of the attitudes, values, and motivations of an entrepreneur EEP3： Increase practical management knowledge and skills of how to start a new venture EEP4: Increase ability to create networks
After studying more EEP courses, EEP4 had the most significant positive impact on EOI1, while EEP3 was the factor that had the most significant positive effect on EOI1. However, compared to the study of EEP compulsory courses, after receiving more systems, the improvement of this project was 0.082, which is relatively small. However, EEP2 has decreased from having a positive impact to no effect.	

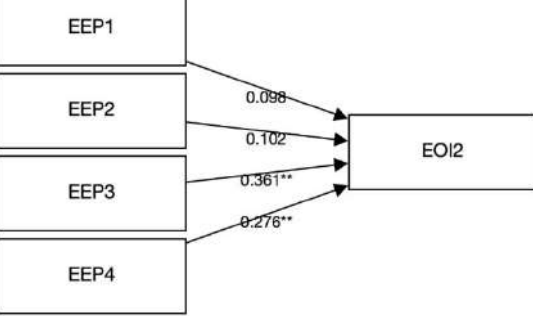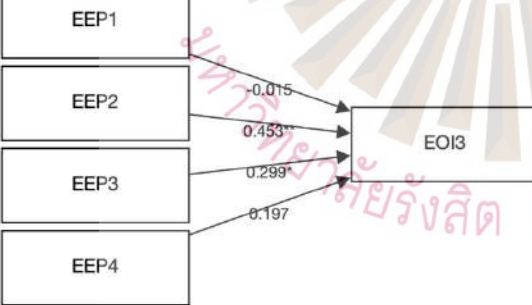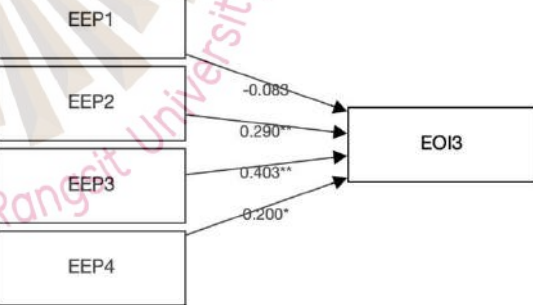Figure 4.3 Regression coefficient value(EOI Sub Items)

Significant influencing factors:	Significant influencing factors:
EEP2：Increase knowledge of the attitudes, values, and motivations of an entrepreneur	EEP3：Increase practical management knowledge and skills of how to start a new venture
EEP4：Increase ability to create networks	EEP4：Increase ability to create networks

After studying more EEP courses, the positive impact of EEP2 on EOI2 has the most remarkable improvement, ranging from no significant positive relationship to a significant positive correlation. The EEP3 decreased from a positive correlation to no significant correlation; The EEP4 decreased from a significant positive correlation to a general positive correlation.

Significant influencing factors:	Significant influencing factors:
EEP2：Increase knowledge of the attitudes, values, and motivations of an entrepreneur	EEP2：Increase knowledge of the attitudes, values, and motivations of an entrepreneur. EEP3：Increase practical management knowledge and skills of how to start a new venture. EEP4：Increase ability to create networks
EEP3：Increase practical management knowledge and skills of how to start a new venture	

Figure 4.3 Regression coefficient value(EOI Sub Items) (Cont.)

Significant influencing factors：

EEP2 ： Increase knowledge of the attitudes, values, and motivations of an entrepreneur

Significant influencing factors：

EEP3 ： Increase practical management knowledge and skills of how to start a new venture

EEP4: Increase ability to create networks

After studying more EEP courses, the positive impact of EEP2 on EOI4 increased the most. At the same time, EEP3 decreased from a significant positive correlation to a general positive correlation, while EEP4 decreased from a general positive correlation to no significant positive correlation.

Significant influencing factors：

EEP3 ： Increase practical management knowledge and skills of how to start a new venture

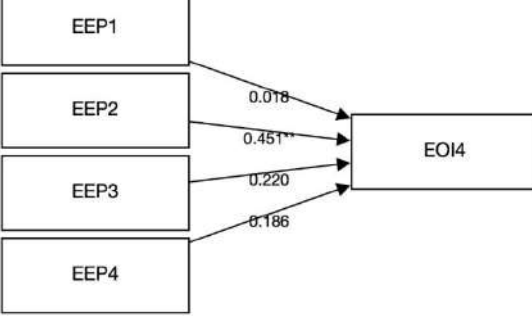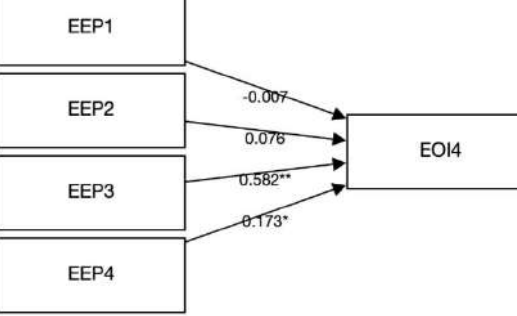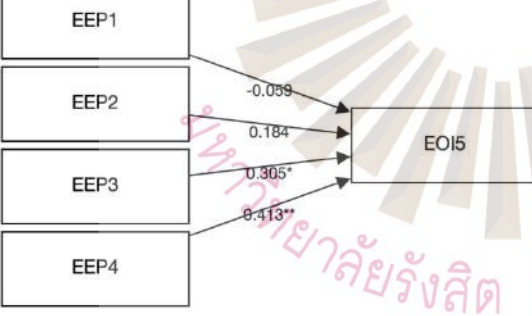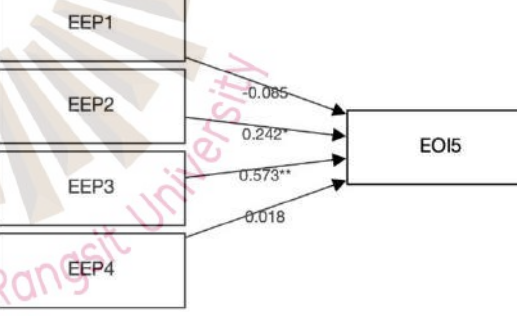EEP4: Increase ability to create networks

Significant influencing factors：

EEP2 ： Increase knowledge of the attitudes, values, and motivations of an entrepreneur

EEP3：Increase practical management knowledge and skills of how to start a new venture

Figure 4.3 Regression coefficient value(EOI Sub Items) (Cont.)
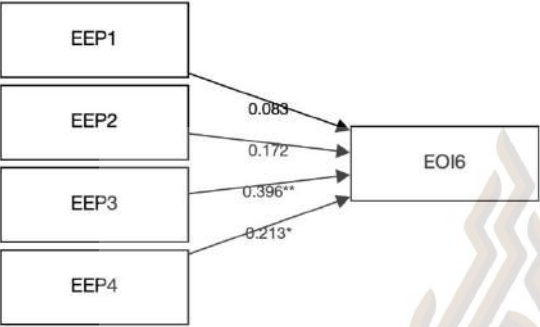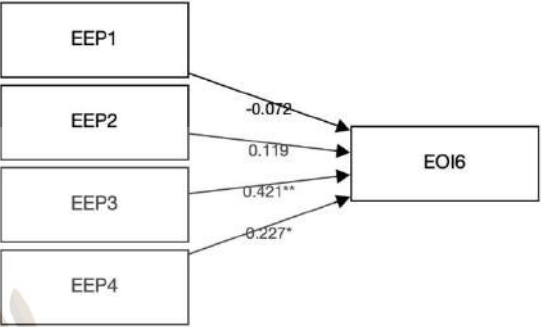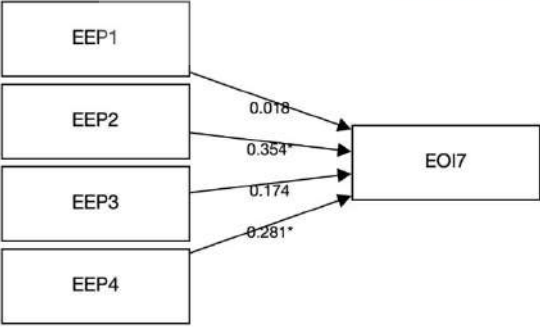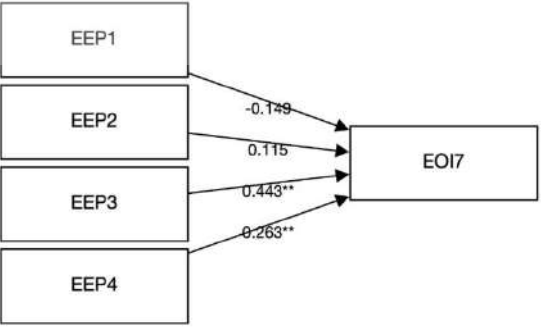
After studying more EEP courses, EEP4 showed the most significant increase in the positive impact of EOI5, from no positive effect to a very significant positive correlation. At the same time, EEP3 decreased from a significant positive correlation to a general positive correlation; EEP2 decreased from a general positive correlation to no significant positive correlation.

Significant influencing factors：

EEP3 ： Increase practical management knowledge and skills of how to start a new venture

EEP4: Increase ability to create networks

Significant influencing factors：

EEP3 ： Increase practical management knowledge and skills of how to start a new venture

EEP4: Increase ability to create networks

After studying more EEP courses, both influential factors of EEP have decreased. The positive impact of EEP3 on EOI6 is still very significant and positively correlated, but the numerical value has reduced slightly. The positive effects of EEP4 are still generally positively correlated, and the numerical value has also decreased somewhat.

Figure 4.3 Regression coefficient value(EOI Sub Items) (Cont.)

Significant influencing factors：	Significant influencing factors：
EEP2 ： Increase knowledge of the attitudes, values, and motivations of an entrepreneur. EEP4：Increase ability to create networks	EEP3：Increase practical management knowledge and skills of how to start a new venture. EEP4：Increase ability to create networks

After studying more EEP courses, the positive correlation of one factor in EEP increased, while the positive correlation of two influential factors decreased. The EEP2 has increased from no significant correlation to a general positive correlation, while the EEP3 and EOI7 have declined from a very significant positive correlation to no significant correlation. The 'create network' is still a significant positive correlation, but the value has decreased slightly.

Significant influencing factors:	Significant influencing factors：
EEP1 ： Increase understanding of the action one needs to take to start a business. EEP3 ： Increase practical management knowledge and skills of how to start a new venture. EEP4 ： Increase ability to create networks	EEP1 ： Increase understanding of the action one needs to take to start a business. EEP3 ： Increase practical management knowledge and skills of how to start a new venture. EEP4 ： Increase ability to create networks

After studying more EEP courses, the positive correlation between the two factors in EEP increased, while the positive correlation between the two influential factors decreased. The positive impact of EEP2 on EOI8 has a tremendous increase, rising from no significant relationship to a significant positive correlation; The EEP3 is still a very significant positive correlation, with a slight rise; The EEP4 is still a very significant positive correlation, but the value has decreased slightly.

Figure 4.3 Regression coefficient value(EOI Sub Items) (Cont.)

