THE DEVELOPMENT OF DIGITAL ENTREPRENEURIAL INTELLIGENCE USING WHOLE BRAIN LITERACY (WBL) AMONG SECONDARY STUDENTS

WARINTHRONE VASUWAT

DOCTOR OF PHILOSOPHY
IN DIGITAL INNOVATION AND FINANCIAL TECHNOLOGY

CHAING MAI UNIVERSITY
JUNE 2024

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A THESIS SUBMITTED TO CHIANG MAI UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN DIGITAL INNOVATION AND FINANCIAL TECHNOLOGY

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OF THE REQUIREMENTS FOR THE DEGREE OF
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29 June 2024

To

Dr. Perla Rizalina M. Tayko

and

Dr. Udomsak Soponkij who were experts in

Whole Brain Literacy (WBL)

and are now deceased

The spark that awakened the light of thought

and

Perspectives on developing the four areas of

Brain potential in me

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The dissertation on the development of digital entrepreneurial intelligence using Whole Brain Literacy (WBL) among secondary students was successfully completed with the support and suggestion of many individuals. The researcher would like to extend heartfelt thanks to all those involved in this research study.

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Finally, I am grateful for all the problems, mistakes, and obstacles that occurred during the course of this research. They have provided valuable lessons and experiences that are crucial in developing a resilient and thoughtful approach to life, contributing to society and the nation with pride and grace forever.

Warinthrone Vasuwat

หัวข้อดุษฎีนิพนธ์	การพัฒนาเชาว์ปัญญาด้านภาวะผู้ประกอบการดิจิทัลโดยใช้กระบวนการ Whole Brain Literacy (WBL) ในนักเรียนระดับชั้นมัธยมศึกษา
ผู้เขียน	นายวรินทร วสุวัต
ปริญญา	ปรัชญาดุษฎีบัณฑิต (นวัตกรรมดิจิทัลและเทคโนโลยีการเงิน)
คณะกรรมการที่ปรึกษา	ผศ. ดร.อาหมัด ยาฮา ดาวุด อาจารย์ที่ปรึกษาหลัก อ. ดร.เพียงออ เลาหะวิไล อาจารย์ที่ปรึกษาร่วม ผศ. ดร.ณพศิษฏ์ จักรพิทักษ์ อาจารย์ที่ปรึกษาร่วม

บทคัดย่อ

องค์กรที่มีสำคัญในระดับโลกมากมาย อาทิเช่น UNESCO, OECD, World Bank, UKCES รวมถึงWorld Economic Forum (WEF) เป็นต้น อีกทั้ง แผนพัฒนาเศรษฐกิจ และ สังคมของประเทศไทย (2023 - 2027) นั้น ได้นำเสนอกรอบแนวทาง และ กำหนดนโยบายการศึกษาของโลกในอนาคตในปี ค.ศ. 2030 ไว้ โดยมีจุดมุ่งหมายที่คล้ายคลึงกัน ดังนี้ คือ การศึกษาในอนาคตนั้นผู้เรียนจะต้องสามารถเชื่อมโยงระหว่างความรู้ด้านเทคโนโลยีดิจิทัล และ สมรรถนะทางด้านภาวะผู้ประกอบการเข้าไว้ด้วยกัน เพื่อเพิ่มศักยภาพทางความรู้ความสามารถ รวมไปถึงการพัฒนาด้านเชาว์ปัญญา – ระดับสติปัญญาของผู้เรียนที่สามารถใช้องค์ความรู้ดังกล่าวในการสร้างแพลตฟอร์ม หรือโมเดลใหม่ๆ เพื่อยกระดับการแข่งขันทางธุรกิจในอนาคตได้ และนอกจากนี้ยังพบว่า มีความเชื่อมโยงจากสถิติ และงานวิจัยหลายแห่งที่นำเสนอประเด็นที่ว่า หากต้องการที่จะขับเคลื่อนสภาพเศรษฐกิจ และสังคมของประเทศให้ประสบความสำเร็จ และ ยั่งยืนในอนาคตได้นั้น จำเป็นที่จะต้องเริ่ม และ เร่งพัฒนาเยาวชนของชาติให้มีความรู้, ความเข้าใจ และ ศักยภาพด้านนวัตกรรมดิจิทัล และ ผู้ประกอบการก่อนเป็นอันดับแรก เป็นต้น

อีกทั้งผู้วิจัยได้ศึกษาเพิ่มเติม พบว่า การเรียนการสอนของประเทศไทยในระดับชั้นมัธยมศึกษานั้น ยังขาดหลักสูตร และ รูปแบบการพัฒนาด้านผู้ประกอบการดิจิทัล ด้วยเหตุนี้ ผู้วิจัยจึงได้นำเสนอแนวทางการแก้ไขปัญหาด้วยการใช้ต้นแบบการพัฒนา Digital Entrepreneurial Intelligence (DEI) ซึ่งออกแบบ และ พัฒนา – ต่อยอดมาจากหลักการ- ทฤษฎีทางการศึกษาที่มีชื่อว่า Whole Brain Literacy

(WBL) หรือ Four Human Brain Functions ซึ่งสามารถพัฒนา และ เชื่อมโยงจนถึงระดับขั้นเชาวน์ปัญญาของผู้เรียน โดยสามารถยกระดับรูปแบบการเรียนรู้ได้ดีกว่าการศึกษาในปัจจุบันที่มักมุ่งเน้นไปที่ด้านความรู้ และ ความเข้าใจเพียงเท่านั้น และที่สำคัญยังไม่ปรากฏหลักฐานทางวิชาการว่าได้มีการศึกษาและค้นคว้าในลักษณะแบบนี้มาก่อน ทั้งนี้การวิจัยได้ดำเนินการที่โรงเรียนมงฟอร์ตวิทยาลัย เชียงใหม่ ประเทศไทย ระหว่างปี ค.ศ. 2020 – 2023 โดยกลุ่มตัวอย่างประชากรที่ใช้ในการศึกษาครั้งนี้ เป็นนักเรียนในระดับชั้นมัธยมศึกษา รวมจำนวนทั้งสิ้น 2,360 คน ระเบียบวิธีวิจัยได้แบ่งออกเป็น 3 ขั้นตอน เริ่มต้นจากการวิจัยในเชิงสำรวจเพื่อวิเคราะห์ความสัมพันธ์ระหว่างความคาดหวังของผู้เรียน – ผู้ที่มีส่วนได้เสีย ต่อการจัดการเรียนรู้ด้านภาวะผู้ประกอบการ และ ลักษณะการทำงานของสมอง เพื่อสร้างเป็น DEI – Prototype 1 จากนั้นทำการวิจัยแบบ Correlational Research เพื่อวิเคราะห์หาความสัมพันธ์ระหว่างตัวแปรต้น คือ Digital Entrepreneurship – Entrepreneurship และ ตัวแปรตาม คือ Digital Intelligence – Entrepreneurial Intelligence เพื่อนำสร้างเป็นต้นแบบ DEI – Prototype 2 และในขั้นตอนสุดท้าย นำต้นแบบจำลองที่จากขั้นตอนที่ 1 และ 2 มาออกแบบรูปแบบการพัฒนา Digital Entrepreneurial Intelligence (DEI) บนหลักการของ WBL ซึ่งประกอบไปด้วยปัจจัยด้านที่เกี่ยวข้อง จำนวน 4 ด้าน คือ Digital Intelligence, Entrepreneurial Intelligence, Digital Entrepreneurship และ Entrepreneurship โดยทำการวิจัยแบบ Experimental Research แบ่งกลุ่มตัวอย่างประชากรในการทดลองออกเป็น 2 กลุ่ม คือ กลุ่มควบคุม และ กลุ่มทดลอง เป็นระยะเวลา 1 ภาคเรียน หรือ 20 สัปดาห์ รวมทั้งสิ้น 100 ชั่วโมง

หลังจากการทดลองในครั้งนี้ ผู้วิจัยพบว่า DEI – WBL Prototype ส่งผลเชิงบวกต่อกลุ่มตัวอย่างประชากรทดลองอย่างมีนัยสำคัญทางสถิติ (ที่ระดับนัยยะสำคัญทางสถิติ p-value < 0.05) และ มีค่าเฉลี่ยของพัฒนาการด้าน DEI เพิ่มขึ้นจากร้อยละ 30.50 เป็นร้อยละ 83.50 แต่ไม่พบความแตกต่างของการพัฒนาด้าน DEI ทั้งก่อน และ หลังการทดลองในกลุ่มตัวอย่างประชากรควบคุม และนอกจากนี้ยังพบว่า กิจกรรมยามว่างของกลุ่มตัวอย่างประชากรทดลองในด้านกีฬา, ด้านศิลปะ และด้านเทคโนโลยี นั้นเป็นปัจจัยรองที่ส่งผลต่อกระทบในเชิงบวกต่อการพัฒนาด้าน DEI เช่นเดียวกัน

จึงพิสูจน์ได้ว่า ต้นแบบจำลอง DEI – WBL Prototype ที่ใช้ทดลองในการพัฒนาด้าน DEI ในครั้งนี้ สามารถช่วยในการพัฒนาด้าน Digital Entrepreneurial Intelligence (DEI) ของนักเรียนในระดับชั้นมัธยมศึกษาได้จริง พร้อมกันนี้ผู้วิจัยยังสามารถนำไปสร้างรูปแบบการจัดการเรียนการสอน และ นำไปกำหนดเป็นนโยบายในการพัฒนาด้าน DEI ของนักเรียนในระดับชั้นมัธยมศึกษาอีกด้วย

Dissertation Title The Development of Digital Entrepreneurial Intelligence Using Whole Brain Literacy (WBL) Among Secondary Students

Author Mr. Warinthrone Vasuwat

Degree Doctor of Philosophy (Digital Innovation and Financial Technology)

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ABSTRACT

Many significant global organizations, such as UNESCO, OECD, World Bank, UKCES, and the World Economic Forum (WEF), along with Thailand's economic and social development plan (2023-2027), have established frameworks and policies for future education in 2030. Their vision emphasizes the need for learners to integrate digital technology knowledge with entrepreneurial competencies. This integration aims to enhance students' knowledge, abilities, and intelligence, enabling them to create new platforms or models that will elevate future business competition. In addition, statistical data and numerous studies indicated that to achieve successful and sustainable economic and societal development, it is crucial to start by enhancing the knowledge, understanding, and potential of the nation's youth in digital innovation and entrepreneurship.

Moreover, it was found that secondary education in Thailand lacks a curriculum and development model for digital entrepreneurs. To address this gap, a digital entrepreneurial intelligence (DEI) development model was proposed, building on the principles and theories of the Whole Brain Literacy (WBL) educational program, or

Four Human Brain Functions. This approach can better develop and connect learners' intelligence levels and enhance learning styles beyond the traditional focus on knowledge and understanding. Importantly, no prior academic studies or research have explored this topic. The research, conducted at Montfort College, Chiang Mai, Thailand, between 2020 and 2023, involved 2,360 secondary students. The research method was divided into three steps: First, survey research was conducted to analyze the relationship between the expectations of students and stakeholders towards the entrepreneurship learning management and the brain functions, leading to the creation of DEI – Prototype 1. Next, correlational research analyzed the relationship between the independent variables—digital entrepreneurship and entrepreneurship, and the dependent variables—digital intelligence and entrepreneurial intelligence, to develop DEI – Prototype 2. Finally, in the experimental research, the prototype models from the first two steps were used to design the digital entrepreneurial intelligence (DEI) development model based on WBL principles. This model, which includes four related factors (digital intelligence, entrepreneurial intelligence, digital entrepreneurship, and entrepreneurship), was tested by dividing the sample population into a control group and an experimental group over one semester (20 weeks, totaling 100 hours).

After this experiment, the researcher found the DEI – WBL Prototype had a positive and statistically significant impact on the experimental group (p-value < 0.05). The average DEI development increased from 30.50% to 83.50%. In contrast, there was no significant difference in DEI development before and after the experiment in the control group. Additionally, hobbies related to sports, art, and technology had a positive impact on DEI development.

Therefore, it is proven that the DEI – WBL Prototype effectively enhances the digital entrepreneurial intelligence of secondary students. This model can also be used to create teaching and learning strategies and formulate policies to develop DEI for secondary students.