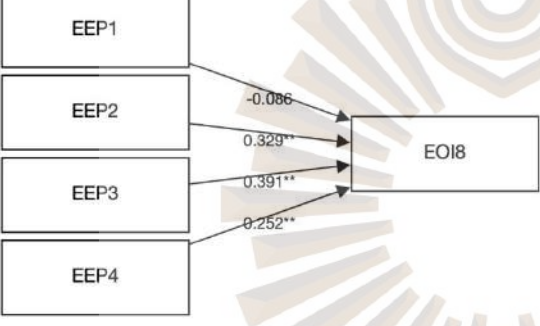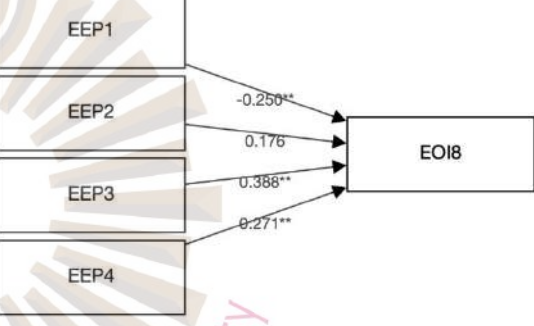| Regression coefficient value(Total)	
Experiment Group	Control Group

Significant influencing factors:	Significant influencing factors:
EEP2 ： Increase knowledge of the attitudes, values, and motivations of an entrepreneur	EEP2 ： Increase knowledge of the attitudes, values, and motivations of an entrepreneur
EEP3 ： Increase practical management knowledge and skills of how to start a new venture	EEP3 ： Increase practical management knowledge and skills of how to start a new venture
EEP4：Increase ability to create networks	EEP4：Increase ability to create networks

After studying more EEP courses, EEP4 had the most significant positive impact on EOI, while EEP3 was the factor that had the most significant positive effect on EOI. However, compared to the study of EEP compulsory courses, after receiving more classes, the improvement of this project was 0.082, which is relatively small. However, EEP2 has decreased from having a positive impact to no effect.
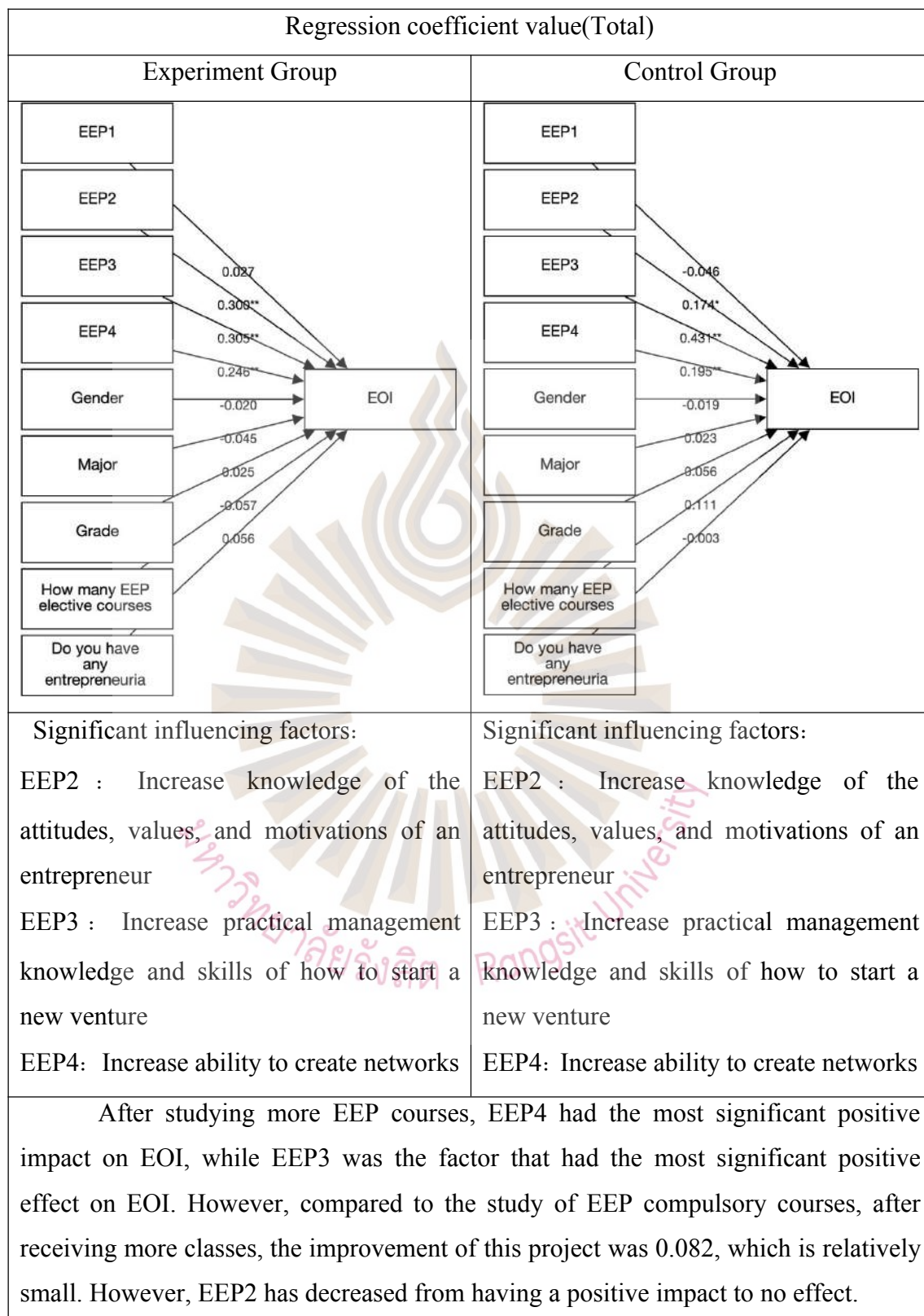
Figure 4.4 Regression coefficient value(Total)

From the regression analysis results in Figure 4.4, other variables may influence the relationship between EEP and EOI. In order to obtain the impact of each independent variable on the dependent variable, the control factors measured in the study (gender, major, grade, how many EEP elective courses did you study, do you have any introductory experience) will be introduced into the regression model, this will explain the impact of each variable on the dependent variable and notify the control of the impact of other variables (Mueller, 2011). Figure 4.4 shows the multiple regression relationship between the experiment and control groups. None of these five control factors are statistically significant, and adding these control variables has no explanatory significance for the model. Table 4.8-4.21 shows details.

Overall, based on the statistical analysis results, the variables identified in this study are valid, and the hypothetical relationships based on entrepreneurial education theory also provide compelling evidence in different analytical contexts.

4.4.4 The relative success rate of entrepreneurship education projects at Jiaxing University

According to the statistical results of this study, the entrepreneurship education programs provided by Jiaxing University are to some extent successful and have a specific effect on improving the EOI ability of college students, mainly by improving their "attributes, values, and motivations of an entrepreneur," "management knowledge and skills," and "create networks." At the same time, "start a business" does not significantly impact EOI.

4.5 Validate the EOI Course

4.5.1 EOI Course development survey questionnaire analysis

After validating the first experiment, it proves that a course titled "Identification of Entrepreneurship Opportunities for Engineering Students" needs to be developed for engineering students. Firstly, a survey questionnaire collects data on

students' needs for learning the course. The same sample size as Phase 1 was used, with a sample size of 220, including 82 engineering students (Experiment Group) who had studied EEP compulsory and elective courses and 138 engineering students (Control Group) who had studied EEP compulsory courses. The two groups were compared and analyzed.

1) If the EOI course is separate, which of the following type should it belong to?

Table 4.26 Course attribute selection

X\Y	A. Public compulsory course	B. Public elective course	C. Professional compulsory course	D. Professional elective course	Total Samples
Experiment Group	13(15.85%)	45(54.88%)	5(6.10%)	19(23.17%)	82
Control Group	26(18.84%)	90(65.22%)	7(5.07%)	15(10.87%)	138
Total	39(17.73%)	135(61.36%)	12(5.45%)	34(15.46%)	220

Among all samples in Table 4.28, 61.36% of students hoped to take public elective courses, 17.73% chose general compulsory courses, 15.45% chose professional elective courses, and 5.45% chose professional required courses. The support rate for public elective courses was significantly higher than other course types, indicating that many students did not want to be forced to study but instead want to choose whether to take this course in a more accessible and more flexible way, which may be related to many courses of Jiaxing University and the high learning pressure on students. Therefore, elective courses may be more suitable for the real needs of current college students.

Table 4.26 showed that in selecting Professional elective courses, the experiment group had 23.17%, while the control group had 10.87%. The proportion

difference was the largest, with the former being more than twice that of the latter. It indicated that after studying more EEP courses, students' demand for in-depth learning in entrepreneurship increases. At the same time, it also verified that the more EEP courses they investigated, the stronger their learning stickiness. At the same time, after learning a certain level of compulsory entrepreneurship courses, it was necessary to conduct more in-depth and professional integration of entrepreneurship courses, which put higher requirements on the design of entrepreneurship courses. At the same time, professional elective courses had specialized educational targeting. When students wanted to engage in in-depth entrepreneurial learning, they prefered to learn techniques that combine entrepreneurship with their majors, filling the loophole in the universality of EEP public compulsory courses. Therefore, in terms of the nature of the study, more consideration could be given to characterizing it as a Professional elective course.

2) In what form do you think this course should be embedded in teaching?

There was not much difference between the two groups in terms of "Separate course" and "Combined with the professional course" in Table 4.27, but 49.09% of students chose "Combined with entrepreneurship course." It indicates that students prefer to learn more about identifying entrepreneurial opportunities through entrepreneurship courses rather than setting up a specialized system, which may be due to two reasons: they wanted the course burden manageable. Secondly, students needed more confidence in entrepreneurship courses, which means that the attractiveness of entrepreneurship courses was low. Therefore, before developing new entrepreneurship-related courses, it was necessary to conduct sufficient research work, including students' actual needs, social development needs, and educational trends. Based on research reports, accurately locate course content and design courses around these needs, and the effectiveness of the courses will be higher. 32.27% of students hope to "Combine with professional courses," which reflected that not a few students were willing to engage in entrepreneurship in their majors and engage in integrated learning of professional and entrepreneurial education, which might enhance their

professionalism in entrepreneurship. The combination of professional education and entrepreneurship education was a good way to deepen the development of entrepreneurship education and also an excellent way to enhance professional entrepreneurship. From the current situation, it was possible first to offer a separate course, which belonged to the "testing type course." During the teaching process of this course, various types of data were gradually collected, and finally, the embedding form of this course was determined.

Table 4.27 Teaching Format

X\Y	A.Separate course	B.Combined with entrepreneurship course	C.Combined with professional course	Total Samples
Experiment Group	14(17.07%)	43(52.44%)	25(30.49%)	82
Control Group	27(19.57%)	65(47.10%)	46(33.33%)	138
Total	41(18.64%)	108(49.09%)	71(32.27%)	220

3) What do you think is the reasonable length of this course?

Table 4.28 Course Length

X\Y	A.64 class hours	B.48 class hours	C.32 class hours	D.16 class hours	Total Samples
Experiment Group	8(9.76%)	16(19.51%)	27(32.93%)	31(37.80%)	82
Control Group	13(9.42%)	17(12.32%)	56(40.58%)	52(37.68%)	138
Total	21(9.54%)	33(15.00%)	83(37.73%)	83(37.73%)	220

In terms of class length of Table 4.28, 37.73% of students chose 32 class hours, and 37.73% of students chose 16 class hours, which means 75.46%(37.73%+37.73%) of students hope that the course would have shorter class

hours. The experiment group decided on 48 class hours, which was 7.19%(19.51%-12.32%) more than the control group, and the difference was significant. That is to say, students who had studied more EEP courses hoped to have more class hours. However, the practical requirements of entrepreneurship courses were higher, so lesson design could be carried out in the form of "a small number of theoretical class hours and a large number of practical training class hours" to enhance the participation and experience of the course, allowing students to quickly apply the theory they had learned in practice in the classroom, achieving the effect of "learning is useful."

4) Considering the excellent connection with other courses, which academic year do you think this course is reasonable?

Compared to the two groups, the difference was most significant in the third academic year, and setting this course in this academic year might have the best effect in Table 4.29. From the perspective of entrepreneurship education, first-year students and sophomores had already learned some introductory courses in entrepreneurship education, and junior year was an excellent transitional period; From the perspective of professional education, after two years of studying professional courses, students had a particular professional foundation in their major and were becoming quasi-professional technical talents, already possessing the thinking foundation of professional entrepreneurship; From an employment perspective, junior students had higher employment needs. Opening this course at this time would help them better integrate their professional skills and entrepreneurial skills.