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LIST OF ABBREVIATIONS

AI	Artificial intelligence
AU	Assumption University (Thailand)
BACII	The Bachelor of Arts and Science in Integrated Innovation
CEO	Chief Executive Officer
CMU	Chiang Mai University (Thailand)
COVID-19	Corona Virus Disease 2019
CU	Chulalongkorn University (Thailand)
DE	Digital Entrepreneurship
DEI	Digital Entrepreneurial Intelligence
DEI-WBL	Digital Entrepreneurial Intelligence using Whole Brain Literacy
DI	Digital Intelligence
DigComp	The Digital Competence Framework (European Commission)
DIN	Digital Innovation
EI	Entrepreneurial Intelligence
EntreComp	The Entrepreneurship Competence Framework (European Commission)
ESB	Entrepreneurship and Small Business (USA)
FinTech	Financial Technology
GDP	Gross Domestic Product
ICDI	The International College of Digital Innovation (CMU)
I-C	I-Control (Anterior Left Brain)
I-E	I-Explore (Anterior Right Brain)
I-PR	I-Preserve (Posterior Right Brain)
I-PU	I-Pursue (Posterior Left Brain)
IoT	Internet of Things
IT	Information Technology
KMUTT	King Mongkut's University of Technology Thonburi (Thailand)
KPA	Bloom’s Taxonomy – 3 Learning Domains

MC	Montfort College Chaing Mai (Thailand)
MOE	Ministry of Education (Thailand)
OECD	Organization for Economic Co-operation and Development
PIM	Panyapiwat Institute of Management (Thailand)
SDGs	Sustainable Development Goals
SMEs	Small-and Medium-sized Enterprises
UNESCO	Nations Educational, Scientific and Cultural Organization
VR	Virtual Reality
WEF	World Economic Forum
WBL	Whole Brain Literacy (4 Human Brain Functions)
4IR	The fourth Industrial Revolution

ข้อความแห่งการริเริ่ม

ผู้วิจัยขอรับรองว่าวิทยานิพนธ์เล่มนี้มิได้ละเมิดลิขสิทธิ์ของผู้ใด รวมถึงมิได้ขัดต่อสิทธิ์ในการเป็นเจ้าของทรัพย์สินใดๆ และ ขอรับรองด้วยว่าแนวคิด เทคนิค คำกล่าว หรือ เนื้อหาอื่นใด จากงานของผู้อื่นที่ได้รวมอยู่ในวิทยานิพนธ์เล่มนี้ ได้รับการยอมรับอย่างครบถ้วนโดยทั่วกันตามหลักมาตรฐานการอ้างอิงแล้ว

ผู้วิจัยขอแจ้งว่า เอกสารเล่มนี้เป็นสำเนาถูกต้องของวิทยานิพนธ์ของผู้วิจัย ซึ่งรวมไปถึงการแก้ไขปรับปรุงล่าสุด ตามที่ถูกรับรองจากคณะกรรมการสอบวิทยานิพนธ์ และ บัณฑิตวิทยาลัย และขอแจ้งด้วยว่าวิทยานิพนธ์นี้ มิเคยถูกนำเสนอเพื่อการสำเร็จการศึกษาจากมหาวิทยาลัย หรือ สถาบันใดๆ มาก่อน

STATEMENTS OF ORIGINALITY

I certify that, to the best of my knowledge, my thesis does not infringe upon anyone's copyright nor violate any proprietary rights and that any ideas, techniques, quotations, or any other material from the work of other people included in my thesis, published or otherwise, are fully acknowledged in accordance with the standard referencing practices.

I declare that this is a true copy of my thesis, including any final revisions, as approved by my thesis committee and the Graduate School, and that this thesis has not been submitted for any degree to any other University or Institution.

CHAPTER 1

INTRODUCTION

1.1 Research Background

One of the key indicators for considering economic and social growth, levels of education quality, and national development can be analyzed by factors of competence, specific qualifications, and the potential of entrepreneurs in a country. An entrepreneur is also a prominent factor that is important to drive development in various dimensions such as job creation - income generation, innovative development, creative businesses, as well ashuman technologies in the future (World Bank, 2017).

In addition, UNESCO (2016) recognized the importance of entrepreneurship development in educational institutions. It is considered a factor driving world's economic and social contexts in the future. UNESCO, therefore, has established a framework and guideline for educational development through entrepreneurship skills and processes consistent with the direction of the 21th century and the future world's education skills (2030), as well as the context of Social 5.0. The goal of SDGs Goal 4 - Target 8 is stated as "There is a direct link among such areas as economic vitality, entrepreneurship, job market skills and levels of education".

Moreover, the researcher found that OECD (2018) has introduced the guideline for national development through a framework for developing future learning skills or OECD Learning Framework 2030. It is stated that in order for a country to develop, citizens and youth must enhance a thinking process related to businesses which can create a newbusiness model, leading to the economic, social, and cultural drive.

The key finding of the Global Innovation Index (2019) was also summarized, namely that entrepreneurship education and potential development can enhance the standard of technology and innovation, which can foster the addition of value to various sectors of the economy such as trades, services, and industries. The economy, politics, and social contexts on a national and international scale are primarily driven by it.

1.2 Problem Statement

1.2.1 Problems and Causes of Entrepreneurship Learning Process in Thailand

According to the study in 2020, it found that there were 41,258 secondary schools in Thailand. The number of students in Grades 7-12 was approximately 4.6 million people (MOE Thailand, 2020). In 2015, Kenan Institute Asia (2015) surveyed and analyzed achievement in home economics at the secondary school level which is associated with three main factors: business skill, financial skill, and entrepreneurship. It was revealed that the number of students having an average score between 0 - 25 was 40 percent, an average score between 26 - 50 was 35 percent, an average score between 51 - 75 was 20 percent, and an average score between 76 - 100 was only five percent. Thus, the researcher found that 75 percent of students whose scores did not meet the criteria, had mean scores between 0 - 50. If these results are compared with the total number of students in Thailand at the secondary level, approximately 3.45 million students out of 4.6 million students do not meet the entrepreneurship competency criteria. This problem reflects the failure of Thailand’s curriculum on financial skills, business management, and entrepreneurship, as well as teaching and learning models and methods in secondary schools which are inconsistent with the future education direction in the world.

Moreover, the study also showed that Chulalongkorn University Educational Journal (2017) surveyed factors resulting in the failure of business skill learning in secondary schools. There are four main reasons as follows:

1) The policy from the Ministry of Education (MOE) does not recognize the importance of business skill development. Furthermore, it also does not promote and support teaching and learning which provide students with opportunities to enhance their business skills, accounting skills, financial skills, as well as career skills in secondary programs. Basic Education Core Curriculum B.E. 2551 (revised B.E. 2561) has provided only 0.5 credits or an hour per week for home economics, which is insufficient for the development of students’ necessary skillsin the future.

2) It results from the parents' expectations and values for secondary students. The survey found that 88.5 percent of the parents do not wish their students to study in business or entrepreneurship programs. Most of them would like their children to focus on science, medicine, or engineering programs. Only 12.5 percent of parents wish their children to develop financial skills, accounting skills, business skills, and entrepreneurship. These statistics also indicate the values of the learning society in Thailand.

3) Another significant reason for failure in business-entrepreneurship skill learning is teachers' quality and efficiency. There are 75 percent of the teachers do not graduate with a direct degree in business, entrepreneurship, or finance-accounting and economics. However, most secondary schools allow them to teach those courses, leading to poor quality teaching and learning due to incompetency, lack of content insights, and inexperience in teaching. As a result, those subjects and skills will fail as well.

4) The learning teaching method is the last significant factor. The content of the core curriculum from the Ministry of Education has not yet been developed and updated to be consistent with practical and future essential skills, such as digital skills, entrepreneurship skills, or financial management skills. A few research studies on various aspects influencing secondary school students' success in entrepreneurship have also been conducted. Consequently, the method of instruction and learning style.

1.2.2 The problem of the learning and teaching process of Entrepreneurship between the World and Thailand

The study found that Thailand's government has a policy known as Thailand 4.0 that emphasizes the value of fostering entrepreneurship. For instance, the New Entrepreneur Creation (NEC) advocates for and places a strong emphasis on teaching and learning, particularly in higher education and across the public and private sectors (Ministry of Education of Thailand, 2018). Nevertheless, since the context and the policy are not consistent with the directions and principles of Lackeus (2015) who proposed that entrepreneurial teachingcan be taught at every stage of life through proper processes and methods, so learners can have opportunities to express their potential through simulation and actual situations.

This is consistent with Swanson et al. (2018) concept, which states that entrepreneurial teaching and learning can be successful at any educational level, gender, or age. However, instructors must create an effective curriculum, appropriate teaching methods, and skills - competencies in individual analysis - diagnosis. They should be able to provide feedback to learners in order to help them reach their full entrepreneurial potential.

In addition, from the study of conformity and connection with concepts and principles of Erikson's psychosocial development and Steiner's anthroposophy cited by Patel (2016), world-famous educational psychologists, the principles of identity and role confusion stage and thinking stage: comparison and analysis can be summarized that teaching focusing on learners' ability to analyze and classify advantages-disadvantages, strengths-weakness, profit-loss or business logical concepts (turnover-profits) should be arranged in the secondary level, where learners are between 14 - 18 years of age (secondary schools). This will lead to the best learning.

From the above concept, the researcher has conducted a comparative study of problems arising in the education system of Thailand and the top five developed countries with the highest GDP growth in the world in 2019 in terms of patterns and education levels for promoting and developing entrepreneurship learning, it can be concluded in developed countries, learners will be encouraged to develop their skills and knowledge on business, commerce, finance-investment, as well as entrepreneurship starting from the primary section until the secondary section. For instance, the United States of America, the world's largest economic power provides students with a second section with a wide range of entrepreneurial learning options and programs such as Youth Entrepreneur Academy, Business Professional of America, and Future Business Leader of America (Kauffman, 2019). Furthermore, it was revealed that in China, fifth-grade students across the country are encouraged to learn about stock markets andinvestment as required subjects in government curricula (BBC, 2019). The government of Japan also supports the addition of finance-investment subjects as a required course in the core curriculum to enhance the entrepreneurial skills of students across the country (Japan Times, 2021). Moreover, India establishes a required curriculum for students in a secondary section to gain knowledge in commerce such as accounting, investment, and trade (India Trade Promotion Organization, 2020). In South

Korea, it was found that the national curriculum has been revised to focus on equipping primary students with skills related to the digital economy and Cryptocurrency (Gyeongsangbuk-Do Office of Education South Korea, 2020).

The model of education management in developed countries above is consistent with the principles and concepts of world-famous educational psychologists such as Erikson and Steiner stating that high school students (aged 14-18) can improve their learning potentials in business studies and entrepreneurship the best.

However, problems encountered in Thailand concerning the support and promotion of entrepreneurial learning based on The Thailand 4.0 are due to the government. Much of the government's policy focuses on and emphasizes higher education. Entrepreneurial skills are not considered important for secondary school, which is the best time for self-development. As a result, Thailand has a shortage of pupils-students with knowledge, expertise, abilities, and skills in entrepreneurship. From Table 1.4, it can be seen that Thailand has only 0.107 percent of new entrepreneurs in 2019. When compared to developed countries such as the United States, there are new entrepreneurs 92 times or 9.29 percent higher than in Thailand.

The researcher has studied the drafted 13th National Economic and Social Development Plan of Thailand (2023-2027). It was revealed that in the next five years, 2027, the government has a policy and goal of creating new entrepreneurs by 15 percent, or 82,000 people from 72,958 people in 2021. This is considered a great challenge for the development and promotion of new entrepreneurs in the future (Office of the National Economic and Social Development Council, 2021).

These causes and problems are likely to be obviously reflecting factors of the actual crisis in Thailand and will result in a shortage of the country's major career, entrepreneur. This directly affects the national economic and social development and growth in the future.

1.2.3 The problem of the Entrepreneurial learning process in Montfort College Secondary School, Thailand

In this recent research study, the researcher selected a target group of a private school in Chiang Mai, Thailand, which is Montfort College Secondary Section because the researcher himself has duties and roles in academic administration as well as course management, learning methods, and various student development activities. This directly affects the teaching management of grade 7-12 students. At present, there are approximately 3,200 students, divided into Thai and English programs (Montfort College, 2021). The school has been operating since 1932 until the current academic year 2022, totaling 90 years. It has also been famous for academic achievement in Northern Thailand for a long time, building many good quality alumni and famous important people in Thailand such as prime ministers, ministers, politicians, senior government officials, and academics who have influenced the education industry. If this research study achieves its objectives, it will result in a learning model that enhances students' potential to be able to compete at an international level and be an important workforce in the country's development in the future.

1) Current Situation and Crisis of the Classrooms in Montfort College Secondary Section

The current situation and crisis in Montfort College Secondary Section are consistent with the research conducted by Kenan Institute Asia (2015) and ChulalongkornUniversity Educational Journal (2017). According to the survey and data collection Montfort College Annual SAR Report 2021 (Montfort College, 2021), it was found that grade 7-12 students had results and skills in business, finance, and economics at an average of 62.75%, which was lower than the school and national criteria defined at an average of70 percent (Montfort College, 2021). The situation and results of students reflected the problems arising from the government policy and curriculum from the Ministry of Education (B.E. 2551, revised B.E. 2560). Home economics is stipulated as 0.5 credits and taught one period/week. As well, the teaching management methods, curriculum, and classroom activities in the present are not responsive, consistentwith, and keep pace with changes in future education.

From the information mentioned above, the researcher realized the nature of factors, causes, and various components which can and cannot be addressed, as well as a limitation as follows:

a) Causes and problems which cannot be addressed immediately or are difficult to be resolved may take a very long time to solve since these factors have an impact onmacroeconomic levels, such as government policies, the country's Ministry of Education, social and parental values about encouraging students to choose a study program in secondary section and undergraduate level. Another important reason is the quality and qualification improvement of teachers teaching entrepreneurship in schools due to policy and budget limitations in each school.

b) Problems and causes which are likely to be addressed or improved include learning models and teaching methods since the causes-factors of these problems can be examined and a solving process can be directly developed for students in class. It is more convenient than waiting for policies, regulations, and budgets supported by the government.

Hence, the researcher has objectives, expectations, and inspiration to conduct the study and research to emphatically know the actual causes and factors in order to find a solution to the problems in the Thai education system accurately, relevantly, and urgently. Moreover, it can enhance the quality and develop a teaching management model in Digital Entrepreneurial Intelligence (DEI) for secondary students to have potential, knowledge, and skills, leading to the development of essential skills for their careers in the country and abroad. Then, they will become quality global citizens in the future.

1.3 Problem Definition

"The main purpose of this study is on the initial impact of the learning process using Whole Brain Literacy (WBL) on Digital Entrepreneurial Intelligence (DEI) among secondary students in Montfort College Secondary Section."

1.4 Research Questions

1) How does school learning program affect Digital Entrepreneurial Intelligence (DEI) in secondary students?

2) How does student's hobby affect Digital Entrepreneurial Intelligence (DEI) in secondary students?

3) How does Whole Brain Literacy (WBL) affect Digital Entrepreneurial Intelligence (DEI) in secondary students?

4) How to design a suitable learning process on Digital Entrepreneurial Intelligence (DEI) using the Whole Brain Literacy (WBL) in secondary students?

5) How to develop the learning process on Digital Entrepreneurial

Intelligence (DEI) using theWhole Brain Literacy (WBL) in secondary students?

6) How to propose and apply the learning process on Digital Entrepreneurial Intelligence (DEI) using Whole Brain Literacy (WBL) in secondary school?

1.5 Objectives of the Study

1) To identify and analyze the factors affecting Digital Entrepreneurial Intelligence (DEI)in secondary students, at Montfort College.

2) To design the learning process using Whole Brain Literacy (WBL) for DigitalEntrepreneurial Intelligence (DEI) in secondary students, at Montfort College.

3) To test and compare the learning process using Whole Brain Literacy (WBL) for Digital Entrepreneurial Intelligence (DEI) in secondary students, Montfort College.

4) To develop the learning process using Whole Brain Literacy (WBL) process for Digital Entrepreneurial Intelligence (DEI) in secondary students, Montfort College.

5) To propose the learning process

6) and Academic policy using Whole Brain Literacy (WBL) for Digital Entrepreneurial Intelligence (DEI) to Montfort College Secondary Section.

1.6 Main Contributions of the Research

In this study on The Development of Digital Entrepreneurial Intelligence (DEI) Using Whole Brain Literacy (WBL) among Secondary Students, the researcher expected academic and practical contributions as follows:

1.6.1 Academic Contributions

This recent research will bring academic contributions as follows:

1) The knowledge about human brain functions based on the Whole Brain Literacy (WBL) theory, modern educational psychology, was applied to develop a learning model as well as teaching and learning management on Digital Entrepreneurial Intelligence (DEI) among secondary students. Nowadays, it was found that there have been no domestic and international studies on a causal structural relationship model of these factors. Therefore, this research created new knowledge and theory related to

modern educational psychology in the context of entrepreneurship, which is considered a different perspective on current research studies.

2) The knowledge and principles related to Whole Brain Literacy (WBL) were used to design a measurement and assessment of secondary students. The results can be measuredin four aspects based on the principles of human brain functions and used to assessDigital Entrepreneurial Intelligence (DEI) in a classroom. The current measurement model based on Bloom's Taxonomy (KPA) principle can only measure three aspects. This research, hence, created new knowledge in the development of teaching and learning models and learner assessment, which is different from the previous studies.

1.6.2 Practical Contributions

This recent research will bring practical contributions as follows:

1) Students and the Learning Process in Classrooms

Students are expected to receive an opportunity for education with an effective learning process and model affecting the development of Digital Entrepreneurial Intelligence (DEI) to prepare themselves with skills essential for the digital economy and global citizens.

2) Teachers and Effective Teaching Pedagogies

Another important issue for this study was to develop and promote the pedagogy of teachers to be more effective, modern, and consistent with future education directions. Teachers are expected to integrate the body of knowledge of their present subject with those related to Digital Entrepreneurial Intelligence (DEI) from this study to apply in their pedagogy or develop new educational innovations where students can apply skills to solve problems in their daily life.

3) School Academic Policies

For the significance of the study, a case study of Montfort College Secondary Section, the researcher would like to improve and develop learning process in business studies, entrepreneurial skills, and Digital Entrepreneurial Intelligence (DEI) in secondary levels so that the standard curriculum of an educational institution can be increased to be consistent with future education directions. Moreover, educational policies and strategies can be driven to focus on preparing students as future global citizens with the necessary skills for a career under the National Economic and Social Development Plan and the National Strategy to be entering the digital economy. As well, they can respond to the educational policies of a country.

4) Other Schools and Educational Collaborations

In terms of dissemination of research results to other schools, organizations, or other educational institutions related to teaching and learning management, the researcher expects to foster academic collaboration between educational institutions such as establishing a center for young entrepreneurs, that can provide concrete knowledge and skills with standardized learning in Digital Entrepreneurial Intelligence (DEI) for both public and private schools. As well, cooperation in research between schools at the higher levels can be created to develop new educational innovations for the benefit of thecountry in the future.

1.7 Research Scopes

This recent research aims at developing an effective learning process affecting the Digital Entrepreneurial Intelligence (DEI) of secondary students in Montfort College Secondary Section using the Whole Brain Literacy (WBL).

Scope 1: The target group was specified for interviews in order to use data for analysis and development of a learning process suitable for secondary students by considering the predictive learning model (DEI prototype-1). The survey were conducted with group1: 300 current students, group2: 300 alumni, 300 parents, 50 teachers and group3: 10 business successer (top five World ranking and top five Thailand ranking) whose occupation is entrepreneurs-business people, totaling 960 people.

Scope 2: The population in this study was determined to find a correlation of factors that have a positive impact between Digital Entrepreneurship, Entreprenuership , student daily routine, school lerning program and Digital Entrepreneurial Intelligence (DEI) to develop a predictive learning model (DEI prototype - 2). The population included upper secondary students from 200 science –math program classes, 200 students from an Arts program, and 200 students from English program classes. The total population was 600 students.

Scope 3: The population in the experiment of the developed predictive learning model (DEI – WBL prototype) was determined to compare the controlled and experimental groups before and after the experiment using action experimental research to find the sample positively responding to the predictive learning model the most. The total sample was 200 upper secondary students from science – math program class, 200 students from art – business EP program, 200 students from international curriculum approach, and 200 students from science – math program (Government school: Chaing Rai province), totaling 800 students.

1.8 Conceptual Framework

In this study, the researcher expected to find causes-factors affecting Digital Entrepreneurial Intelligence (DEI) among secondary students in Montfort College Secondary Section using Whole Brain Literacy (WBL) and propose those factors to develop an effective learning process for students. Furthermore, the results of this study are expected to positively affect the directions and academic education policies of the school and can lead the school to become a model business school and a young entrepreneurial development center for secondary students in the future as shown in Figure 1.1 below.

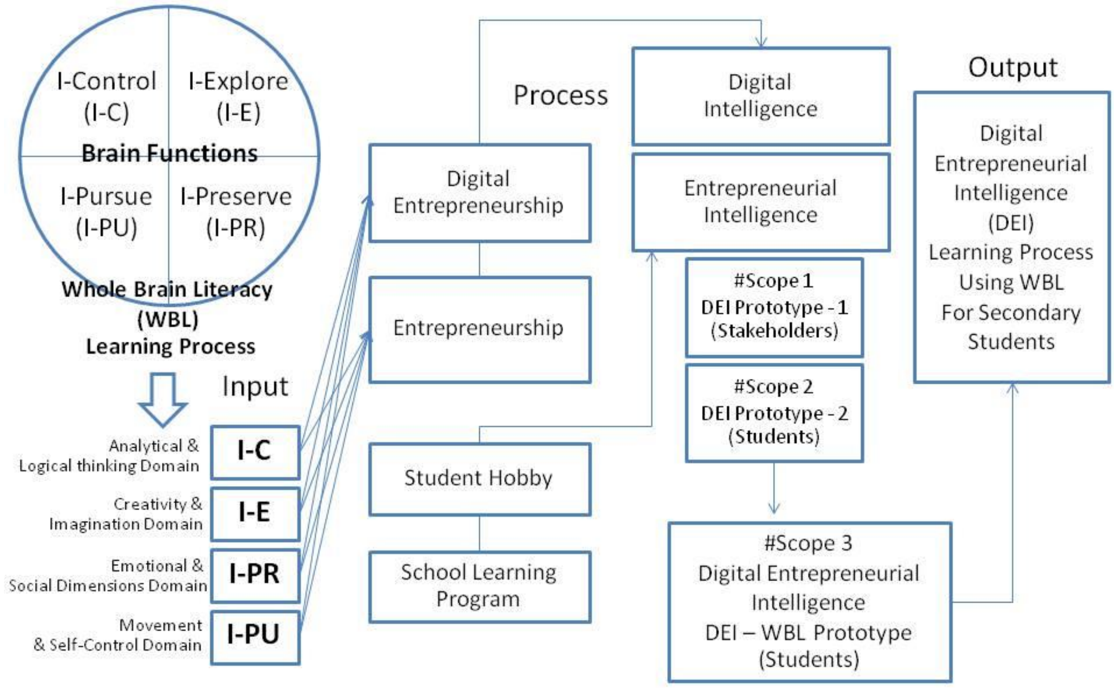


Figure 1.1 Research Conceptual Framework

The research conceptual framework was explained in 10 steps as follows:

1) An analysis and study of problems related to Digital Entrepreneurial Intelligence (DEI) of secondary students.
2) A study of causes and factors affecting Digital Entrepreneurial Intelligence (DEI) development of secondary students by using Whole Brain Literacy (WBL).
3) A design of research conceptual framework in the study.
4) Development of a predictive learning model (prototype) using Whole Brain Literacy (WBL).
5) A data collection of parents, teachers and alumni to analyze data for the predictive learning model and test the prototype with the research population.
6) A data collection of behaviors (student hobby), extracurricular activities, student learning program and personal activities after classes.
7) A design of a DEI – WBL learning process using Whole Brain Literacy (WBL).
8) An experiment and comparison of the sample as a case study.
9) Development of a DEI – WBL learning process to be applied and furthered in Educational Institutions.
10) A presentation of policies and direction of developing a learning process in Digital Entrepreneurial Intelligence (DEI) of secondary students in Montfort College Secondary Section.

1.9 Thesis Outlines

From the details above in Chapter 1, the researcher recognized statements and significance of the problems of entrepreneurship which affects the global and national economic and social contexts, a teaching and learning model in class, as well as guidelines for problem-solving, and research objectives.

Subsequently, in Chapter 2, a literature review related to the research was explained such as theories on educational psychology for secondary students, learner measurement and assessment, entrepreneurship development, digital technology, the Whole Brain Literacy (WBL) process, and the selection of factors and principles related to research methodology.

Chapter 3 presented the models, methods, and principles related to the research methodology used in this research.

Then, Chapter 4 presented and explained the results and the data obtained from the research experiment.

In Chapter 5, there were evaluations, discussions, solutions, and models to solve problems in this study, as well as a comparative study of the research results with other relevant studies.

In the last part, Chapter 6, there were research conclusions, reccomendations, findings, limitations, andfurther studies in the future.

CHAPTER 2

LITERATURE REVIEW

2.1 Global Future Educational Trends for the Development of Entrepreneurship and Digital Intelligence

At present, the world is in the era of the 4th Industrial Revolution (IR4.0), an era of rapid technological advancement for economic and social development along with the business and cultures of people in a country. This results in rapid changes in various dimensions such as the use of automation in the production process, big data analytics, and artificial intelligence to formulate strategies to meet consumer demands (Linthorst & Waal, 2020).

The 4th Industrial Revolution (IR4.0) is a huge shift in terms of the size, speed, and scope of digital traffic. This has been changed many times faster than the previous eras. It is expected that the influence of the 4th Industrial Revolution will reach $3.7 trillion by 2025. Technologies such as the Internet of Things (IoT), Advanced Robotics, Artificial Intelligence (AI), and additive manufacturing will certainly play a role in driving the world's GDP (Frost & Sullivan, 2022).

Examples of new economies emerging in the era of the 4th Industrial Revolution are the digital economy, sharing economy, 5G economy, and on-demand economy. The on-demand economy tends to expand continuously in various sectors of economic systems. Consumer expectations and product demand, as well as instant service, are generating growth in many areas from Cloud computing to same-day transport of fresh food and other goods through digital-online platforms and mobile phones by the on-demand new economy sector (World Bank, 2020).

According to the study, by 2025 people in the world will be connected to their digital devices up to 4,800 times a day or every 18 seconds. From Data Age 2025, it is expected that the amount of data will be increased from 33 zettabytes in 2018 to 175 zettabytes in 2025 with a 61 percent annual growth rate. Massive amounts of data will be generated from data sources such as Cloud, data centers, cell towers, and transmitting and receiving devices such as smartphones and IoT devices. These are the main variables that generate more than 50 percent of the total data production (World Economic Forum, 2021).

In addition, the trends in technological changes above will also contribute to the development of future essential skills for entrepreneurs such as digital skills, knowledge of platform economy and shared economy, big data analytics skills, as well as skills in using artificial intelligence and automation (Office of the National Economic and Social Development Council, 2023).

Furthermore, the important and challenging issues of the 13th National Economic and Social Development Plan of Thailand (2023) are that policies and the main goal of restructuring production and developing an entrepreneurial system towards a digital and innovative economy aim at increasing GDP from $7,050 in 2020 to $8,800 in 2027. This is to be achieved by developing digital skills and new innovations for citizens and entrepreneurs in the country to create competitive business and industry values.

From the rationale and significance of developing digital skills that affect the quality and potential of entrepreneurs in the future, the researcher would like to know the causes and factors affecting the development of digital skills that influence entrepreneurship among secondary students to create a learning model in Digital Entrepreneurial Intelligence (DEI), the main objective of this study.