Table 4.29 Expected academic year of studying the course

X\Y	A. The first academic year	B. The second academic year	C. The third academic year	D. The Fourth academic year	Total Samples
Experiment Group	24(29.27%)	24(29.27%)	24(29.27%)	10(12.20%)	82

Table 4.29 Expected academic year of studying the course (Cont.)

| Control Group | 42(30.43%) | 54(39.13%) | 32(23.19%) | 10(7.25%) | 138 |
| Total | 66(30.00%) | 78(35.46%) | 56(25.45%) | 20(9.09%) | 220 |

5) Which of the following aspects do you think must be included in the teaching objectives?

Table 4.30 Expected teaching objectives

X\Y	A. Concept and meaning of EOI	B. Identification process of EOI	C. Case analysis of EOI	D. Design of EOI	Total Samples
Experiment Group	51(62.20%)	55(67.07%)	62(75.61%)	50(60.98%)	82
Control Group	94(68.12%)	104(75.36%)	111(80.43%)	99(71.74%)	138
Total	145(65.91%)	159(72.27%)	173(78.64%)	149(67.73%)	220

It is a multiple-choice question, and the four options in both groups are above 60% in Table 4.30, indicating that both groups of students have needs in these four aspects. Students have the most choices for 'Case analysis of EOI', followed by 'Identification process of EOI'. The two groups only had differences in the selection of 'Design of EOI' and 'Concept and meaning of EOI,' indicating that students generally had more demand for case analysis, mainly because case analysis could put theoretical knowledge into practical production for understanding, enabling a smooth transition of academic knowledge to practical applications, it was a vital link.

6) What do you think must be included in the teaching content?

It was a multiple-choice question, "Cognitive domain: knowledge and information sharing" referred to the relevant theoretical knowledge of EOI 、 "Affective domain: emotion, belief, attitude and value identification" referred to the

learning of the appropriate qualities of EOI's entrepreneurial spirit、 "Psychomotor domain: skills and adaptive behaviors" referred to EOI related skills. This question was a multiple-choice question, and the two groups had the highest selection rate for 'Cognitive domain: knowledge and information sharing, ' which indicated that students generally had a high demand for learning theoretical knowledge related to EOI and in course design; this part of the content should be strengthened in Table 4.31.

Table 4.31 Expected teaching contents

X\Y	A. Cognitive domain: knowledge and information sharing	B. Affective domain: emotion, belief, attitude and value identification	C. Psychomotor domain: skills and adaptive behaviors	Total Samples
Experiment Group	67(81.71%)	63(76.83%)	60(73.17%)	82
Control Group	123(89.13%)	106(76.81%)	106(76.81%)	138
Total	190(86.36%)	169(76.82%)	166(75.46%)	220

7) What aspects do you think should be evaluated?

Table 4.32 Aspects of the course evaluation

X\Y	A. Cognitive domain	B. Affective domain	C. Psychomotor domain	Total Samples
Experiment Group	66(80.49%)	66(80.49%)	61(74.39%)	82
Control Group	118(85.51%)	104(75.36%)	105(76.09%)	138
Total	184(83.64%)	170(77.27%)	166(75.46%)	220

It was a multiple-choice question, and the four options in both groups were above 74% in Table 4.32. It indicated that both groups of students agree with these three aspects, primarily the "Cognitive domain" choice. It showed that students generally had more needs in the cognitive field of EOI course. In the course design of this part of the content, teachers should pay attention to achieving teaching objectives and collecting data for evaluation and assessment to improve this part of the course content.

8) Do you think it is necessary to develop an EOI scale suitable for Chinese engineering students?

Table 4.33 The necessity of developing a Chinese engineering students' EOI scale

X\Y	A. Yes	B. No	Total Samples
Experiment Group	73(89.02%)	9(10.98%)	82
Control Group	112(81.16%)	26(18.84%)	138
Total	185(84.09%)	35(15.91%)	220

The recognition percentages of both groups are above 81%(89.02%、81.16%)in Table 4.33, indicating that both groups of students believe that after learning a course, it is necessary to quantitatively test the students' EOI level to achieve an understanding of learning effectiveness.

9) What evaluation tools do you think need to be developed?

Table 4.34 Evaluation tools that need to be developed

X\Y	A. Questionnaire	B. Nonstructural interview	Total Samples
Experiment Group	67(81.71%)	43(52.44%)	82
Control Group	110(79.71%)	70(50.72%)	138
Total	177(80.46%)	113(51.36%)	220

The recognition percentages of both groups are above 50% in Table 4.34, indicating that both groups of students can accept both "Questionnaire" and "Non-structural interview," and their acceptance of the Questionnaire is higher.

10) What kinds of course evaluation models do you think can be used?

Table 4.35 Applicable Course Evaluation Model

X\Y	A. Teaching achievement evaluation (third-party experts)	B. Teaching reflection (teaching teacher)	C. Learning experience (students)	Total Samples
Experiment Group	70(85.37%)	58(70.73%)	68(82.93%)	82
Control Group	114(82.61%)	94(68.12%)	108(78.26%)	138
Total	184(83.64%)	152(69.09%)	176(80.00%)	220

The recognition percentages of both groups were above 68% in Table 4.35, indicating that both groups of students were relatively satisfied with the three types of evaluation models. However, the selection rate on "Teaching achievement evaluation (third party experts)" was the highest, indicating that students still hoped to objectively evaluate the course through authoritative third-party experts, which also helped to ensure the fairness and fairness of teaching effectiveness of the course.

Conclusion

Overall, after a survey of the courses to be developed, it was found that students had high enthusiasm and expectations for the course and that their feedback could be fully designed into the course content.

4.5.2 Quantitative data analysis

Phase 2 aims to develop and validate the effectiveness of the EOI course through literature and evaluation support. Twenty-six samples were recruited to participate in the teaching activities of this course—a survey questionnaire to conduct pretest and post-test on the group of students. The mean values of pretest and post-test data were compared and analyzed to test whether the intervention course can effectively improve the EOI ability of engineering students.

H2： The EOI course can effectively improve the EOI ability of engineering students.

After comparing and analyzing the data in Table 4.36, the researcher found that the mean EOI of the post-test was more significant than the mean EOI of the pretest. The overall score of EOI increased from 3 points to over 4 points, which means that understanding one's EOI ability has increased from uncertainty to "certainty," which is a qualitative improvement in evaluating one's EOI ability. It verifies the effectiveness of this course in improving EOI ability, and hypothesis 2 holds.

Table 4.36 Comparison of mean values between pretest and post-test

Variables	Items	Pretest		Post-test		Mean2-Mean1
		Mean1	Std. deviation	Mean2	Std. deviation	
EOI	exploit an opportunity	3.630	1.006	4.111	0.751	+0.481
	perceive the unmet market demand	3.741	0.859	4.074	0.781	+0.333
	predict the prospects of the industry	3.667	0.920	4.074	0.829	+0.407
	identify the products and services	3.704	0.823	4.074	0.781	+0.370

Table 4.36 Comparison of mean values between pretest and post-test (Cont.)

	spend more time and energy looking for	3.741	0.813	4.111	0.751	+0.370
	make resource allocation decisions	3.630	0.792	4.111	0.698	+0.481
	organize and motivate employees	3.667	0.961	4.037	0.706	+0.370
	organize resources and coordinate various work	3.815	0.681	4.111	0.698	+0.296

4.5.3 Interview Findings

The researcher interviewed 26 students who participated in the EOI course, and the interview was used to measure student's knowledge and skills in mastering the course. The study obtained results using the qualitative analysis software NVIVO as shown in Table 4.37. Specifically, questions 1, 2, 3, and 11 had the highest response rates, all with 20 or more responses. Among them, questions 1 and 2 belong to the theoretical knowledge category of the EOI, indicating that students have a better understanding of the basic concepts of this course, and questions 3 and 11 examine the practical expansion of the theoretical knowledge, indicating that students also have better learning feedback in terms of expanding the theoretical understanding of this course, which is successful in terms of academic instruction.

Questions 4, 6, 8, 9, and 10 had a high response rate, with 13-15 answers. Questions 4, 9, and 10 examine the degree of understanding and application of theoretical knowledge, which is a higher-order requirement of academic expertise, and indicate that students have a higher degree of application ability of theoretical knowledge. Questions 6 and 8 are about the understanding and analysis of course cases, which mainly examine students' understanding and application ability of practical cases, and the number of answers is 15 items, with a relatively high feedback

rate, which shows that students have a better grasp of this aspect and the case teaching aspect is successful.

Questions 5, 7, and 12 had low response rates, with a 7 and 0 items response volume. Among them, question 5 is the understanding and analysis of the fuzzy screening model for entrepreneurial opportunity identification; the answer quantity is seven items, and the number of students who master this ability is not much; this may be because the fuzzy screening model is complex for students to learn, it is possible that because the course experiment is using the centralized training method.

Due to the solid theoretical content of this part, it needed some time to think and master, which also caused some students to the design of entrepreneurial opportunities could not be done with the precision of entrepreneurial opportunities. For future course improvement, it may be necessary to provide methods to explain the model so that students can learn and master it more easily. In terms of class time allocation, the class time for this part should be increased to provide students with sufficient opportunities for study and practice. Questions 7 and 12 are higher-order measures of the application of the fuzzy screening model with 0 items of answers, indicating that students have a poor grasp of the integrated application of the fuzzy screening model and the feature analysis model and are not confident enough to make effective responses, further indicating that this section needs more detailed lectures and teaching to enhance the effectiveness of student learning in this area.

Table 4.37 Interview Effective Frequency Table

	Title of the questions	Files	Reference point
01	What is the definition of entrepreneurial opportunity identification?	1	25
02	What are the three main stages of entrepreneurial opportunity identification?	1	22

Table 4.37 Interview Effective Frequency Table (Cont.)

03	Please give an entrepreneurial opportunity identification case related to your major.	1	24
04	Explain the feature analysis model and analysis steps in your own language.	1	15
05	Explain the fuzzy screening model and analysis steps in your own language.	1	7
06	Please choose a case given in the class. If it is you, how will you determine the entrepreneurial opportunity?	1	15
07	Analyze and calculate a case using feature analysis and fuzzy screening models.	0	0
08	Please select a case given in the class and conduct an overall analysis according to the whole process of entrepreneurial opportunity identification.	1	15
09	What is the main stage in the whole process of analysis?	1	14
10	What can be optimized in this case?	1	13
11	Which of the three cases given in the course do you think is the best? Why?	1	20
12	Starting from your major, please use the feature analysis and fuzzy screening models to design an entrepreneurial opportunity.	0	0

Qualitative analysis of the data leads to the following conclusions: Students had a good understanding and mastery of the theoretical knowledge and extension of EOI, which could prove that this course was significantly practical. However, there was still a need for better teaching methods for fuzzy screening models in terms of details to help students to have a deeper understanding and proficient application for better teaching effectiveness.

CHAPTER 5

CONCLUSION, DISCUSSION AND RECOMMENDATIONS

The four sections of this chapter include conclusion, discussion, recommendations, and implication. This chapter summarized and discussed the research results and provided suggestions and insights for future research on entrepreneurship education and entrepreneurial opportunity identification.

5.1 Conclusion

This study has three research objectives, 1) To explore the influence of EEP courses on the EOI ability of engineering students at Jiaxing University, 2) To experiment the EOI course on the EOI ability of engineering students in EEP at Jiaxing University, and 3) To validate the EOI course on the EOI ability of engineering students in EEP at Jiaxing University. The researcher used mixed research methods, quantitative and qualitative. Quantitative data were obtained through questionnaires, while qualitative data were obtained through structured interview. The analysis of research data shows the following conclusions.