2.1.1 Global Contexts:

1) UNESCO: (United Nations Educational, Scientific and Culture Organization)

According to Issues and Trends in Education for sustainable development, Agenda 21 to target 4.7 (Alexander,2023) “Sustainable Development Goals: SDG4 (Quality Education) had aimed to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. In 2030, SDG4 related to target 8 from 17 targets (UNESCO,2016) which will achieve to direct link among such areas as economic vitality, entrepreneurship, job market skill, and level of education” as shown in Table 2.1 below:

Table 2.1 SDG Goals 4 Explanation 2018

SDGs Goal 4	Target	Explaination
4 QUALITY EDUCATION	8	There is a direct link among such areas as economic vitality, ***entrepreneurship***, job market skills, and levels of education.

2) OECD: (Organization for Economic Co-operation and Development)

According to Figure 2.1, The OECD learning framework 2030 (OECD, 2018) the future of education and skills education in 2030: OECD has identified three learning competencies in 2030 such as creating new value, reconciling tensions and dilemmas, and taking responsibility. OECD suggested the key transformative competencies to prepare a creating new value of education in 2030 that “people should be able to think creatively, develop new products and services, new jobs, new processes and methods, new ways of thinking and living, new enterprises, new sectors, new business models and new social models. Increasingly, innovation springs not from individuals thinking and working alone, but through cooperation and collaboration with others to draw on existing knowledge to create new knowledge. The constructs that underpin the competency include adaptability, creativity, curiosity, and open-mindedness.”

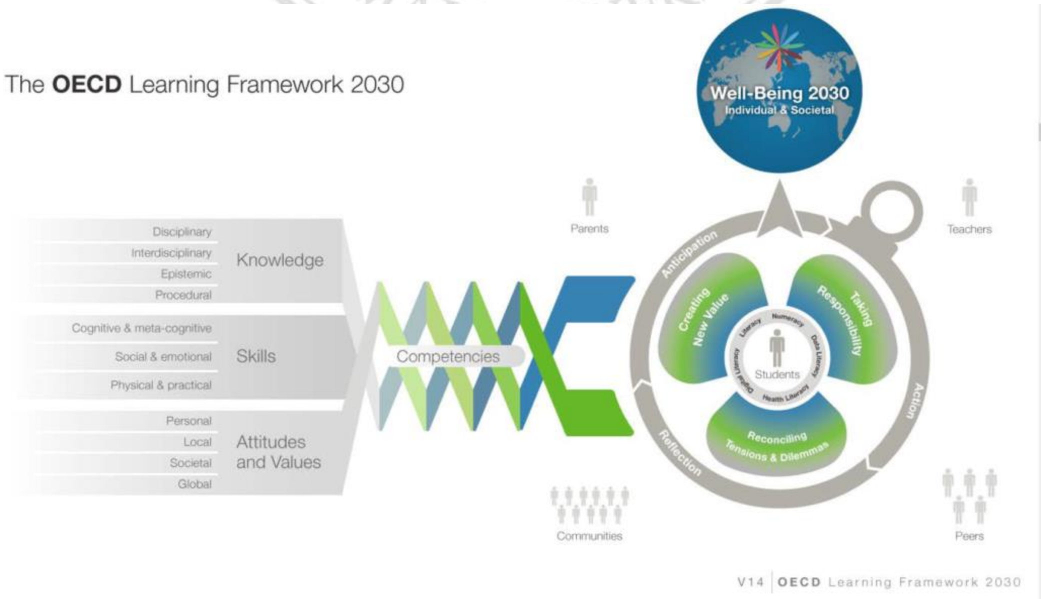


Figure 2.1 The OECD learning framework 2030.

Source: OECD (2018)

Moreover, this paper summarized a global effort for education change and collected ideas and examples of good practices for making the learning framework actionable. They called on:

- National, regional and local governments to share their policy design and curriculum design experiences related to the learning framework.
- Students, teachers, school leaders, and parents to share practices and experiences as concrete examples of using the OECD Learning Compass 2030.
- Experts and researchers help strengthen the links between evidence-based policy and practice, especially on the constructs of the framework.
- Local communities, professional associations, and industries, including representatives of teachers' unions and the business sector, to share practices of supporting student learning and creating appropriate learning environments.
- International communities and organizations to contribute to the OECD Education 2030 dialogue in support of the UN Sustainable Development Goal 4.7 and other relevant initiatives.

In addition, the OECD Future of Education and Skills 2030 (OECD, 2019) pointed out the global educational key competencies in 2030 " By taking responsibility for the various aspects of the business, with the guidance and mentoring of teachers and specialized staff, students develop agency and co-agency. They create new value for themselves, for the business, and for the communities, they serve as they develop their familiarity with the challenges and opportunities of running a business."

3) Incheon Declaration 2016

UNESCO (2016), Incheon Declaration and SDG4 – Education 2030 Framework for Action has aimed global education framework in 2030 which refereed to SDGs (Sustainable Development Goals) goal 4 (4.4) that " By 2030, substantially increase the number of youth and adults who gave skills, including technical and vocational skills, for employment, decent jobs, and entrepreneurship".

Against a background of rapidly changing labor markets, growing unemployment, particularly among youth, aging labor forces in some countries, migration, and technological advancements, all countries are facing the need to develop people's knowledge, skills, and competencies for decent work, entrepreneurship, and life.

4) Republic of China Contexts

Tan and Hairon (2016) reported that school in Beijing gets students to learn about online shopping where they are tasked to surf the internet for relevant information, discuss in their small groups and present their findings with questions about finance, startup, and online marketing.

Xie (2019) said that " Education ministry and securities regulator agree to include financial knowledge on national curriculum in the future. It will be offered in related subjects taught at primary and middle schools. Chinese children could soon be discussing financial charts and the stock market when their parents ask them what they learned at school."

Figure 2.2 Chinese schools launch stock market in classrooms

Source: BBC (2019)

In 2017, the Shanghai government was embarking on a new round of curriculum reforms, focused on developing the skills of future students. This reform has grounded in the core competencies developed by United Nations (United Nation,2017) Education Committee: social responsibility, civic pride, international awareness, culture and humanity, science and technology, aesthetics, innovation, and learning to learn. All course curricula have been structured around these domains in an effort to help students develop these skills. In five years, after Shanghai has had the opportunity to pilot this new curriculum, it may be modified and implemented in the rest of China.

The Ministry of Education had also revealed its plans to promote digital education in poverty-stricken areas in the country. It will soon conduct training programs for headmasters and management staff of primary and secondary schools in such regions. At present, around 500 schools in the country offer some sort of financial education for children.

China has launched new projects in the southern province of Guangdong, which is aimed for the longer term with stock market lessons for pre-teens. The China Securities Regulatory Commission has asked 36 schools in one of the country's richest provinces to teach upper primary school students "how to manage money and trade stocks", according to the Southern Metropolis Daily newspaper. This will involve about 10,000 students in a pilot program, beginning in 2019 and the new curriculum will expand to the rest of the province. (BBC, 2015)

5) United Kingdom (UK) Context:

UKCES (2016), UK Commission for Employment and Skills Report 84 has categorized action for future skills into four groups such as employees, individuals, education and training providers, and also policymakers.

The main key point of this study is focused on education and training providers' future skills as shown in Figure 2.3 are as follows:

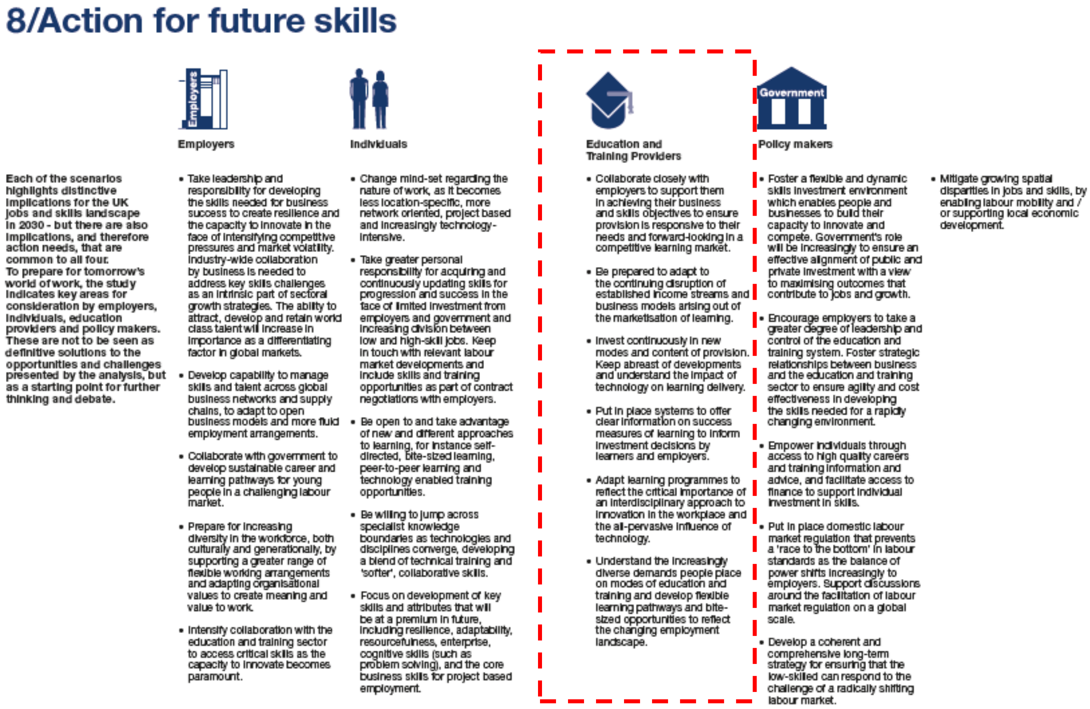


Figure 2.3 UKCES Action for future skills 2030

Source: UKCES (2016)

- Collaborate closely with employers to support them in achieving their business and skills objectives to ensure provision is responsive to their needs and forward-looking in a competitive learning market.
- Be prepared to adapt to the continuing disruption of established income streams and business models arising out of the marketization of learning.
- Invest continuously in new modes and content of provision. Keep abreast of developments and understand the impact of technology on learning delivery.
- Put in place systems to offer clear information on success measures of learning to inform investment decisions by learners and employers.
- Adapt learning programs to reflect the critical importance of an interdisciplinary approach to innovation in the workplace and the all-pervasive influence of technology.
- Understand the increasingly diverse demands people place on modes of education and training and develop flexible learning pathways and bite-sized opportunities to reflect the changing employment landscape.

Furthermore, UKCES (2016) predicted new decentralized work arrangements emerge as knowledge work, services, and skilled crafts and trades become more and more important. People are increasingly becoming micro-entrepreneurs, working from their homes, at co-working spaces, or directly at the customer's location rather than in a conventional office space.

In addition to white-collar workers, craftsmen, manual workers, and service providers are part of this new entrepreneurism using various platforms to offer their skills directly to their customers without the involvement of employers or intermediaries.

6) Other Global Contexts

Holon IQ (2018), is the study of the global education context in 2030, which coordinated with famous and feasible organizations. They also have analyzed a variety of data from expert sources such as the World Bank, OECD, and UNESCO, etc. According to Figure 2.1.4, Educations in 2030 (Holon IQ, 2018), this research classified the field of education into nine groups e.g. ICT, service, natural science – mathematics and statistics, arts – humanities, education, social – science and journalism – construction, health – welfare and also business – administration, and law. This study predicted that in early 2030, business – administration and law are the highest-expectation field of education which will impact to short-cycle tertiary level. Moreover, this field of study will support by OECD and partner countries.

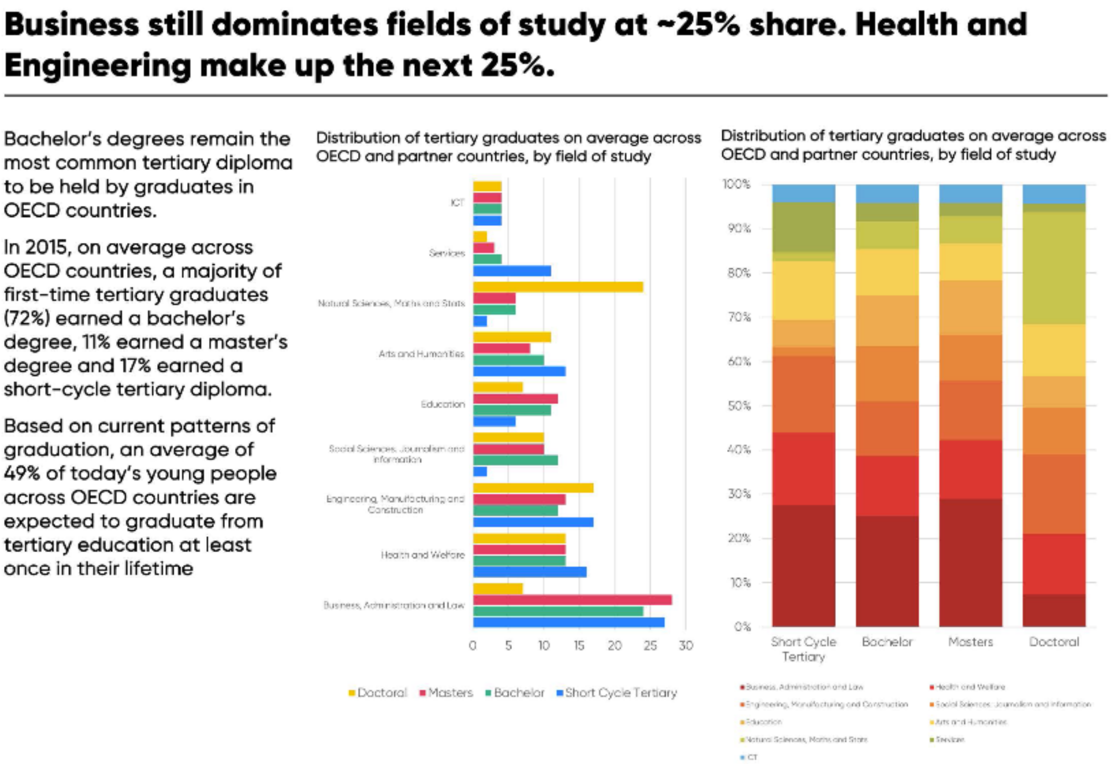


Figure 2.4 Holon IQ Educations in 2030

Source: Holon IQ (2018)

Furthermore, a study conducted in the Asia-Pacific region revealed that the Southeast Asia Ministers of Education Organization Strategic Plan 2030 (SEAMO, 2021) has established guidelines for driving development strategies in ASEAN countries. These guidelines are structured around three main frameworks: education, science, and culture. It encompasses three primary objectives: 1) emphasizing an educational approach that fosters the development of practical skills, 2) focusing on science education aligned with digital literacy such as data science, AI, IoT, etc., and 3) highlighting education and world entrepreneurship development. Countries are encouraged to implement courses that empower individuals to establish businesses, thereby creating job opportunities and generating income for the region, as shown in Figure 2.5.

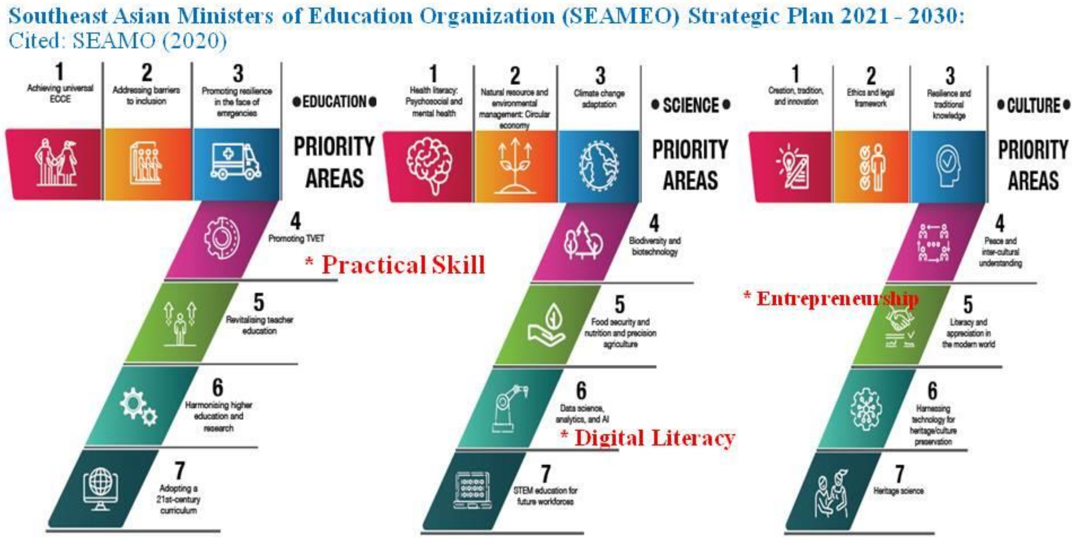


Figure 2.5 SEAMO Strategic Plan 2030

Source: SEAMO (2021)

2.1.2 Thailand (Domestic) Contexts:

1) Thailand Strategy - 2037

According to the National Strategy 2018 – 2037 for National Competitiveness Enhancement (National Strategy Secretariat Office, 2018), aims to encourage and provide youth in the elementary and tertiary levels an opportunity to learn and develop competency in entrepreneurship and leadership. It is believed that this concept would be one factor contributing to the 55% increase in economic GDP in 2037, as well as sustainable social and national development in the future.

2) The King Mongkut's University of Technology Thonburi (KMUTT)

KMUTT (2015) established the Graduate School of Management and Innovation (GMI) in 2002 aiming to integrate knowledge between engineering, technology, and management to craft skillful qualified human resources who possess strong specialized management fundamentals together with the necessary soft skills.

GMI focuses on the integrated curriculum that combines the utmost remarkable curricula of the university, which are science, technology, innovation, entrepreneurship, and engineering with modern and specialized management disciplines. This integrated curriculum will be viewed as a new management education paradigm called “Innovative Entrepreneurship Management”.

Figure 2.6 KMUTT – GMI Educational Programs

Source: KMUTT (2015)

3) PIM: (Panyapiwat Institute of Management- CP All Corperations)

Moore (2018) explained that the Future work skills is defined that the future higher education quality and there are four key competencies of learning in the future as named “4 Connect” such thing as People and Knowledge, People and People, People and Business and also People and Communities. These are the key points of higher education which is a new era of globalization, fast-paced change, and disruptive business models for all schools in the world. (PIM & HR Excellence Center, CP All groups: The largest business sectors in Thailand and the 23rd of the world's most innovative companies), Forbe (2018).

Figure 2.7 PIM Future Educational Competencies 2018

Source: Moore (2018)

4) Chulalongkorn University (CU)

Chulalongkorn University (2018) was the top one ranking of university in Thailand (QS World University Rankings, 2020) where has launched its new program in 2018 is called as "BASCII: Bachelor of Arts and Science in Integrated Innovation". This program supports the future of global education which is defined by five key elements of school such as sustainability, entrepreneurship, innovation, international, and transdisciplinary as shown in Figure 2.8 below:

Figure 2.8 Five Key Elements of BASCII 2018

Source: Chulalongkorn University (2018)

5) Chiang Mai University (CMU)

In 2017, International College has been enhanced her academic roles to entrepreneurship and digital innovation. The enhanced mission directly responds to the Thailand 20 Years Strategic Plan in digital startup especially Digital Economic Cluster for Chiang Mai. This aims at the development of TransNation Education with leading entrepreneurship and innovation universities in the United Kingdom, Australia, China, Korea, etc. The new International College of Digital Innovation (ICDI,2017) offers bachelor, master, and doctoral programs in digital innovation and financial technology. Besides the major courses, ICDI also offers General Education and free elective courses in digital entrepreneurship literacy to any CMU students in other faculties. This helps students to learn disruptive digital technologies for engaging new digital economy and society. Today ICDI has 2+2 dual degree programs in entrepreneurship with the University of Strathclyde and East China University of Science and Technology. As well as in data analytics, ICDI collaborates with Curtin University and the University of Electronic Science and Technology China.

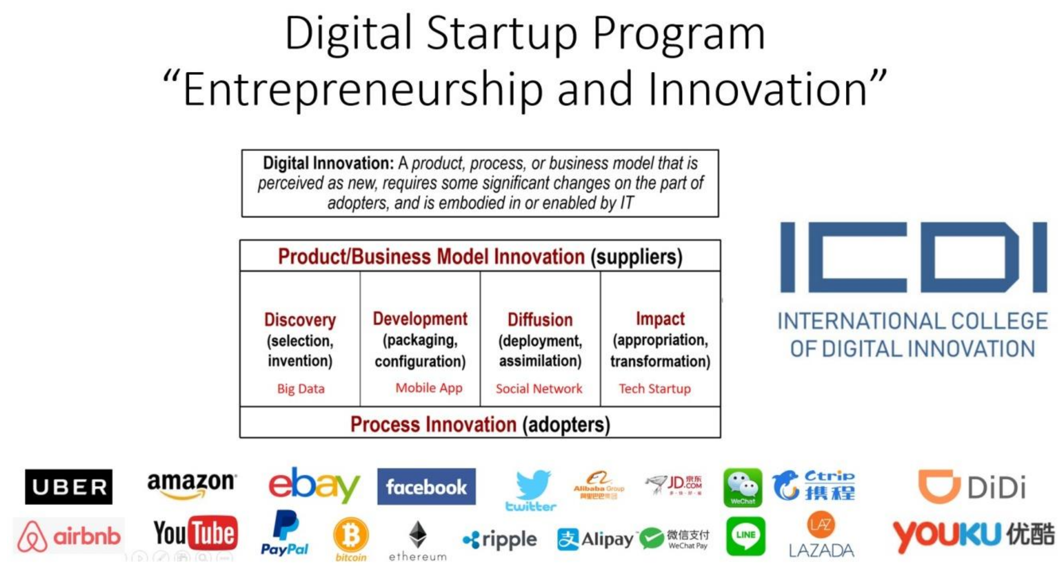


Figure 2.9 CMU – ICDI Roadmap 2017
Source: ICDI (2017)

According to the Educational trend issue in the future 2030 from the above data, this study found evidence, which supported research assumptions that related and consisted to business and entrepreneurship are the key points of future education and learning models which concluded and as shown in Figure 2.10 as following

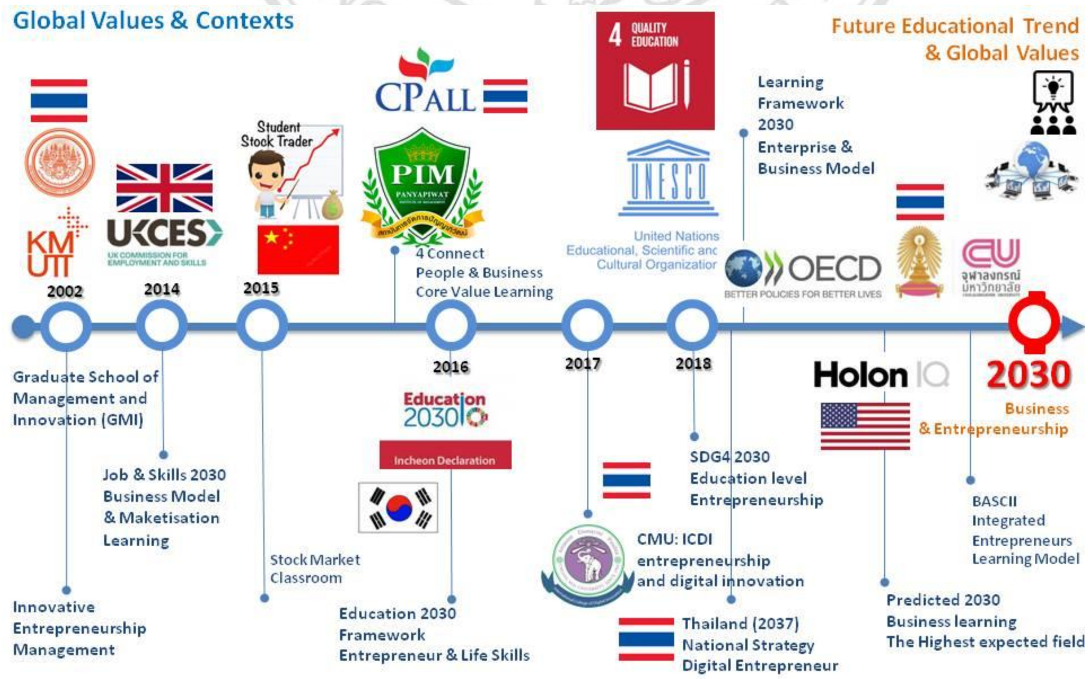


Figure 2.10 Global Future Educational Trend 2030

Since 2015, the UK has aimed for “Job and Skills 2030”, which has recognized business model and marketization learning of national plans.

Moreover, the Republic of China has launched stock market and finance programs to 36 pilot primary schools in 2015, which impacted approximately 10,000 students.

And also in 2015, PIM & HR Excellence Center by CP All groups in Thailand have defined core keys learning in the future is known as “4 Connect” which included people and business competencies for future learning.

In addition, the Education 2030 framework in terms of entrepreneur and life skills are defined by Incheon Declaration 2016 in Korea, there are the main points of the future education model.

In 2018, UNESCO and international partner organizations such as WTO, UNDP, World Bank, etc, They pointed out the main issues for global education in 2030 which related to SDGs target 4 (Quality Education) is as “There is a direct link among such areas as economic vitality, entrepreneurship, job market skills and levels of education.”

Furthermore, OECD Learning Framework 2030, this report has focused on the core purpose of future learning in 2018, which integrated two key factors between enterprise and business models for all learners.

Additionally, HolonIQ US international education organization predicted by 2030 business learning is the highest demand of all secondary schools in the future.

Moreover, In 2017 CMU-ICDI (International College of Digital Innovation) was launched by Chiang Mai University in Thailand which provided an entrepreneurial school for undergraduate programs integrating business models and digital content such as AI, Big data, Cloud computing, digital law, etc.

Finally,In 2018 BASCII (Bachelor of Arts and Science in Integrated Innovation) is launched by Chulalongkorn University (CU) in Thailand. This is the brand new educational model, which integrated a variety of contents together such as Science, Innovation, and Entrepreneurship provided to new global Education.

2.2 The Relationship Between Digital Intelligence and Entrepreneurial Intelligence

According to Rahmi & Cerya (2019), the relationship between digital Intelligence and entrepreneurial curriculum in Indonesia was studied and analyzed among 421 students. The five independent variables in the study related to digital skills included information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving. It was found that the development and learning response of students on digital skills positively affected their entrepreneurship.

The researchers also found that the Department of Economic Education, University of Jember (University of Jember, 2019) conducted a study on the effects of digital Intelligence on entrepreneurial behavior among students in Indonesia. The three main factors used for the experiment included the basics of computer - internet, word processing, and basic of spreadsheets. The results revealed that 70% of the theoretical teaching and 30% of practical training on digital literacy led to the higher development of entrepreneurship among those students.