5.1.1 Responses to First Research Objective

The first research objective is 'To explore the influence of EEP courses on the EOI ability of engineering students at Jiaxing University'. Most research in entrepreneurship education takes the EEP as a whole and researches the impacts on one or a few specific entrepreneurial abilities without looking at the more detailed aspects of the effects of EEP. Based on questionnaire 1, researchers have identified three EEP factors that strongly impact EOI ability. 1) "create networks, 2) "attributes, values, and motivations of an entrepreneur," 3) "management knowledge and skills." It is shown in Figure 5.1.
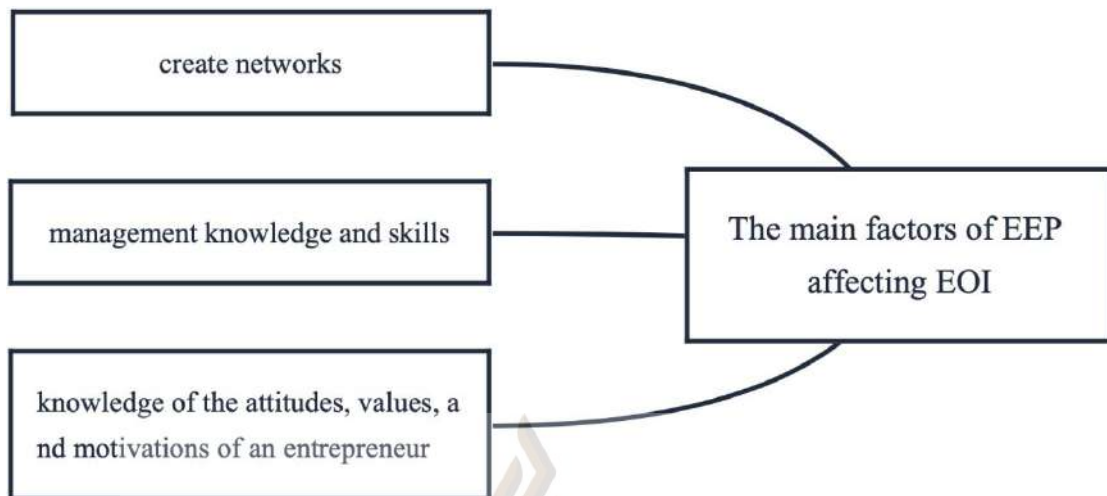
Figure 5.1 Factors of EEP influencing EOI ability

5.1.1.1 Create Networks

As seen in Table 4.27, "creating a network" positively influenced the six elements of the EOI ability in the experiment group, and "creating a network" positively influenced the six elements of the EOI ability in the control group. In "With external support, predict the industry's prospects to develop" (EOI 3) and "Be able to identify the products and services that consumers need effectively" (EOI 4), "creating a network" did not have a significant effect on the experiment group, and in "Willing to spend more time and energy looking for products and services that can bring value to customers" (EOI 5), "creating a network" did not have a significant effect on the control group.

"Creating networks" does not affect EOI3 and EOI4 of the experiment group. As undergraduate students, they are learning professional knowledge and skills and are not familiar with their industry, have a single interpersonal network and a weak ability to predict the industry's development prospects, receive little external support, know little about the market, and cannot effectively identify the needs of consumers. In entrepreneurship education, teachers need to focus on the link between the teaching of professional practical skills of engineering students and the social employment environment, a common need for a good connection between university education and social needs today. The effect of "Create Networks" on EOI3 is 0.197 in the experiment group and 0.200 in the control group, a specific effect with a slight

difference. In the effect of "Create Networks" on EOI4, the values of 0.186 for the experimental group and 0.173 for the control group were considered to have some effect, but the difference between them was insignificant. However, for the effect of "Create Networks" on EOI5, the values of 0.413 in the experiment group and 0.018 in the control group were significant differences. Research has shown that "creating networks" in entrepreneurship education has a significant positive impact on engineering students who study more entrepreneurship education courses.

5.1.1.2 Attributes, values, and motivations of an entrepreneur

As seen in Table 4.27, "Attributes, values, and motivations of an entrepreneur" positively influenced the four elements of the EOI ability in the experiment group, and "Attributes, values, and motivations of an entrepreneur" positively influenced the three elements of the EOI in the control group. In "Increase ability to exploit an opportunity" (EOI 1), "Willing to spend more time and energy looking for products and services that can bring value to customers" (EOI 5), "Be able to make resource allocation decisions to maximize benefits" (EOI 6), and "Be able to manage resources and coordinate various work tasks effectively" (EOI 8), "Attributes, values, and motivations of an entrepreneur" did not have a significant effect on the experiment group, and in "Be able to perceive the unmet market demand accurately" (EOI 2), "Be able to identify the products and services that consumers need effectively" (EOI 4),"Be able to make resource allocation decisions to maximize benefits" (EOI 6),"Be able to organize and motivate employees to achieve corporate goals" (EOI 7), and "Be able to manage resources and coordinate various work tasks effectively" (EOI 8),"Attributes, values, and motivations of an entrepreneur" did not have a significant effect on the control group.

There were no significant effects in the two groups at EOI 6 and EOI 8, it was because EOI 6 needed mature business operation and management skills; the vast majority of students did not have these abilities; universities should create good resources to support and practice entrepreneurship to start students' business. EEP2 in the experiment group had no significant effect on EOI 1 and EOI 5. The values were lower than the control group may be due to the "learning plateau" phenomenon in the

learning process. This phenomenon reinforced the need for courses dedicated to teaching entrepreneurial opportunities.

5.1.1.3 Management knowledge and skills

As seen in Table 4.27, "Management knowledge and skills" positively influenced the five elements of the EOI ability in the experiment group, and "Management knowledge and skills" positively influenced the eight elements of the EOI ability in the control group. In "Be able to perceive the unmet market demand accurately" (EOI 2), "Be able to identify the products and services that consumers need effectively" (EOI 4) and "Be able to organize and motivate employees to achieve corporate goals" (EOI 7), "Management knowledge and skills" did not have a significant effect on the experiment group. EOI 1 - EOI 8 have significant effects on the control group.

It may be because theoretical knowledge is explicitly taught within the compulsory entrepreneurship education courses for these three areas, and students will be more sure about the related issues when they learn only theoretical knowledge. However, after learning more entrepreneurship education courses and without entrepreneurial experience, students need clarification about these three aspects, which is a common difficulty in transitioning from theory to practice.

5.1.2 Responses to Second and Third Research Objectives

The second research objective is 'To experiment with the EOI course on the EOI ability of engineering students in EEP in Jiaxing University', and the third research objective is 'To validate the EOI course on the EOI ability of engineering students in EEP in Jiaxing University'.

5.1.2.1 EOI Course Development Questionnaire

Twenty-six samples participated in the teaching activities of the EOI course, and a questionnaire to conducted a pretest and post-test on them. After comparing and analyzing the data in Table 4.39, the researcher found that the mean of

EOI ability from the post-test was more significant than the mean EOI of the pretest. The overall score of EOI increased from 3 points to over 4 points, which means that understanding one's EOI ability has increased from uncertainty to "certainty," which is a qualitative improvement in evaluating one's EOI ability. It verifies the effectiveness of this course in improving EOI ability, and hypothesis 2 holds.

5.1.2.2 Structured Interview

The researcher interviewed 26 students who participated in the EOI course and used the interview to measure students' knowledge and skills in mastering the course and found that students had a good understanding and mastery of the theoretical knowledge and extension of EOI, which could prove that this course was significantly practical. However, there is still a need for better teaching methods for fuzzy screening models in terms of details to help students have a deeper understanding and proficient application for better teaching effectiveness.

5.2 Discussion

This research extensively studies the literature on entrepreneurship education and entrepreneurial opportunity identification based on social cognitive theory. It analyzes some of the issues of entrepreneurship education in China. In the world, there were few studies had specifically examined the impact of EEP courses on the EOI ability of engineering students. Specifically, no studies have compared the EOI abilities of students who have received different levels of EEP courses, as well as few studies have determined the relationship between EEP courses and students' EOI abilities, and little is known about the critical factors that influence students' EOI abilities. This study examined the impact of EEP on engineering students' EOI at Jiaxing University and, based on the research results, it developed an EOI course for engineering students that could effectively improve EOI ability. This study addressed the following questions: Does EEP enhance the EOI ability of Chinese engineering students? What factors of EEP significantly impact the EOI ability of engineering students? Can the EOI course effectively improve the EOI ability of engineering students?

5.2.1 Responses to the First Research Question

The first research question of this study was, "What factors of EEP courses significantly impact the EOI ability of engineering students?"

This research confirmed the positive impact of entrepreneurship education on entrepreneurial opportunity identification in China. A post-test of engineering students who had taken different levels of EEP courses showed that the mean value of EOI increased and that EEP and EOI were positively correlated. The findings were consistent with previous studies on the impact of EEP on EOI (Cohen et al., 2021; Gedeon, 2017; Goje, 2017)

However, this contrasted with previous research on whether EEP effectively improves EOI capabilities. For example, Karimi et al. (2012) found no effect of supporting EEP on entrepreneurial opportunity identification. The results of the present study show a more significant difference in findings, in addition to the difference with Karimi et al. (2012) study. Liu et al. (2018) surveyed 968 undergraduate students. They showed that entrepreneurship education courses positively moderated the relationship between entrepreneurial self-efficacy and opportunity recognition but did not provide a clear conclusion as to whether it significantly enhanced EOI ability. In this study, we found that the EOI ability of students who participated in the compulsory and elective EEP courses (experiment group) tended to increase compared with the control group, which confirmed that participation in EEP had a positive effect on Chinese engineering students, and also verified that the existing EEP improved students' EOI ability, but only from "disagreed little extent "This confirms the positive effect of participating in EEP on Chinese engineering students.

There may be various reasons why this study differs from previous studies. Most previous studies were descriptive, paralleling entrepreneurial opportunity identification with other factors and on different student samples. Most of the studies conducted in China focused on general education in entrepreneurship education, and

most of these samples were from management disciplines or business fields. However, this study expands the depth and area of research from general entrepreneurship education research to entrepreneurship education integrated with disciplinary majors and from business primary research to engineering significant research. Expanding these areas led to more detail in the independent variables in the study. It increased the specificity of the dependent variables, providing a more detailed explanation for identifying entrepreneurial opportunities. As a result, the results of this study indicate a higher EOI ability in the experiment group than the control group, reflecting that conclusions drawn may be significantly different when the variables are more precise. This study broadened the source of the sample by using a more diverse two-stage experiment for the study and a sample of students from engineering disciplines, particularly those with degrees in construction engineering. Incorporating students' majors into the study context allows for more targeted enhancement of EOI ability for specific populations by capturing their significant preferences.

After taking EEP courses at various levels, students' EOI ability improved somewhat, but the improvement was not significant. Therefore, there is a need to develop a course that can effectively enhance EOI ability and provide continuing education to students to enhance EOI ability effectively.

From the results of the study, the most critical point that emerges from this study is that the enhancement of engineering students' EOI capabilities in the Chinese context depends on students' learning in the areas of "network creation," "attributes, values, and motivations of an entrepreneur," and "management knowledge and skills." EEP is the acquisition of "network creation," "attributes, values, and motivations of an entrepreneur," and "management knowledge and skills." Therefore, in developing EOI abilities, students must focus on learning and acquiring the three factors because they are relatively practical and effective in improving their EOI abilities. They have a relatively valuable and influential role in improving students' EOI abilities. In the entrepreneurship education process, teachers should encourage students to engage in entrepreneurial activities by developing their interpersonal networks, Entrepreneurial spirit, and management skills.

Few previous entrepreneurship education studies have pointed to this point because there still needs to be more in-depth segmented type of research on the impact of EEP courses on EOI ability. However, the results of the study contrast with the views of some previous studies conducted in China. Most previous studies have emphasized students' entrepreneurial intentions, motivation, and self-efficacy rather than entrepreneurial opportunity identification in this context (Abdullahi et al., 2021).