In addition, the study on the effects of digital Intelligence influencing entrepreneurship in Mexico employing the European Digital Intelligence Framework, it consisted of five factors: information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving. From the experiment in the population of 209 business people, it was found that those with higher digital competency development were likely to have higher entrepreneurship (Gasca, 2018).

Apart from the above, the researchers also found that in 2019, a study was conducted on the relationship among digital literacy, AI literacy, and digital entrepreneurship by Hamburg et al. (2019) using DigComp Framework 2.0 which was developed by the European Commission comprising information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving. The experiment was operated with 142 SMEs in Ireland, Germany, Lithuania, Portugal, and Romania. The results revealed that encouraging employees to have digital skills by about 80% allowed more creativity as well as new business innovation, generating an increase in market values and higher business profits for an organization.

Din et al. (2017) examined the effects of digital literacy influencing 50 female entrepreneurs in Malaysia employing three factors: online usage, digital photography, and search engines. It was found that digital skill training hours positively affected the entrepreneurship of female entrepreneurs in Malaysia.

According to the conceptual framework and previous studies, most of them are based on DigComp Framework 2.0 developed by the European Commission consisting of only five factors: information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving. However, in this recent study, the researchers have developed and adapted the research framework based on various important frameworks worldwide such as UNESCO (2015), European Commission (2016), Microsoft Education Framework (2015), DQ Institute (2017), and Certiport Academy (2020) so that an in-depth research on digital literacy in nine aspects affecting entrepreneurial learning including digital right, digital access, digital communication, digital safety, media and information literacy, digital etiquette, digital health, digital commerce, and digital law can be conducted.

2.3 Theoretical Framework

In this research and experiment, the theories, principles, conceptual framework, as well as research studies related to the learner development of digital entrepreneurial intelligence (DEI) can be divided into five parts as follows.

1) Educational psychology consisted of theories related to the principles of educational psychology, multi-intelligence development, and the psychology of learning based on the learners' stage.

2) Theories and principles of learner development by using four brain functions of Whole Brain Literacy (WBL)

3) Digital entrepreneurship and digital intelligence consisted of relevant research, definitions of factors, and characteristics.

4) Entrepreneurial intelligence consisted of relevant research, definitions of factors, and characteristics.

5) The presented definitions of factors and variables of digital entrepreneurial intelligence (DEI) were summarized to be used in this research and experiment.

Then, the elements of all 5 dimensions were linked and summarized as the theoretical framework for this study, as shown in Figure 2.11 below.

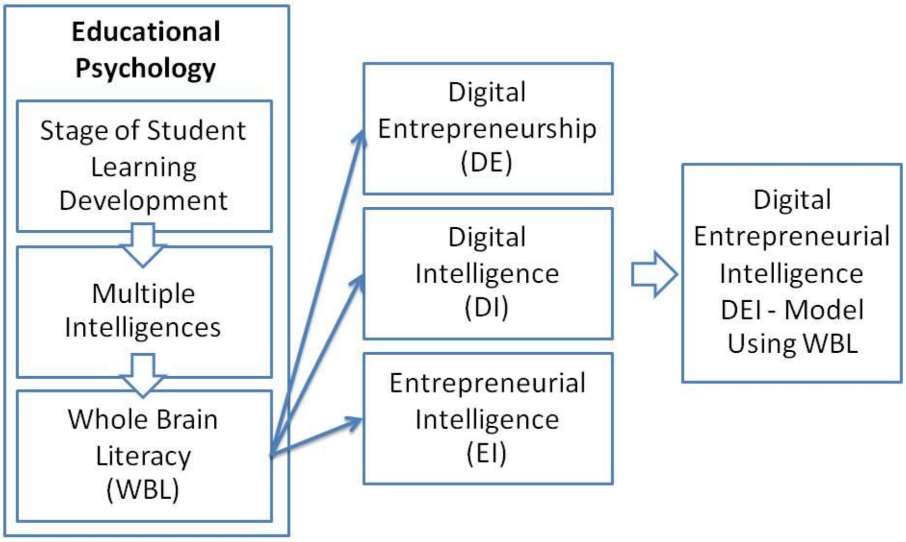


Figure 2.11 Theoretical framework in this research study

2.4 Educational Psychology

2.4.1 Stage of Student Learning Development

According to the study, Mcleod (2023) concluised Erikson's psychosocial development theory for learner development that is appropriate to age ranges and contents in eight stages. Of these principles, Erikson's fifth stage, known as identity versus role confusion, stated that the development and education of students aged 12-18 years (secondary students) should focus on future goals and careers. If learning for future careers is provided at this stage, students can set their goals for future careers as clearly as possible.

Moreover, Cahyani & Yulindaria (2018) redefined Brunner's learner development theory, called Discovery Learning where students aged 14-18 years (secondary students) should be taught intuition by giving them an opportunity to independently explore and unlimitedly think in order to enhance their competency in creativity, imagination, and intuition beyond knowledge learned in class. Hence, this enabled learners to apply them for creating new innovations and advanced technology in the future.

In addition, Gojdon et al. (2015) has also presented Piaget's theory of stages of cognitive development, which is the development of learner intelligence according to age, with four stages. In the fourth stage, called a formal operational period, learners aged 11-15 years (secondary students) should be provided with development and education that emphasizes logical and practical thinking for future use and future careers. If teaching and learning about the use of imagination and scientific logic are given, learners can apply them in their lives and future careers as well.

Selg & Saar (2015) described Steiner's framework for learner development, called anthroposophy, which comprised four stages. Steiner stated that students aged 14-24 years (secondary students) should be provided with awareness-oriented development and education on analyzing pros-cons, profit-loss, etc. Thus, learners can further apply them for creating new innovations and advanced technology in the future.

From the theories and principles of four world-renowned educational psychologists as mentioned above, the researcher can employ the concepts as a guideline for determining the population in the experiment, which was secondary students aged 15-18 years. Furthermore, this group is the most suitable for digital entrepreneurial intelligence development, which consisted of the necessary skills for future career development.

2.4.2 Multiple Intelligences

In order to determine how much a child is intelligent or skillful, the intelligence quotient or IQ, which is popularly used nowadays, may measure only partially because it can only assess language, logic, mathematics, and spatial dimensions. In fact, there are many aspects of competence that current tests cannot cover, such as musical skills, athletic skills, artistic skills, etc.

According to the study, Gardner (2020) was the one who attempted to explain multiple intelligences by proposing the Theory of Multiple Intelligences. It suggested that many aspects of human intelligence were equally important, depending on each individual's unique, outstanding ability. They consisted of eight aspects of intelligence as follows.

1) Linguistic intelligence is the ability to use various forms of languages from a native language to other languages, and be able to recognize, understand, and communicate the language to others as needed. Those who are outstanding in this intelligence are usually poets, writers, speakers, journalists, teachers, lawyers, or politicians.

2) Logical-Mathematical intelligence is an ability to logically thinking, abstractly thinking, forecasting, and computationally thinking. People who are outstanding in this intelligence are accountants, statisticians, mathematicians, researchers, scientists, programmers, or engineers.

3) Visual-Spatial intelligence is an ability to well perceive images, visualize spaces, shapes, distances, and positions in relation to each other and convey them harmoniously, and be sensitive to the sense of direction. People who are outstanding in this intelligence can be both in science and arts. For sciences, they are usually inventors and engineers. For the arts, they are usually artists in various fields such as painters, drawers, cartoonists, sculptors, designers, photographers, or architects.

4) Bodily-Kinesthetic intelligence is an ability to control and express thoughts and feelings by using various parts of the body, as well as an ability to use hands for invention, agility, strength, quickness, flexibility, refinement, and sensory sensitivity. People with this intelligence are likely to be athletes, actors, dancers, ballerinas, or acrobats.

5) Musical intelligence is an ability to absorb and appreciate the aesthetics of music including hearing, perceiving, remembering, and songwriting, memorizing rhythms, melodies, and musical structure, and conveying them by humming, percussing, playing instruments, and singing. People with this intelligence are usually musicians, composers, or singers.

6) Interpersonal intelligence is the ability to understand other people in terms of feelings, thoughts, emotions, and hidden intentions, quickly observe facial expressions, gestures, and tone of voice and respond appropriately, build friendships easily, negotiate, reduce conflicts, and motivate others. This is the type of intelligence that must be present in everyone. People with this intelligence are usually teachers, consultants, diplomats, salespersons, receptionists, public relations, politicians, or businesspeople.

7) Intrapersonal intelligence is the ability to have self-awareness, control expressions appropriately based on situations, know when to confront or avoid, or ask for help, realistically have self-images, realize their own weakness and strength, have emotional awareness, thoughts, expectations, desires, and identity. This is the type of

intelligence that must be present in everyone as well to be able to valuably and happily live life. People with this intelligence are usually thinkers, philosophers, or researchers.

8) Naturalist intelligence is an ability to deeply know and understand nature, laws, phenomena, and various creations of nature, be sensitive to observation in order to anticipate the possibilities of nature and classify types of living creatures such as plants and animals. People with this intelligence are usually geologists, scientists, researchers, or nature explorers.

According to Gardner's conceptual framework, the researcher found that only eight types of intelligence have been proposed. The development of digital entrepreneurial intelligence (DEI) among secondary students has not been discussed. Thus, the researcher was interested and would like to conduct a study and experiment on this subject.

2.5 Whole Brain Literacy (WBL)

2.5.1 The Definition of Whole Brain Literacy (WBL)

From the study of theories and principles related to Whole Brain Literacy or WBL, Tayko et al. (2015) has defined the definition of WBL that WBL helps to manage thinking, feeling, and other things in life for better, more creative, and productive.

Moreover, it was found that Herrmann (2015) described Whole Brain Literacy (WBL) is "a scalable framework which provides a lens for improved understanding and insight. It acknowledges that different tasks require different mental processes, and different people prefer different kinds of thinking. Whole brain thinking helps organizations get better results when they can strategically leverage the full spectrum of thinking available".

Villavicencio (2015) summarized the learner development process using Whole Brain Literacy that WBL is a pattern and process which can be applied for self and organizational development so that we can understand more about the nature of social learning.

In addition, Tayko & Talmo (2015) presented WBL as a tool for leaders, managers, executives, and supervisors to manage their thoughts, feelings, tasks, and time in order to be more creative and productive for their sustainable system. The four-brain model, referred to as the thinking styles of brain functioning, can be analyzed as I-Control (I-C): thinking about analytical and logical thinking, I-Explore (I-E): thinking about creativity and imagination, I-Pursue (I-PU): thinking about movement and self-control, and I-Preserve (I-PR): thinking about emotions and social dimensions.

Soponkij (2017) explained that WBL is a tool for changing many settings where learners with non-linear thinking patterns develop their potential to perform tasks. As Organization Development Implementations (ODIs), WBL and Appreciative Inquiry (AI) significantly change leadership styles, shared values, skills, and employee satisfaction.

In the same point, Vongbunsin (2015) argued that as an OD tool, WBL had a positive impact on the performance of the individual rather than the group.

Furthermore Lynch (2015), if examining the first person who proposed the principles of the human brain functions in the academic field, it was revealed that Lynch’s Brain Map explained Whole Brain Literacy (WBL) as a modern educational philosophy that analyzes cognitive processes, response, and human learning resulted from brain functions in four lobes for the human development to understand oneself, others, and society with diverse and broadened perspectives based on individuality and peaceful coexistence. It can be divided as shown in Figure 2.12

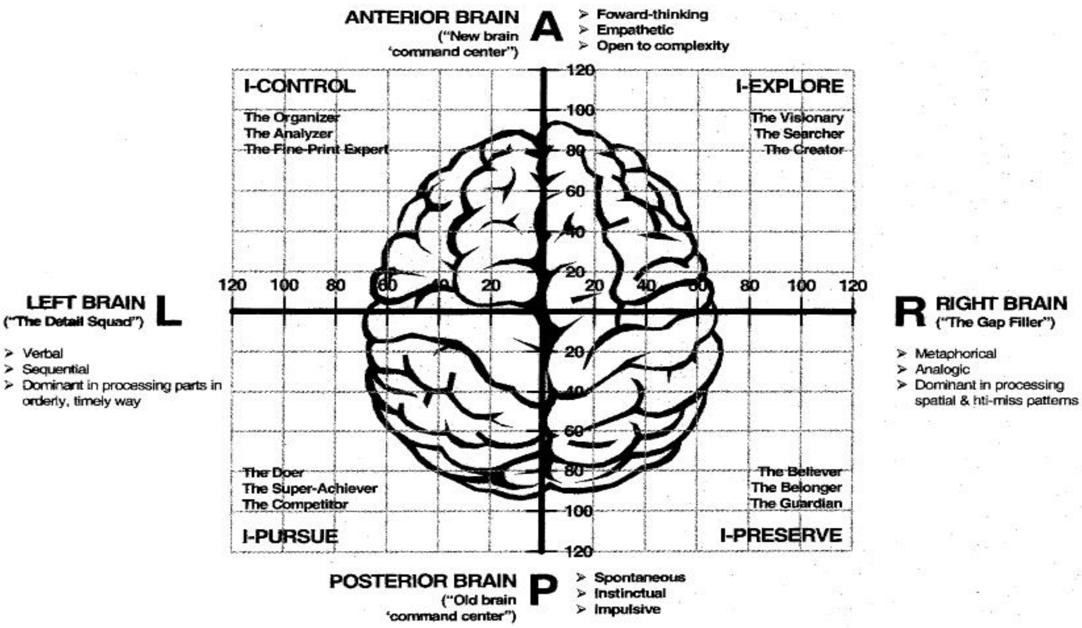


Figure 2.12 Four-Brain Functions Model

Source: Tayko (2015)

From the theories and principles mentioned above, the researcher can gather, summarize, and classify types of factors in the development of human brain functions based on the principles of Whole Brain Literacy (WBL), as shown in Table 2.2.