In addition, the results of this study are inconsistent with previous studies on the impact of gender on EOI ability, where the analysis of demographic data of engineering students yielded no significant effect of gender on the improvement of EOI ability, and the findings of Wieland et al. (2019), which reproduce the role played by the gender gap in entrepreneurial outcomes. However, the effect of gender in this study is minimal, which may be since, in the study of the effect of gender on EOI, most of the samples in the study were from society or companies, not college students. The gender differentiation in the personality traits of college students is not apparent. At the same time, the social division of labor has different needs for physical and gender strengths of different genders, so the "occupational gender " differentiation is evident.

Few researches have been conducted on the influence of disciplinary specialties on EOI ability (Rahim et al., 2021). Moreover, the results of this study show that disciplinary specialties have some potential impact due to the different entrepreneurial characteristics of the specialties that determine the ease of professional innovation and entrepreneurship. Therefore, it is necessary to guide students in entrepreneurship by teaching professional courses when planning to start a business. At a broader level, this study provides empirical evidence for professional ability education in EEP by revealing the factors that influence students' EOI ability in EEP courses.

5.2.2 Responses to the Second Research Question

The second research question of this study is, "Can EOI courses effectively improve the EOI ability of engineering students?"

This study confirms the positive correlation by testing the effect of EEP on EOI and reveals the main factors that influence students' EOI. The researcher identifies the factors that influence students' identification of entrepreneurial opportunities and, based on this, develops an EOI course for engineering students. The ADDIE model and BLOOM theory were used to guide the course development in the study, and the effectiveness of the course was verified through quantitative data obtained from the pre-test and post-test of the experiment group and qualitative data obtained from the interview. The students' EOI was significantly higher after participating in the developmental program, and there was a qualitative improvement from "uncertainty" to "certainty" about their abilities, which indicates that the EOI course developed in this study positively impacted EOI abilities and that the course developed specifically to improve EOI abilities had a higher pedagogical impact. Entrepreneurship education is a fundamental way to gain knowledge about identifying entrepreneurial opportunities, and students are advised to delve into the various abilities required in the entrepreneurial process.

One possible reason for improving student EOI may be related to the variety of skills and teamwork practices students may gain in the EEP. The Chinese EEP emphasizes hands-on skills training and allows students to design business plans and analyze successful entrepreneurial cases. Students can look to them as successful role models for mentoring. Another reason may be that students' enthusiasm for learning may increase as they realize that a new discipline can open up new possibilities for their employment. However, the first experiment of this research experiment showed that Chinese engineering students had relatively low EOI ability scores. Of course, the low scores do not mean that the EEP is ineffective, which may be related to the curriculum design of the EEP. Most Chinese EEP courses are still in the general education curriculum, and taught uniformly (Cai, 2021). In this pedagogical context,

integrating engineering and technology into entrepreneurship education and maximizing the combination of professional characteristics and entrepreneurship training may be challenging, which also has some positive effects on students.

The results of this study are about education in the early stages of entrepreneurship. The ultimate learning value of students' participation in entrepreneurship courses may be reflected in either direct entrepreneurship or post-graduation employment. Prior literature has experimental evidence, and the experimental validation of this study suggests that Chinese engineering students' EOI abilities are affected and are likely to exhibit entrepreneurial behavior in the future. In order to obtain empirical evidence, it would take years to track and investigate students' future development. However, the results of this study suggest that entrepreneurship education at Jiaxing University can positively impact the improvement of engineering students' EOI ability. The existing EEP can also be enhanced to improve students' EOI abilities by reinforcing the relevant factors. Combined with the EOI curriculum developed in this study, EOI can be further improved so that students can acquire the necessary EOI abilities for future entrepreneurship.

5.3 Recommendations

The research found that in the learning process of EEP courses, the improvement of EOI ability among Chinese engineering students is influenced by three factors. 1) "create networks," 2) "attributes, values, and motivations of an entrepreneur," 3) "management knowledge and skills." The researcher made suggestions based on the research results.

5.3.1 Recommendations for Implementation

According to the research findings, the researcher recommends the following points for entrepreneurship education teachers.

1) Create networks: Lecturers should add teaching and practice content on "creating networks" in their instructional design. The teaching content of "creating networks" can include "the concept of the network" and "how to create networks." During the practice of "creating networks," teachers can use the practical hours of the courses to provide students with opportunities for teamwork; teachers can help students establish partnerships, various social networks, and resource networks. When students have further support for entrepreneurial resources, the university provides social resources needed for entrepreneurship, including investors, entrepreneurial mentors, social partners, and entrepreneurial platforms. Teachers can encourage students to discover and utilize family resources, alumni resources, geographical resources, and policy resources, help students establish three-dimensional network relationships to obtain entrepreneurial information and resources, and enhance their market competitiveness; teachers can achieve teaching objectives through offline teaching, online Q&A, and extend learning materials.

2) Attributes, values, and motivations of an entrepreneur: Entrepreneurs are individuals who systematically and consciously combine production factors to produce goods and services, and he is a social leader who will utilize innovative and original methods and opportunities to develop and implement practical solutions for social problems (Ula, 2021). "Attributes, values, and motivations" is an essential quality for entrepreneurs, which can be acquired through learning and reflected through the entrepreneurial consciousness of college students. In cultivating entrepreneurial spirit, teachers can continuously emphasize entrepreneurial awareness during the teaching process of entrepreneurship education courses to make students accept entrepreneurial spirit and be willing to possess it. On the one hand, there are specific requirements for the teaching ability of teachers, and teachers need to design their entrepreneurial awareness and spirit into their teaching subtly.

3) Management knowledge and skills: It is an essential element in college students' entrepreneurial activities, which can help students integrate their entrepreneurial resources reasonably and carry out entrepreneurial activities smoothly. On the one hand, "Management knowledge and skills" is that college students can

achieve mastery of management knowledge through theoretical learning in entrepreneurship courses. On the other hand, students can acquire it through continuous practice in EEP courses. This demand puts forward requirements for the proportion of practical class hours and practical forms in EEP courses.

"Create networks" are the foundation of entrepreneurship, "attributes, values, and motivations of an entrepreneur" is an entrepreneur, and "management knowledge and skills" refers to the ability of entrepreneurs to manage resources. The three form a stable EOI capability triangle model, jointly supporting the EOI capability of entrepreneurs, and the three factors can effectively enhance the EOI ability of engineering students.

5.3.2 Recommendations for Future Studies

Based on the research results, the researcher has proposed seven research suggestions for future researchers.

1) Future research can be expanded to sample engineering students from different universities to ensure more representative samples.

2) The data in this research are all from students. In future research, researchers can invite teachers and experts to quantitatively or qualitatively evaluate students' EOI abilities, improving experimental results' accuracy.

3) The researcher conducted a post-test immediately after the EOI course was taught and did not measure the stability of EOI ability over a certain period. However, addressing the time lag between intention and action may require long-term tracking testing (Krueger et al., 2000). The measurement of EOI stability requires comparative research after students engage in entrepreneurial activities or social work to determine whether they have stable EOI ability or whether their EOI ability has improved again. Subsequent research can improve the research results through long-term tracking testing.

4) This research measures students' EOI ability rather than entrepreneurial behavior. In entrepreneurial practice, students' EOI ability can be reflected in their future careers or entrepreneurial behavior, and further research feedback can be obtained through follow-up surveys. In future research, it is worth further empirical testing how the EOI course developed regulates students' EOI ability in more detailed factors.

5) The improvement of entrepreneurial ability faces various dynamic factors. Future research can incorporate various factors, such as students' learning ability, campus entrepreneurial environment, students' family background, university geographical location, and the economic development level of the city they are located in, into necessary research on whether and how they affect students' motivation for entrepreneurship rate.

6) Entrepreneurship is a behavior influenced by both external and internal factors, so studying the connections between each entrepreneurial element and the factors and connections that affect the ability to identify entrepreneurial opportunities is an exciting and in-depth research direction that may require further development of entrepreneurial learning (Souitaris et al., 2007). Does family background, parent-child relationship, learning ability, entrepreneurship policy, university entrepreneurship environment, frequency of teaching interaction in entrepreneurship teaching classrooms, and frequency of entrepreneurship activities held by universities significantly impact students' EOI ability? Therefore, the direction of future research is exploring which internal and environmental factors affect the EOI ability of Chinese engineering college students.

7) Education is not a process of indoctrination but a process of inspiring students to learn actively. How teachers attract students and encourage them to learn EEP courses after offering EEP courses in universities is a research that can improve the effectiveness of EEP courses.

5.4 Education Implications

Overall, the conclusions of this research assist with future research. Other researchers can use this study to collect the factors and challenges that affect the EOI ability of engineering students in EEP courses and provide teaching strategies for entrepreneurship educators in improving students' EOI ability, achieving the effect of effectively improving students' EOI ability. This research explores the development of EOI course, and other universities can use this course's teaching content and evaluation methods to improve students' EOI abilities effectively. In addition, the development of the EOI course also provides a curriculum design basis for developing other courses in entrepreneurship education. There are three more specific meanings:

1) The results of this study have made essential contributions to the study of the determinants of entrepreneurial education on the ability of engineering students to identify entrepreneurial opportunities. Firstly, by testing the impact of EEP on EOI ability, contributions were made to social cognitive theory in entrepreneurship education research. This study examined the EOI ability of engineering students in EEP at Jiaxing University, providing a deeper understanding of the integration of entrepreneurship education and professional education at Chinese universities. This field has gradually received attention in China since the start of university entrepreneurship education in 2000, but systematic research still needs to be done. The results of this study have filled this gap by verifying the EOI ability of engineering students in Chinese university EEP and developing an EOI course that integrates engineering education. Therefore, this study confirms that EEP positively impacts students' EOI ability and can effectively improve EOI ability through specialized courses.

2) Previous studies have yet to focus on students with engineering backgrounds. This study helps evaluate EEP's impact on engineering students in Chinese universities. Most studies on entrepreneurship education in Chinese universities mainly focus on students majoring in business and all disciplines as a whole, and there is little specialized research on the cultivation of students'

characteristics based on their disciplinary direction. This study conducted research in this area and provided empirical evidence by comparing the experiment and control groups to prove that entrepreneurship education at Jiaxing University positively impacts engineering students and can effectively improve their EOI ability through courses that combine professional and entrepreneurial skills.

3) This study supplements the existing knowledge system on EEP by revealing the positive impact of entrepreneurship education on entrepreneurial opportunity recognition. These courses include entrepreneurial foundations, entrepreneurial attitudes, practical skills, and entrepreneurial opportunity recognition skills, but most still need to be tested for their relationship with entrepreneurial opportunity recognition. This study fills this gap by testing students' EOI ability, opening up a research gap in the slicing of entrepreneurship education, and opening up research ideas for transforming entrepreneurship education from rough education to refined and standardized education. From the perspective of educational practice, the curriculum design that combines EEP's professional education and entrepreneurship education provides a good sample and model, especially in the specialized entrepreneurship education of Chinese engineering students.

In addition, this course can be considered for use, and in the teaching practice process, continuous thinking and improvement methods for entrepreneurship education of engineering students are proposed to further research the entrepreneurship education of engineering students. To achieve the goal of entrepreneurship education for engineering students, that is, to enhance their entrepreneurial level and professional technology entrepreneurship rate. The researcher has provided evidence for the research on entrepreneurship education and identified entrepreneurial opportunities through this study.

REFERENCES

Abdullahi, M. S., Khalid, N., Ahmed, U., Ahmed, E. M., & Gumawa, A. M. (2021). Effect of entrepreneurship education on entrepreneurial intention among university students. *Journal of Technical Education and Training, 13*(3), 40-53.

Abd Rahim, N., Mohamed, Z., Amrin, A., & Masrom, M. (2021). Impact of self-regulated learning on entrepreneurial opportunity recognition and academic entrepreneurship performance. *International Journal of Innovation and Technology Management, 18*(04), 2150016.

Ardichvili, A., Cardozo, R., & Ray, S. (2003). A theory of entrepreneurial opportunity identification and development. *Journal of Business venturing, 18*(1), 105-123.

Asante, E. A., & Affum-Osei, E. (2019). Entrepreneurship as a career choice: The impact of locus of control on aspiring entrepreneurs' opportunity recognition. *Journal of Business Research*, *98*, 227-235.

Baggen, Y., Mainert, J., Lans, T., Biemans, H. J., Greiff, S., & Mulder, M. (2015). Linking complex problem solving to opportunity identification competence within the context of entrepreneurship. *International Journal of Lifelong Education, 34*(4), 412-429.

Baručić, A., & Umihanić, B. (2016). Entrepreneurship education as a factor of entrepreneurial opportunity recognition for starting a new business. *Management: journal of contemporary management issues, 21*(2), 27-44.

Beauchamp, M. R., Crawford, K. L., & Jackson, B. (2019). Social cognitive theory and physical activity: Mechanisms of behavior change, critique, and legacy. *Psychology of Sport and Exercise*, *42*, 110-117.

Bergmann, H., Geissler, M., Hundt, C., & Grave, B. (2018). The climate for entrepreneurship at higher education institutions. *Research Policy, 47*(4), 700-716.

REFERENCES (CONT.)

Bergmann, H., Hundt, C., & Sternberg, R. (2016). What makes student entrepreneurs? On the relevance (and irrelevance) of the university and the regional context for student start-ups. *Small business economics*, *47*, 53-76.

Bliemel, M. J. (2013). Getting entrepreneurship education out of the classroom and into students' heads. *Entrepreneurship Research Journal, 4*(2), 237-260.

Boateng, E. (2019). *The impact of management and entrepreneurship education on entrepreneurial activities of university graduates in Ghana* (Unpublished Master's thesis). Kwame Nkrumah University of Science & Technology, Ghana.

Boyles, T. (2012). 21st century knowledge, skills, and abilities and entrepreneurial competencies: A model for undergraduate entrepreneurship education. *Journal of Entrepreneurship Education*, *15*, 41-45.

Cai, J. (2021). Current Situation of Entrepreneurship Education and Talent Training Mode of College Students in China. In *2021 2nd International Conference on Computers, Information Processing and Advanced Education (CIPAE 2021)* (pp. 405-407). New York: Associatation for Computing Machinery.

Chen, M. H., & Tseng, M. (2021). Creative entrepreneurs' artistic creativity and entrepreneurial alertness: the guanxi network perspective. *International Journal of Entrepreneurial Behavior & Research, 27*(4), 1082-1102.

Cheng, Y. M., Wang, K., & Lee, I. K. (2018). Application of engineering education in entrepreneurship construction system. Eurasia Journal of Mathematics, *Science and Technology Education, 14*(6), 2185-2191.

Clark, K., & Ramachandran, I. (2019). Subsidiary entrepreneurship and entrepreneurial opportunity: An institutional perspective. *Journal of International Management, 25*(1), 37-50.

Cohen, D., Hsu, D. K., & Shinnar, R. S. (2021). Identifying innovative opportunities in the entrepreneurship classroom: a new approach and empirical test. *Small Business Economics, 57*(4), 1931-1955.

REFERENCES (CONT.)

Dutta, D. K., Li, J., & Merenda, M. (2011). Fostering entrepreneurship: impact of specialization and diversity in education. *International Entrepreneurship and Management Journal, 7*(2), 163-179.

Eckhardt, J. T., & Shane, S. A. (2003). Opportunities and entrepreneurship. *Journal of management, 29*(3), 333-349.

Efklides, A., & Misailidi, P. (2019). Emotional self-regulation in the early years: The role of cognition, metacognition and social interaction. In D. Whitebread (Ed.), *The SAGE handbook of developmental psychology and early childhood education* (pp.502-516). New York: SAGE Publications Ltd.

Fayolle, A., Doucet, J. L., Gillet, J. F., Bourland, N., & Lejeune, P. (2013). Tree allometry in Central Africa: Testing the validity of pantropical multi-species allometric equations for estimating biomass and carbon stocks. *Forest Ecology and Management, 305*, 29-37.

Gaglio, C. M., & Dimov, D. (2018). Opportunity identification redux. In J. A. Kate & A. C. Corbett (Eds.), *Advance in Entrepreneurship, Film Emergence and Growth* (pp. 49-69). n.p.:Emerald Group Publishing Ltd.

Gedeon, S. A. (2017). Measuring student transformation in entrepreneurship education programs. *Education Research International, 2017*, 1-12.

Gibb, A. (2002). Creating conducive environments for learning and entrepreneurship: living with, dealing with, creating and enjoying uncertainty and complexity. *Industry &Higher Education, 16*(3), 135-148.

Gielnik, M. M., Frese, M., Kahara-Kawuki, A., Wasswa Katono, I., Kyejjusa, S., Ngoma, M., . . . Dlugosch, T. J. (2015). Action and action-regulation in entrepreneurship: Evaluating a student training for promoting entrepreneurship. *Academy of Management Learning & Education, 14*(1), 69-94.

REFERENCES (CONT.)

Gielnik, M. M., Frese, M., Kahara-Kawuki, A., Katono, I. W., Kyejjusa, S., & Ngoma, M., et al. (2017). Action and action-regulation in entrepreneurship: evaluating a student training for promoting entrepreneurship. *Academy of Management Learning & Education, 14*(1), 69-94.

Goje, H. (2017). *The impact of entrepreneurship education program on students' entrepreneurial intentions in Nigerian universities* (Unpublished Doctoral dissertation). Nottingham Trent University, UK.

Hassan, A., Saleem, I., Anwar, I., & Hussain, S. A. (2020). Entrepreneurial intention of Indian university students: the role of opportunity recognition and entrepreneurship education. *Education + Training, 62*(7/8), 843-861.

Ho, C. S. M., & Man, T. W. Y. (2022). The conditions of opportunity recognition in schools: an investigation of how entrepreneurial teachers discover new educational opportunities. *Journal of Professional Capital and Community, 7*(2), 109-125.

Hu, X. (2018). Methodological implications of critical realism for entrepreneurship research. *Journal of critical realism, 17*(2), 118-139.

Israr, M., & Saleem, M. (2018). Entrepreneurial intentions among university students in Italy. *Journal of Global Entrepreneurship Research, 8*(1), 1-14.

Iwu, C. G., Opute, P. A., Nchu, R., Eresia-Eke, C., Tengeh, R. K., Jaiyeoba, O., & Aliyu, O. A. (2021). Entrepreneurship education, curriculum and lecturer-competency as antecedents of student entrepreneurial intention. *The International Journal of Management Education, 19*(1), 100295.

Jena, R. K. (2020). Measuring the impact of business management Student's attitude towards entrepreneurship education on entrepreneurial intention: A case study. *Computers in Human Behavior, 107*, 106275.

Karimi, S., Biemans, H. J., Lans, T., Mulder, M., & Chizari, M. (2012, November). *The impact of entrepreneurship education on students entrepreneurial intentions and opportunity identification perceptions.* Proceedings of 26th Annual RENT Conference, Lyon, France.

REFERENCES (CONT.)

Karimi, S., Biemans, H. J., Lans, T., Aazami, M., & Mulder, M. (2016). Fostering students' competence in identifying business opportunities in entrepreneurship education. *Innovations in education and teaching international, 53*(2), 215-229.

Kim, K. C., ElTarabishy, A., & Bae, Z. T. (2018). Humane entrepreneurship: How focusing on people can drive a new era of wealth and quality job creation in a sustainable world. *Journal of Small Business Management, 56*, 10-29.

Klofsten, M., Fayolle, A., Guerrero, M., Mian, S., Urbano, D., & Wright, M. (2019). The entrepreneurial university as driver for economic growth and social change-Key strategic challenges. *Technological Forecasting and Social Change, 141*, 149-158.

Kolb, A. Y., & Kolb, D. A. (2009). The learning way: Meta-cognitive aspects of experiential learning. *Simulation & Gaming, 40*(3), 297-327.

Laguna-Sánchez, P., Abad, P., de la Fuente-Cabrero, C., & Calero, R. (2020). A university training programme for acquiring entrepreneurial and transversal employability skills, a students' assessment. *Sustainability, 12*(3), 796.

Lindsay, C., Bright, G., & Hippner, M. (2000). Advanced material handling system for computer integrated manufacturing. *Robotics and Computer-Integrated Manufacturing, 16*(6), 437-441.

Liu, J. W., Wu, J. L., & Gu, J. B. (2018). Entrepreneurial self-efficacy and opportunity recognition: the moderating effect of entrepreneurship education. *Sci. Technol. Manage. Res, 38,* 210-216.

Malebana, M. J., & Swanepoel, E. (2015). Graduate entrepreneurial intentions in the rural provinces of South Africa. *Southern African Business Review, 19*(1), 89-111.

Martins, I., Perez, J. P., & Novoa, S. (2022). Developing orientation to achieve entrepreneurial intention: A pretest-post-test analysis of entrepreneurship education programs. *The International Journal of Management Education, 20*(2), 100593.

REFERENCES (CONT.)

Mason, C. M., Carter, S., & Tagg, S. (2011). Invisible businesses: The characteristics of home-based businesses in the United Kingdom. *Regional Studies, 45*(5), 625-639.

Mei, W., & Symaco, L. P. (2022). Students' Entrepreneurial Identity Construction: Role and Social Identity Influences. *Sage Open, 12*(2), 21582440221089961.

Milana, C., & Ashta, A. (2020). Microfinance and financial inclusion: Challenges and opportunities. *Strategic Change, 29*(3), 257-266.

Milanesi, M. (2018). Exploring passion in hobby-related entrepreneurship. Evidence from Italian cases. *Journal of Business Research*, *92*, 423-430.

Neck, H. M., & Greene, P. G. (2011). Entrepreneurship education: known worlds and new frontiers. *Journal of small business management, 49*(1), 55-70.

Parida, V., George, N. M., Lahti, T., & Wincent, J. (2016). Influence of subjective interpretation, causation, and effectuation on initial venture sale. *Journal of business Research, 69*(11), 4815-4819.

Ratten, V., Costa, C., & Bogers, M. (2019). Artisan, cultural and tourism entrepreneurship. *International Journal of Entrepreneurial Behavior & Research, 25*(4), 582-591.

Reigeluth, C. M. (Ed.). (2013). *Instructional-design theories and models: A new paradigm of instructional theory* (Vol. 2). New York: Routledge.

Renko, M., Shrader, R. C., & Simon, M. (2012). Perception of entrepreneurial opportunity: a general framework. *Management Decision, 50*(7), 1233-1251.

Schunk, D. H., & DiBenedetto, M. K. (2020). Motivation and social cognitive theory. *Contemporary Educational Psychology*, *60*, 101832.

Shan, S., Jia, Y., Zheng, X., & Xu, X. (2018). Assessing relationship and contribution of China's technological entrepreneurship to socio-economic development. *Technological Forecasting and Social Change*, *135*, 83-90.

REFERENCES (CONT.)

Siew, C. S., Wulff, D. U., Beckage, N. M., & Kenett, Y. N. (2019). Cognitive network science: A review of research on cognition through the lens of network representations, processes, and dynamics. *Complexity, 2019*, Article ID 2108423.

Singh, R. P., & Gibbs, S. R. (2013). Opportunity recognition processes of black entrepreneurs. *Journal of Small Business & Entrepreneurship, 26*(6), 643-659.

Sirelkhatim, F., & Gangi, Y. (2015). Entrepreneurship education: A systematic literature review of curricula contents and teaching methods. *Cogent Business & Management, 2*(1), 1052034.

Sussman, R., & Gifford, R. (2019). Causality in the theory of planned behavior. *Personality and Social Psychology Bulletin, 45*(6), 920-933.