Table 2.2 An analysis and classification of factors in the development of human brain functions based on the principles and theories of Whole Brain Literacy (WBL)

Whole Brain Literacy (WBL)	**Human Brain functions**	**Learning functions**	**Types of Indicators & definitions**
Anterior left brain lobe I-Control (I-C)	Involved in the development of analytical and logical thinking	Thinkers and analysts often learn from systematic thinking. (23 indicators)	C01 = Efficiency
			C02 = Finance
			C03 = Performance
			C04 = Logic
			C05 = Analysis
			C06 = Quantitative
			C07 = Qualify
			C08 = Realistic
			C09 = Direction
			C10 = Goal
			C11 = Objective
			C12 = Numbers
			C13 = Systematic
			C14 = Rational
			C15 = Theoretical
			C16 = Methodology
			C17 = Control
			C18 = Commitment
			C19 = Critical
			C20 = Evaluation
			C21 = Leading
			C22 = Proactive
			C23 = Planning

Table 2.2 An analysis and classification of factors in the development of human brain functions based on the principles and theories of Whole Brain Literacy (WBL) (continued)

Whole Brain Literacy(WBL)	**Human Brain functions**	**Learning functions**	**Types of indicators & definitions**
Posterior left brain lobe I-Pursue (I-PU)	Involved in the development of movement and self-control	Organizers and inspectors often learn from reading and studying regulations. (22 indicators)	U01 = Regulations
			U02 = Qualitative
			U03 = Risk reduction
			U04 = Timing
			U05 = Policy
			U06 = Forming
			U07 = Sequential
			U08 = Organizing
			U09 = Detailed
			U10 = Prioritize
			U11 = Focused
			U12 = Ordered
			U13 = Tasking
			U14 = Tradition
			U15 = Reliable
			U16 = Punctuality
			U17 = Decision
			U18 = Action
			U19 = Result
			U20 = Productive
			U21 = Completion
			U22 = Permission

Table 2.2 An analysis and classification of factors in the development of human brain functions based on the principles and theories of Whole Brain Literacy (WBL) (continued)

Whole Brain Literacy (WBL)	Human Brain functions	Learning functions	Types of Indicators & definitions
Anterior right brain lobe I-Explore (I-E)	Involved in the development of creativity and imagination	Experimenters, creators, and innovators often learn from operating, experimenting, and taking risks. (19 indicators)	E01 = Competition
			E02 = Future trend
			E03 = Flexibility
			E04 = Visionary
			E05 = Long term
			E06 = Innovation
			E07 = Choice
			E08 = Optional
			E09 = Holistic
			E10 = Intuitive idea
			E11 = Integration
			E12 = Synthesizing
			E13 = Infer
			E14 = Speculation
			E15 = Creativity
			E16 = Conceptualizing
			E17 = Taking a risk
			E18 = Bends the rules
			E12 = Curious
			E13 = Difference
			E14 = Novelty
			E15 = Imagination
			E16 = Big picture
			E17 = Possible option
			E18 = Think out of the box
			E19 = Open-minded

Table 2.2 An analysis and classification of factors in the development of human brain functions based on the principles and theories of Whole Brain Literacy (WBL) (continued)

Whole Brain Literacy (WBL)	Human Brain functions	Learning functions	Types of Indicators & definitions
Posterior right brain lobe I-Preserve (I-PR)	Involved in the development of emotions and social dimensions	Helpers and coordinators often learn from listening, sharing experiences, and working with others. (24 indicators)	R01 = Training
			R02 = Team
			R03 = Relationship
			R04 = Community
			R05=Communication
			R06 = Culture
			R07 = Recognition
			R08 = Feeling
			R09 = Emotional
			R10 = Interpersonal
			R11 = Support Others
			R12 = Spiritual
			R13 = Sensitive
			R14 = Sharing
			R15 = Giving
			R16 = Expressive
			R17 = Cooperative
			R18 = Collaborative
			R19 = Conversational
			R20 = Linguistic
			R21 = Compromise
			R22 = Synergize
			R23 = Connection
			R24 = Faith
		Total 88 Indicators	

2.5.2 Patterns and Process of Implementing Whole Brain Literacy (WBL) for Learning in the Classroom

According to the study of learner development principles and theories based on Whole Brain Literacy (WBL), the researcher discovered that Villavicencio (2015), Rattanaphan (2023), Tayko & Talmo (2015), and Soponkij (2017) proposed and determined the four steps of applying Whole Brain Literacy (WBL) with learners to develop four lobes of brain functions as follows.

Step 1: Discovery and experiment (beginning with inspiration and imagination)

The class should begin with stimulating learning through I-Explore (I-E) by using the anterior right brain lobe. The skills used in this step include searching, using imagination to find the best methods, as well as conducting experiments - laboratories such as invention, art creation, playing music, computers, science experiments, exploration, application, strategy generations, new idea creation, and innovations.

Step 2: Communication and harmonizing (collaborate with the team)

In step two, learners are stimulated through I-Preserve (I-PR) learning where the posterior right brain lobe is used. The skills employed in this step include group work, team brainstorming, eliminating undesirable behaviors, team goals presentation, training - seminars, interviews, interaction with people, outdoor group activities by unity such as Ice Breaking, Feed Back, Brain Storming, Group Presentation, Group Project, Project Base Learning (PBL), communication-public relations, and customer relations.

Step 3: Designing and planning (thinking step by step)

In step three, learners are stimulated through I-Control (I-C) using the anterior left brain lobe. The skills used in this step are systematic planning, systematic thinking, critical thinking, logical thinking, data analysis and synthesis, numerical calculation, statistics, methods - principles - theories such as subjects related to theories, statistics, mathematics, economics, science, computation, as well as step-by-step experimental planning, flow chart, Step by Step, business planning and marketing.

Step 4: Organizing (done completely)

In the last step, learners are stimulated through I-Pursue (I-PU) using the posterior left brain lobe. The skills employed in this step include systematic implementation and clear regulations, work management according to the plan, work - goods - products quality control, time management, punctuality, policies - practices - rules - procedures enforcement, use of measurement tools, data collections such as on topics related to data collection, product sampling, product manufacturing, product creation, management, supervision and following up, law, principles of law, issuing regulations - drafting various schedules.

2.5.3 Related Research Analysis of Whole Brain Literacy (WBL)

Emyus et al. (2020) conducted action research in a population of pre-kindergarten students (pre-school aged 5-6 years) about a learning model using Whole Brain Literacy (WBL) affecting the development of motoric and linguistic skills by applying measurement and evaluation tools from a quasi-experiment. The research demonstrated that Whole Brain Literacy (WBL) learning process significantly positively affected the population. However, this experiment has never been used in a population at a secondary level on entrepreneurial intelligence development (the main factor to be experimented with in this recent study).

Boer et al. (2020) conducted action research among 7,000 students (unspecified education levels) in South Africa about a learning model of Whole Brain Literacy (WBL) affecting the development of information literacy by applying the measurement and evaluation tools from the Hermann Brain Dominance Instrument (HBDI). The study demonstrated that the learning process of Whole Brain Literacy (WBL) significantly positively affected the research population. However, it has never been tried in secondary students about entrepreneurial intelligence development (the main factor to be experimented with in this recent study).

Kharsati & G.S. (2017) conducted action research among students (unspecified education level and university) about the Whole Brain Literacy (WBL) learning model affecting the development of critical thinking by applying the measurement and evaluation tools from the Whole Brain Teaching (WBT) test. It was found that the learning process of Whole Brain Literacy (WBL) significantly positively affected the research population. However, it has never been tried in secondary students on entrepreneurial intelligence development (the main factor to be experimented with in this recent study).

Los Angeles County Report (2017) conducted action research among primary students in South Africa about a learning model of Whole Brain Literacy (WBL) affecting the development of fine arts by applying the measurement and evaluation tools from the test of the Whole Brain Literacy Process. The study demonstrated that the learning process of Whole Brain Literacy (WBL) significantly positively affected the research population. However, it has never been tried in secondary students about entrepreneurial intelligence development (the main factor to be experimented with in this recent study).

Thitatorn (2016) conducted action research among the working population in Thailand about a learning model of Whole Brain Literacy (WBL) affecting the development of leadership by applying the measurement and evaluation tools from the MLQ5 Test. The study showed that the learning process of Whole Brain Literacy (WBL) significantly positively affected the research population. However, it has never been tried in secondary students about entrepreneurial intelligence development (the main factor to be experimented with in this recent study).

Villavicencio (2015) conducted action research among graduate students at Assumption University, Thailand about a learning model of Whole Brain Literacy (WBL) affecting the development of problem identification by applying the measurement and evaluation tools from the test of Tayko and Talmo (2015). The study demonstrated that the learning process of Whole Brain Literacy (WBL) significantly positively affected the research population. However, it has never been tried in secondary students about entrepreneurial intelligence development (the main factor to be experimented with in this recent study).

Disphanurat (2015) conducted an action research among undergraduate students at Assumption University, Thailand about a learning model of Whole Brain Literacy (WBL) affecting the development of ethics by applying the measurement and evaluation tools from the WBL-Klob Learning Process. The study demonstrated that the learning process of Whole Brain Literacy (WBL) significantly positively affected the research population. However, it has never been tried in secondary students about entrepreneurial intelligence development (the main factor to be experimented in this recent study).

Vongbunsin (2015) conducted an action research among undergraduate students Architectural Design, Assumption University, Thailand about a learning model of Whole Brain Literacy (WBL) affecting the development of interpersonal communication by applying the measurement and evaluation tools from the Whole Brain Literacy Test. The study demonstrated that the learning process of Whole Brain Literacy (WBL) significantly positively affected the research population. However, it has never been tried in secondary students about entrepreneurial intelligence development (the main factor to be experimented with in this recent study).

According to eight studies related to learner development by using Whole Brain Literacy from (WBL) 2015 - 2020, they can be compared, analyzed, and summarized in Table 2.3 below.

Table 2.3 A comparison and analysis of research related to learner development by using Whole Brain Literacy (WBL)

No.	Year	Authors	Population	Dependent Variables
1	2020	Emyus et al.	Pre-kindergarten students	Motoric and linguistic skills
2	2020	Boer et al.	Students (unspecified education level)	Information literacy
3	2017	Kharsati and G.S.	University students	Critical thinking
4	2017	Los Angeles County Report	Primary students	Fine arts
5	2016	Thitatorn	Working population	Leadership
6	2015	Villavicencio	Graduate students	Problem identification
7	2015	Disphanurat	Undergraduate students	Ethics
8	2015	Vongbunsin	Undergraduate students	Interpersonal communication

From Table 2.3, the comparison and analysis of research related to learner development by using Whole Brain Literacy (WBL) can be concluded and explained as follows.

1) It was found that most of the experiments were conducted in a population of working-aged students, university students, primary students, and pre-kindergarten students. However, the researcher has not yet found that there was a trial in a population of secondary students.

2) The factors and dependent variables used in the experiments did not appear to be a model for the digital entrepreneurial intelligence (DEI) development, which is the main factor that the researcher was interested in and conducted an experiment in this recent study,

3) Most of the tools for data collection were in quantitative forms such as questionnaires and surveys. Qualitative data collection were rarely found such as personal interviews or daily-routine monitoring. Thus, in this study, the researcher added the tools for qualitative data collection from the population so that related factors/variables could be more precisely and accurately analyzed and predicted.

4) Most of the researchers used traditional paper questionnaires for data collection, which caused high costs of research budgets and delays. None of the research applied technology for collecting data such as IoT or online surveys - Google Forms, to reduce and save the budget in research and facilitate the data analysis. In this recent study, the researcher applied the technology as part of a tool for data collection and data analysis.

2.5.4 The Comparative Study of Developing Entrepreneurial Intelligence in Learners Using Whole Brain Literacy (WBL) and Bloom's Taxonomy

Contexts and problems related to the current teaching and learning management model of both domestic and international secondary schools are that they aim to primarily develop learners to have knowledge of the content or cognitive domain since the knowledge evaluation can be easily processed. Only using simple assessment tools such as multiple-choice exams or subjective exams, the knowledge level of learners can be classified. This is insufficient to enhance the potential of learners in all dimensions.

Adams (2015) expalined Bloom’s Taxonomy, it was found that the measurement and evaluation ratio of learners consists of three main aspects:

1) Cognitive domain (K),

2) Psychomotor domain (P),

3) Affective domain (A), or called as “K.P.A.”

The prominent problem often found in secondary schools is excessive emphasis on the cognitive domain or K. For example, from the scoring patterns in general fundamental subjects related to theories such as mathematics, science, social studies, and English, most often, the ratio for measurement and evaluation of K.P.A is equal to 80:15:5 or 80:10:10. It can be described that the measurement of the cognitive domain is 80 percent while that of the psychomotor domain and the affective domain is only 15 percent and five percent, respectively (The Evaluation Criteria of National Curriculum, 2023).

Likewise, practical subjects such as physical education, home economics, fundamental finance - accounting, as well as business studies have the measurement and evaluation ratio of K.P.A equal to 70:20:10 or 70:25:5. It can be explained that the measurement of the cognitive domain is relatively high at 70 percent whereas that of the psychomotor domain and the affective domain is only 20 percent and 10 percent (National Curriculum from the Ministry of Education in 2008 revised in 2023). From the above data, the measurement and evaluation between theoretical and practical subjects are not different. Therefore, it influences teachers’ learning and teaching models in class, patterns, and activities, as well as media design in classes, which cannot fully enhance learners’ learning potential in every dimension.