Syaiful, L., Ismail, M., & Abd Aziz, Z. (2019). A review of methods to measure affective domain in learning. In *2019 IEEE 9th Symposium on Computer Applications & Industrial Electronics (ISCAIE)* (pp. 282-286). IEEE.

Taylor, R. W. (2002). Pros and cons of online learning – a faculty perspective. *Journal of European Industrial Training, 26*(1), 24-37.

Turner, T., & Gianiodis, P. (2018). Entrepreneurship unleashed: Understanding entrepreneurial education outside of the business school. *Journal of Small Business Management, 56*(1), 131-149.

Ula, D. (2021). Social entrepreneurship in children and young people. *Euroasia Journal of Social Sciences and Humanities, 8*(21), 22.

Wang, C., Mundorf, N., & Salzarulo-McGuigan, A. (2022). Entrepreneurship education enhances entrepreneurial creativity: The mediating role of entrepreneurial inspiration. *The International Journal of Management Education, 20*(2), 100570.

Wei, X., Liu, X., & Sha, J. (2019). How does the entrepreneurship education influence the students' innovation? Testing on the multiple mediation model. *Frontiers in psychology, 10,* 1557.

REFERENCES (CONT.)

Wenninger, H. (2019). Student assessment of venture creation courses in entrepreneurship higher education—an interdisciplinary literature review and practical case analysis. *Entrepreneurship Education & Pedagogy, 2*(1), 58-81.

Wieland, A. M., Kemmelmeier, M., Gupta, V. K., & McKelvey, W. (2019). Gendered cognitions: a socio-cognitive model of how gender affects entrepreneurial preferences. *Entrepreneurship & Regional Development, 31*(3-4), 178-197.

Yasir, N., Mahmood, N., Jutt, A. A., Babar, M., Irfan, M., Jamil, F., . . . Liren, A. (2020). How can entrepreneurial self-efficacy, proactivity and creativity enhance sustainable recognition opportunity? The effect of entrepreneurial alertness is to mediate the formation of sustainable entrepreneurial intention. *Rev. Argent. Clin. Psicol, 29*, 1004-1023.

Yu, C. W. (2018). Understanding the ecosystems of Chinese and American entrepreneurship education. *Journal of Entrepreneurship Education, 21*(2), 1-18.

Zhang, H., Chen, W., & Liu, Z. (2022). Spatiotemporal Evolution of Entrepreneurial Activities and Its Driving Factors in the Yangtze River Delta, China. *Land, 11*(2), 216.

APPENDICES

APPENDIX A

QUESTIONNAIRE 1

Questionnaire 1: Entrepreneurial opportunity identification survey of Chinese engineering students

This study is one part of the Ed.D. program at Suryadhep Teachers College of Rangsit University. This questionnaire aims to examine whether EEP courses can improve your EOI ability.

It will take you about 15 minutes. Please complete all the following questions based on your own experience to reflect your attitude and answers as accurately as possible. This questionnaire is voluntary, and the data collected will be kept confidential. All collected data is for educational purposes only.

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1. Demographics

We want to know some of your personal information, which can help us compare the different types of samples on this issue.

1.1	Gender	1) Male 2) Female
1.2	Major	1) Engineering management
		2) Building environment and energy application engineering
		3)Architecture
		4) Civil engineering
1.3	What grade are you in university?	1) Sophomore 2) Junior
1.4	How many EEP elective courses did you study?	1) 0
		2) 1
		3) 2
		4) 3
		5) 4
1.5	Do you have any entrepreneurial experience?	1) NO
		2) Running a family business.
		3) Start a new company.

| | | 4) Personal business activities (selling products, services, etc.) |
| | | 5) Follow Entrepreneurship (Follow teachers, elders, classmates, associations, etc.) |

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2. Entrepreneurship Education Program

(compulsory and elective courses of EEP)

Below are relevant enterprising ideas. To what extent did the entrepreneurship program increase the following? 1= not at all to 5= a great extent (Please indicate your knowledge in all areas).

[1] Not at all   [2] Little extent   [3] Not sure   [4] Great extent   [5] A very great extent

2.1	Increase understanding of the action one needs to take in order to start a business	
2.2	Increase understanding of the attitudes, values, and motivations of an entrepreneur	
2.3	Increase practical management knowledge and skills of how to start a new venture	
2.4	Increase abilities to create networks	

_ _

3. Entrepreneurial Opportunity Identification

Below is the relevant EOI. To what extent did the EEP increase the following? 1= not at all to 5= a great extent (Please indicate your knowledge in all areas).

[1] Not at all   [2] Little extent   [3] Not sure   [4] Great extent   [5] A very great extent

3.1	Increase ability to exploit an opportunity	
3.2	Be able to accurately perceive the unmet market demand.	
3.3	With external support, be able to predict the prospects of the industry to be developed.	

3.4	Be able to effectively identify the products and services that consumers need.	
3.5	Willing to spend more time and energy looking for products and services that can bring value to customers.	
3.6	Be able to make resource allocation decisions to maximize benefits.	
3.7	Be able to organize and motivate employees to achieve corporate goals.	
3.8	Be able to organize resources and coordinate various work tasks effectively.	

‒ ‒

4. the EOI Course Cognition

The purpose of this part is to collect students' views on the EOI course to be developed.

Course planning		
4.1	If the EOI course is a separate course, which of the following type do you think it should belong to?	1) Public compulsory course 2) Public elective course 3) Professional compulsory course 4) Professional elective course
4.2	In what form do you think this course should be embedded in teaching?	1) Separate course 2) Combined with entrepreneurship courses 3) Combined with professional courses
4.3	What do you think is the reasonable length of this course?	1) 64 class hours 2) 48 class hours 3) 36 class hours 4) 16 class hours
4.4	Considering the good connection with other courses, which academic year do you think this course is more	1) The first academic year 2) The second academic year 3) The third academic year

	reasonable?	4) The Fourth academic year
Teaching content		
4.5	What do you think must be included in the teaching content?	1) Concept and meaning of entrepreneurial opportunity identification 2) Identification process of entrepreneurial opportunity 3) Case analysis of entrepreneurial opportunity Design of entrepreneurial opportunity identification
Teaching objectives		
4.6	Which of the following aspects do you think must be included in the teaching objectives?	1) Cognitive domain: knowledge and information sharing 2) Affective domain: emotion, belief, attitude and value identification 3) Psychomotor domain: skills and adaptive behaviors
Teaching evaluation		
4.7	What aspects do you think should be evaluated?	1) Cognitive domain 2) Affective domain 3) Psychomotor domain
4.8	Do you think it is necessary to develop an EOI scale suitable for Chinese engineering students?	1) YES 2) NO
4.9	What evaluation tools do you think need to be developed?	1) Questionnaire 2) Nonstructural interview
4.10	What kinds of course evaluation models do you think can be used?	1) Teaching achievement evaluation (third-party experts) 2) Teaching reflection (teaching

| | | teacher) |
| | | 3) Learning experience (students) |

Contact Information：

     To further investigate the experimental needs, please fill in your contact information. Contact information can be used: mobile phone number, WeChat, email, etc.

     Thank you for your valuable time, and I wish you success in your studies and career!

APPENDIX B

QUESTIONNAIRE 2

Questionnaire 2: Entrepreneurial opportunity identification survey of Chinese engineering students

This study is one part of the Ed.D. program at Suryadhep Teachers College of Rangsit University. This questionnaire aims to examine your EOI ability.

It will take you about 5 minutes. Please complete all the following questions based on your own experience to reflect your attitude and answers as accurately as possible. This questionnaire is voluntary, and the data collected will be kept confidential. All collected data is for educational purposes only.

_ _

Entrepreneurial Opportunity Identification

Below is the relevant EOI. To what extent did the EEP increase the following? 1= not at all to 5= a great extent (Please indicate your knowledge in all areas).

[2] Not at all   [2] Little extent   [3] Not sure   [4] Great extent   [5] A very great extent

1	Increase ability to exploit an opportunity	
2	Be able to accurately perceive the unmet market demand.	
3	With external support, be able to predict the prospects of the industry to be developed.	
4	Be able to effectively identify the products and services that consumers need.	
5	Willing to spend more time and energy looking for products and services that can bring value to customers.	
6	Be able to make resource allocation decisions to maximize benefits.	
7	Be able to organize and motivate employees to achieve corporate goals.	
8	Be able to organize resources and coordinate various work tasks effectively.	

_ _

Contact Information：

To further investigate the experimental needs, please fill in your contact information. Contact information can be used: mobile phone number, WeChat, email, etc. Thank you for your valuable time, and I wish you success in your studies and career!

APPENDIX C

INTERVIEW

Interview: EOI Course Cognition

1. What is the definition of entrepreneurial opportunity identification?

2. What are the three main stages of entrepreneurial opportunity identification?

3. Please give an entrepreneurial opportunity identification case related to your major.

4. Explain the feature analysis model and analysis steps in your own language.

5. Explain the fuzzy screening model and analysis steps in your own language.

6. Please choose a case given in the class. If it is you, how will you determine the entrepreneurial opportunity.

7. Analyze and calculate a case using feature analysis model and fuzzy screening model.

8. Please select a case given in the class and conduct an overall analysis according to the whole process of entrepreneurial opportunity identification.

9. What is the main stage in the whole process of analysis?

10. What can be optimized in this case?

11. Which of the three cases given in the course do you think is the best? Why?

12. Starting from this major, please use the feature analysis model and fuzzy screening model to design an entrepreneurial opportunity.

APPENDIX D

ACHIEVEMENT TEST & QUESTIONNAIRE

1. EOI Achievement Test (100 points)

EOI Achievement Test
1.1 What is the definition of entrepreneurial opportunity identification? (2 points)
1.2 What are the three main stages of entrepreneurial opportunity identification? (3 points)
1.3 Please give an entrepreneurial opportunity identification case related to your major. (5 points)
1.4 Explain the feature analysis model and analysis steps in your own language. (5 points)
1.5 Explain the fuzzy screening model and analysis steps in your own language. (5 points)
1.6 Please choose a case given in the class. If it is you, how will you determine the entrepreneurial opportunity. (10 points)

1.7 Analyze and calculate a case using feature analysis model and fuzzy screening model. (10 points)
1.8 Please select a case given in the class and conduct an overall analysis according to the whole process of entrepreneurial opportunity identification. (7 points)
1.9 What is the main stage in the whole process of analysis? (6 points)
1.10 What can be optimized in this case? (7 points)
1.11 Which of the three cases given in the course do you think is the best? Why? (20 points)
1.12 Starting from this major, please use the feature analysis model and fuzzy screening model to design an entrepreneurial opportunity. (20 points)

2. EOI Affective Questionnaire

EOI Affective Questionnaire
2.1 What did you learn in this course?
2.2 What difficulties have you encountered?
2.3 Evaluate the strengths and weaknesses of the course content?
2.4 What is your own opinion on this issue and other ideas.

3. EOI Psychomotor Test

EOI Psychomotor Test
3.1 Please analyze the EOI in the case.
3.2 Please analyze the evaluation of entrepreneurial opportunities in the case.
3.3 Please analyze the development of entrepreneurial opportunities in cases.
3.4 Please form teams and make them work well.
3.5 Please use two models to design entrepreneurial opportunities.

3.6 Please skillfully introduce the EOI plan.

3.7 Please skillfully evaluate the entrepreneurial opportunities of other teams.

APPENDIX E

TEACHING PLAN

Teaching plan of "the Entrepreneurial opportunity identification training course."

1. Course background

According to China's "Notice of the general office of the Ministry of education on printing and distributing the basic requirements for EEP and teaching in ordinary undergraduate schools (Trial)" (JGT [2012] No. 4), given the status, that the entrepreneurship rate of engineering students is low and high-tech entrepreneurship has not been fully developed, an elective course of "identification of entrepreneurial opportunities for engineering students" is offered to engineering students in the university.

2. Teaching content and objectives

2.1 Teaching objectives

Through the teaching of "identification of entrepreneurial opportunities for engineering students," the following objectives are planned to be achieved:

Concept and principle ：Students can explain the concept of EOI and the occurrence of EOI, and the students can give examples of Engineering EOI.

Entrepreneurial opportunity model ：Students can explain the feature analysis model, and students can explain the fuzzy screening model.

Entrepreneurial opportunity cases ：Students can analyze the EOI in the case, students can explore the evaluation of entrepreneurial opportunities in the case, and students can study the development of entrepreneurial opportunities in cases

The practice of EOI ：Students can form teams and make them work well, students can use two models to design entrepreneurial opportunities, students can skillfully introduce the EOI plan, and students can skillfully evaluate the entrepreneurial opportunities of other teams.

2.2 Teaching Content

The concept of EOI and the occurrence process of EOI; Identification concepts and examples of Engineering entrepreneurship opportunities; The characteristic analysis model and fuzzy screening model of EOI; Case 1 focuses on the identification of opportunities, case 2 focuses on the evaluation of opportunities, and case 3 focuses on the development of opportunities; Use the model to find creative opportunities, deepen entrepreneurial opportunities through student team cooperation, and make entrepreneurial opportunity plans, reports and mutual evaluation of entrepreneurial opportunity plans.

3. Teaching methods and requirements

"EOI course for engineering students" is theoretical, scientific, and practical. We should follow the law of education and teaching, combine academic teaching with case analysis, group discussion with role experience, experience teaching with entrepreneurial practice, unify knowledge teaching, thought collision, and practical experience, mobilize students' enthusiasm, initiative, and creativity in learning, and improve teaching quality and level.

4. Course system and class arrangement

Course nature: professional elective course, public elective course

Teaching object: engineering students in sophomores, juniors, and seniors of all majors in the University

Starting time: the second semester of each academic year

Class hours: 60 class hours

Credits: 3.5 points

Course name	Opening time	Class hours (60 hours)	cred

			it
EOI course of engineering students	2-9 weeks in the second semester	4hours *2 times / week	3.5

5. Evaluation of teaching results

Teaching evaluation is carried out from two aspects: Students' understanding and mastery of knowledge and real entrepreneurial opportunities and entrepreneurial ability. The course adopts a combination of process evaluation and result evaluation in result evaluation. Assessment indicators and scores are formulated concerning Bloom's classification of teaching objectives.

Prepared by: Yanan Hu
Scheduled for: July 2022

APPENDIX F

IOC RESULT OF THE QUESTIONNAIRE
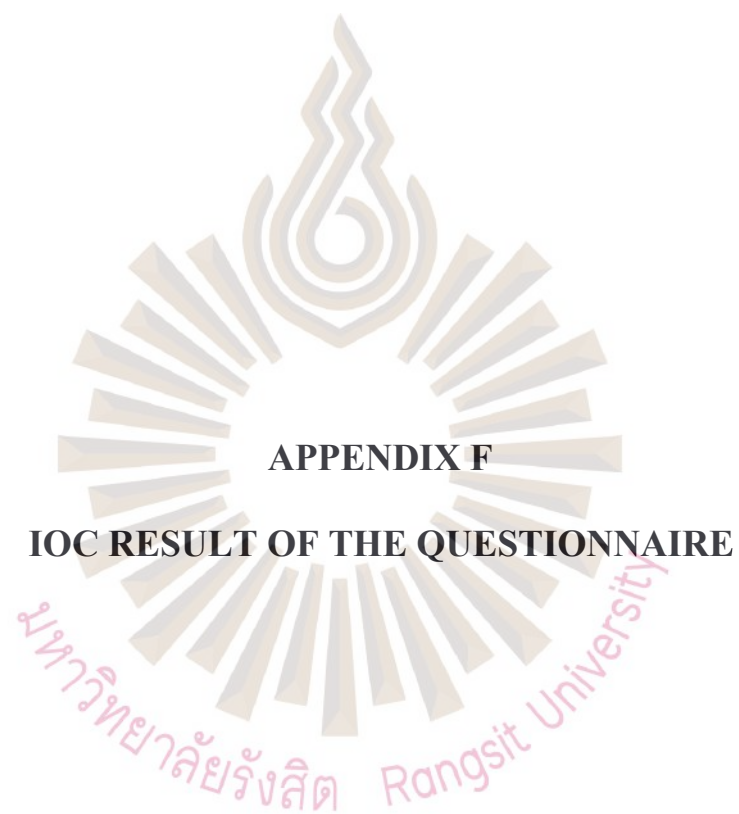
IOC Result of the Questionnaire

Items	Rating by Experts					IOC Average
	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	
Part Ⅰ Demographics						
1	1	1	1	1	1	1
2	1	1	1	1	1	1
3	0	1	0	1	1	0.6
4	1	1	1	1	1	1
5	1	1	1	1	1	1
Part Ⅱ Entrepreneurship Education Program						
6	1	1	1	1	1	1
7	1	1	1	1	1	1
8	1	1	1	1	1	1
9	1	1	1	1	1	1
10	1	1	1	1	1	1
Part III Entrepreneurial Opportunity Identification						
11	1	1	1	1	1	1
12	1	1	1	1	1	1
13	1	1	1	1	1	1
14	1	1	1	1	1	1
15	1	1	1	1	1	1
16	1	1	1	1	1	1
17	1	1	1	1	1	1

Part IV					
EOI course Cognition Questionnaire					
1. Course planning					
18	1	1	1	1	1	1
19	1	1	1	1	1	1
20	1	1	1	1	1	1
21	1	1	1	1	1	1
2. Teaching objectives					
22	1	1	1	0	1	0.8
3. Teaching content					
23	1	1	1	1	1	1
4. Teaching evaluation					
24	1	1	1	1	1	1
25	1	1	1	1	1	1
26	1	0	1	1	1	0.8
27	1	1	0	1	1	0.8
5. Course development					
28	1	1	1	1	1	1
Part III Open-ended Question					
1.EOI Achievement Test for Students (100 points)					
29	1	1	1	1	1	1
30	1	1	1	1	1	1
31	1	1	1	1	1	1
32	1	1	1	1	1	1
33	1	1	1	1	1	1
34	1	1	1	1	1	1
35	1	1	1	1	1	1
36	1	1	1	1	1	1
37	1	1	1	1	1	1
38	1	1	1	1	1	1
39	1	1	1	1	1	1

40	1	1	1	1	1	1

APPENDIX G

IOC EXPERT INVITATION LETTERS

STC 4800/

November 8, 2022

Subject: Invitation for you to be an Index Item - Objective Congruence (IOC) expert

Dear Dr. Natchaporn Dechrach

Head of Department of Chinese Language and Assistant Dean of Academic Affairs,

College of Liberal Arts, Rangsit University

The Doctoral Degree Program in Education Studies, Suryadhep Teachers College at Rangsit University organized a Research Proposal Defense for Yanan Hu, Student Number 6206106 (Asst.Prof.Dr. Supinda Lertlit is her advisor) on 14 Aug, 2022. Her research title is "ENTREPRENEURSHIP EDUCATION PROGRAM: ENTREPRENEURIAL OPPORTUNITY IDENTIFICATION OF CHINESE ENGINEERING UNDERGRADUATE STUDENTS". Currently, she is in the middle of the instrument design phase and has come up with the instrument for her study.

Thus, the Program would like to invite you to be our IOC expert for examining the research instruments and we believe that you will give useful suggestions to improve our student's research by accepting our invitation. Suryadhep Teachers College truly appreciates the kind support you will give us.

Sincerely yours,

Dr. Malivan Praditteera

Dean, Suryadhep Teachers College

Rangsit University

STC 4800/

November 8, 2022

Subject: Invitation for you to be an Index Item - Objective Congruence (IOC) expert

Dear Dr. Li Haochang

Department of Chinese Language, College of Liberal Arts,

Rangsit University

The Doctoral Degree Program in Education Studies, Suryadhep Teachers College at Rangsit University organized a Research Proposal Defense for Yanan Hu, Student Number 6206106 (Asst.Prof.Dr. Supinda Lertlit is her advisor) on 14 Aug, 2022. Her research title is "ENTREPRENEURSHIP EDUCATION PROGRAM: ENTREPRENEURIAL OPPORTUNITY IDENTIFICATION OF CHINESE ENGINEERING UNDERGRADUATE STUDENTS". Currently, she is in the middle of the instrument design phase and has come up with the instrument for her study.

Thus, the Program would like to invite you to be our IOC expert for examining the research instruments and we believe that you will give useful suggestions to improve our student's research by accepting our invitation. Suryadhep Teachers College truly appreciates the kind support you will give us.

Sincerely yours,

Dr. Malivan Praditteera

Dean, Suryadhep Teachers College

Rangsit University

STC 4800/

November 8, 2022

Subject: Invitation for you to be an Index Item - Objective Congruence (IOC) expert

Dear Dr. Kanchana Sirisitthimahachon

Department of Chinese Language, College of Liberal Arts,

Rangsit University

The Doctoral Degree Program in Education Studies, Suryadhep Teachers College at Rangsit University organized a Research Proposal Defense for Yanan Hu, Student Number 6206106 (Asst.Prof.Dr. Supinda Lertlit is her advisor) on 14 Aug, 2022. Her research title is "ENTREPRENEURSHIP EDUCATION PROGRAM: ENTREPRENEURIAL OPPORTUNITY IDENTIFICATION OF CHINESE ENGINEERING UNDERGRADUATE STUDENTS". Currently, she is in the middle of the instrument design phase and has come up with the instrument for her study.

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Sincerely yours,

Dr. Malivan Praditteera

Dean, Suryadhep Teachers College

Rangsit University

STC 4800/

November 8, 2022

Subject: Invitation for you to be an Index Item - Objective Congruence (IOC) expert

Dear Dr. Li Zhiyong,

Department of Building environment and energy application engineering, College of Civil Engineering and Architecture, Jiaxing University, China

The Doctoral Degree Program in Education Studies, Suryadhep Teachers College at Rangsit University organized a Research Proposal Defense for Yanan Hu, Student Number 6206106 (Asst.Prof.Dr. Supinda Lertlit is her advisor) on 14 Aug, 2022. Her research title is "ENTREPRENEURSHIP EDUCATION PROGRAM: ENTREPRENEURIAL OPPORTUNITY IDENTIFICATION OF CHINESE ENGINEERING UNDERGRADUATE STUDENTS". Currently, she is in the middle of the instrument design phase and has come up with the instrument for her study.

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Sincerely yours,

Dr. Malivan Praditteera

Dean, Suryadhep Teachers College

Rangsit University

STC 4800/0770

November 8, 2022

Subject: Invitation for you to be an Index Item - Objective Congruence (IOC) expert

Dear Dr. Zhou Xiaolu

Department of Management, College of Education,

Shanghai Normal University, China

The Doctoral Degree Program in Education Studies, Suryadhep Teachers College at Rangsit University organized a Research Proposal Defense for Yanan Hu, Student Number 6206106 (Asst.Prof.Dr. Supinda Lertlit is her advisor) on 14 Aug, 2022. Her research title is "ENTREPRENEURSHIP EDUCATION PROGRAM: ENTREPRENEURIAL OPPORTUNITY IDENTIFICATION OF CHINESE ENGINEERING UNDERGRADUATE STUDENTS". Currently, she is in the middle of the instrument design phase and has come up with the instrument for her study.

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Sincerely yours,

Dr. Malivan Praditteera

Dean, Suryadhep Teachers College

Rangsit University

BIOGRAPHY

Name	Yanan Hu
Date of birth	March 10, 1981
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Education background	China University of mining and technology
	Bachelor of Engineering, 2005
	Huaqiao University, China
	Master of Engineering, 2009
	Rangsit University, Thailand
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Work position	Lecturer