Nevertheless, since 2015, modern educational psychologists have developed learning methods better respond to the individual learning potentials of learners. For instance, Lynch (2015), Testa (2024), and Hermann (2015) discovered modern educational psychology patterns, which promote and enhance the learning potentials of learners in all dimensions such as physical, emotional, social, intellectual, and spiritual dimensions, called as brain functions or brain map. Moreover, Tayko (2015) applied this principle to develop a new human development model referred to as Whole Brain Literacy or WBL. He stated that learning development and evaluation of learners in all dimensions cannot be assessed only in the cognitive domain and psychomotor domain as performed in the past. However, today, human intelligence development relies on brain function development, consisting of four aspects as follows:

1) Analytical and logical thinking domain is functioned by the anterior left brain lobe (I-Control: I-C).

2) Creativity and imagination domain is functions by the anterior right brain lobe (I-Explore: I-E).

3) Emotions and social dimensions domain is functioned by the posterior right brain lobe (I-Preserve: I-PR).

4) Movement and self-control domain is functioned by the posterior left brain lobe (I-Pursue: I-PU).

Based on the Whole Brain Literacy (WBL), it depicts more domains of learning development and evaluation of learners than Bloom's Taxonomy which consists of only three domains: cognitive domain, psychomotor domain, and affective domain.

Hence, from the information summarized above, it is rational and significant that the researcher would like to examine the instrument called WBL and new approaches that can respond to the entrepreneurial development of learners with more dimensions and perspectives of achievement measurement and accuracy. Additionally, it can also be used to create and develop a learning model more effectively than the one currently used in secondary schools in Thailand.

2.5.5 Comparison of Secondary School Learning Style and Student's Evaluation for Intelligence Development Related to Whole Brain Literacy (WBL)

Based on the analysis of the MOE curriculum model (Ministry of Education Thailand, 2023), as well as the measurement and evaluation of learners in Thai secondary schools, compared with the education management and priorities of secondary schools in the international school system with the aims to examine alternative models for designing teaching and learning activities that are consistent with the development of digital entrepreneurial intelligence (DEI) involved in the experimental design in this research, it can be categorized and presented in Table 2.4 as follows:

Table 2.4 A Comparison of Secondary School Learning Style and Student's Evaluation for Intelligence Development Related to WBL

No.	List of Secondary School Learning Processes	Thai Core Curriculum (Secondary)	Thai Science Gifted School (MWIT)	Thai Business School (PIM-CP All)	English Program School	International School in Thailand
1	Fundamental Subject (3 Learning Domains: K-P-A)	✓	✓	✓	✓	✓
2	Supplementary Subject (3 Learning Domains: K-P-A)	✓	✓	✓	✓	✓
3	International Standards (CEFR)	✓	✓	-	-	✓
4	National / International Academic Competition - PISA / Academic Olympic etc.	✓	✓	-	-	✓

Table 2.4 A Comparison of Secondary School Learning Style and Student's Evaluation for Intelligence Development Related to WBL (continued)

No.	**List of Secondary School Learning Process**	**Thai Core Curriculum (Secondary)**	**Thai Science Gifted School (MWIT)**	**Thai Business School (PIM-CP All)**	**English Program School**	**International School in Thailand**
5	Academic Focused and Extra Activity Development					
	5.1 Digital and Technology	✓	✓	-	✓	✓
	5.2 Research & Innovation (* Intelligence Function)	-	✓	-	-	-
	5.3 Science Project	✓	✓	-	✓	✓
	5.4 Creativity (* Intelligence Function)	-	✓	-	✓	✓
	5.5 Leadership	-	✓	✓	✓	✓
	5.6 Art / Music / Dance	✓	✓	✓	✓	✓
	5.7 Project Work – PBL – Project Base Learning	-	✓	✓	✓	✓
	5.8 Entrepreneurship – SMEs / Business Project	-	-	✓	-	✓

Table 2.4 A Comparison of Secondary School Learning Style and Student's Evaluation for Intelligence Development Related to WBL (continued)

No.	**List of Secondary School Learning Process**	**Thai Core Curriculum (Secondary)**	**Thai Science Gifted School (MWIT)**	**Thai Business School (PIM-CP All)**	**English Program School**	**International School in Thailand**
	5.9 Business Literacy – Accounting / Financial etc.	-	-	✓	-	✓
	5.10 Internship / Field Trip Activity	-	-	✓	-	✓
6	CSR (Corporate Social Responsibility)	-	✓	✓	-	✓

From the table above, it is possible to analyze the strengths and weaknesses of the curriculum as well as the teaching and learning management in Thai secondary schools from the five main curricula: 1) secondary school curriculum in Thailand, 2) science genius school curriculum (Mahidol Wittayanusorn or M-WIT), 3) business and entrepreneurship school program (Panyapiwat or PIM CP All), 4) English program, and 5) international school curriculum in Thailand.

The researcher will employ the study formatting model mentioned above to design the experimental methodology in Chapter 3.

2.6 Entrepreneurial Intelligence (EI)

2.6.1 Related Research Analysis and Definitions of Entrepreneurial Intelligence (EI)

In this study, the researcher summarized and analyzed various documents, as well as research papers published related to the development of entrepreneurial intelligence for 15 topics, which can be summarized and explained as follows.

The Annual Civic Education Conference 2021, Syaifullah et al.(2021) proposed the research entitled "Students' Entrepreneurial Intelligence Development through Program Mahasiswa Wirausaha (PWM) at Universitas Pendidikan Indonesia". This research examined entrepreneurial intelligence development among undergraduate students in Entrepreneurial Student Program (ESP) in Indonesia using group workshop activities and questionnaires for research evaluation. The definitions of factors used in entrepreneurial intelligence development were defined as follows. Three factors including interpersonal skill, creative skill, and innovative skill statistically significantly positively affected the experiment model. However, the research had limitations and weaknesses. 1) The research was a population-specific experiment, where the population was only those studying in business, which cannot be clearly identified whether such statistical significance will differently affect students in other different fields. 2) This process has not been tested in secondary students, which was a new target group for the recent research study.

Elia et al. (2020) conducted research on a digital technology factor affecting the entrepreneurial intelligence development among employees of 9 private business firms using a model and tool called the Digital Entrepreneurial Ecosystem (DEE) and New Scio-Technical Paradigm. The results of the study and the definitions of factors used in the development of entrepreneurial intelligence can be summarized as follows. Four factors namely digital actors, digital activities, digital motivations, and digital organizations had a statistically significant positive effect on the experiment model. Nevertheless, such an experiment had some limitations and weaknesses. 1) It was a population-specific study among the working population with a wide range of ages. It cannot be clearly identified whether and how such statistical significance will differently affect groups of people with different occupations or ages. 2) The process has not been tested among secondary students, which was a new target group for the recent research study.

Caserio (2018) conducted a cohort study on start-ups in European countries regarding a factor of the role of business education influencing entrepreneurial intelligence among new entrepreneurs using the experiment model called Structural Equation Modelling and questionnaires for research measurement and evaluation. The research results and definitions of factors developing entrepreneurial intelligence can be summarized as follows. Three factors including proactive, innovativeness, and risk-taking statistically significantly positively affected the experiment model. The limitation and weakness are that such an experimental method was appropriate for those who have already started a business operation, which cannot be measured and assessed in secondary students since it collected information in terms of perception from the direct experiences of entrepreneurs.

Inaddition, Miao et al. (2018) studied the relationship between emotional intelligence affecting entrepreneurial intelligence development among the population of business owners in the United States of America by organizing a training and group workshop and assessing results using questionnaires. The research results and definitions of factors developing entrepreneurial intelligence can be summarized as follows. Four factors namely job performance, leadership, physical health, and mental health had a statistically significant positive effect on the experiment model. Nevertheless, such experiments had limitations and weaknesses. Such an experiment was suitable for those who have already started a business operation, which cannot be measured and assessed in secondary students since it collected information in terms of perception from the direct experiences of entrepreneurs.

The researcher also found that Baum et al. (2018) presented research on the relationship between incentives to expand capital growth and entrepreneurial intelligence among 229 entrepreneurs and CEOs in the United States of America using questionnaires as a data collection and analysis tool. The duration of this research was six years long. The research results and definitions of factors developing entrepreneurial intelligence can be summarized as follows. Three factors including communicated vision, self-efficacy, and goals had a statistically significant positive effect on the experiment model. However, such an experiment had limitations and weaknesses. Such an experiment was suitable for those who have already started a business operation, which cannot be measured and assessed in secondary students since it collected information in terms of perception from the direct experiences of entrepreneurs.

Furthermore, Tiwari (2017) investigated factors of attitudes and emotional intelligence affecting entrepreneurial intelligence among 230 undergraduate students. The model presented in the experiment was the theory of planned behavior framework, and questionnaires were used for research evaluation. The research results and definitions of factors developing entrepreneurial intelligence can be summarized as follows. Four factors including emotional intelligence, self-efficacy, attitude towards becoming a social entrepreneur, and social entrepreneurial intentions had a statistically significant positive effect on the experiment model. Yet, the experiment had limitations and weaknesses. 1) The measurement tool was only for undergraduate students, which cannot be clearly identified whether and how such statistical significance will differently affect other students in different levels. 2) Such a process has not been tested with secondary students, which was a new target group for the recent research study.

In addition, it was found that Oosthuizen (2017) proposed a model called 4-IR (Fourth Industrial Revolution) for the development of entrepreneurial intelligence of future entrepreneurs. Dependent variables can be defined and factors can be categorized into 4 aspects: contextual intelligence (mind), inspired intelligence (soul), emotional intelligence (heart), and physical intelligence (body). The model and principles were similar to those of Whole Brain Literacy (WBL), which was used in recent research since the development was based on the principles of brain functions for four aspects and four dimensions. Nonetheless, this research had limitations and weaknesses. The 4-IR model has never been applied and tried on a real population. This was only a presentation of the research framework and definition of variable terms used.

Besides, Zampetakis et al. (2016) conducted an experiment on the relationship between emotional intelligence affecting entrepreneurial intelligence development among 280 undergraduate students in the Faculty of Administration, Engineering, and Science in Greek by using questionnaires as a data analysis tool. The research results and definitions of factors developing entrepreneurial intelligence can be summarized as follows. Four factors including emotional intelligence, creativity, proactive, and attitude/mindset had a statistically significant positive effect on the experiment model. However, such an experiment had limitations and weaknesses. 1) It was only a study of the specific students, which cannot be clearly identified whether and how such statistical significance will differently affect other groups of people with different fields. 2) Such a process has not been tested with secondary students, which was a new target group for the recent research study.

In 2015, a study on the relationship of cognitive model affecting entrepreneurial intelligence development among 234 general people in England was conducted by Envick (2015) using the experiment model called Three Cognitive Qualities Direct Observation. The research results and definitions of factors developing entrepreneurial intelligence can be summarized as follows. Three factors namely passion, vision, and courage statistically significantly positively influenced the experiment model. The limitation and weakness were that such an experiment method was suitable for those who have already started a business operation, which cannot be measured and assessed in secondary students since it collected information in terms of perception from the direct experiences of entrepreneurs.

Additionally, it was also found that Mortana et al. (2015) conducted an experiment on 394 people aged 18-35 years in Spain and Portugal. The relationship between emotional factors affecting entrepreneurial intelligence development was investigated using a questionnaire for measurement and evaluation. The research results and definitions of factors developing entrepreneurial intelligence can be summarized as follows. Two factors including self-regulation and utilization of emotion statistically significantly positively affected the experiment model. However, such an experiment had limitations and weaknesses. 1) It was a study of the working-age group with various age ranges that were unable to be clearly classified. Thus, it cannot be clearly identified whether and how such statistical significance will differently affect groups of people with different occupations or ages. 2) Such a process has not been tested with secondary students, which was a new target group for the recent research study.

Demirel (2015) presented a model named “Multiple Intelligence Development Assessment (MIDA) through a small group seminar process in the population of 880

SME entrepreneurs in Turkey to find the relationship between multiple intelligence in eight aspects using questionnaires as a measurement tool. The research results and definitions of factors developing entrepreneurial intelligence can be summarized as follows. Eight factors including mathematical intelligence, bodily intelligence, spatial intelligence, linguistic intelligence, musical intelligence, social intelligence, naturalistic intelligence, and intrapersonal intelligence had a statistically significant positive effect on the experiment model. However, such an experiment had limitations and weaknesses. 1) It was only a study of SME entrepreneurs, which cannot be clearly identified whether and how such statistical significance will differently affect other groups of people in different fields. 2) Such a process has not been tested with secondary students, which was a new target group for the recent research study.

Moreover, it was revealed that Bahadori (2015) examined the relationship between emotional intelligence affecting entrepreneurial intelligence development among 107 managers working in a university in the field of Medical Science in Iran using questionnaires as a measurement tool. The research results and definitions of factors developing entrepreneurial intelligence can be summarized as follows. Four factors including self-emotional appraisal, others' emotional appraisal, regulation of emotion, and use of emotion had a statistically significant positive effect on the experiment model. However, such an experiment had limitations and weaknesses. 1) It was only a study of the managers working in the field of Medical Science, which cannot be clearly identified whether and how such statistical significance will differently affect other groups of people with different fields. 2) Such a process has not been tested with secondary students, which was a new target group for the recent research study.

The researcher also found that Azma & Mostafapour (2015) investigated the relationship between digital data technology and entrepreneurial intelligence among business executive managers in Iran using software to process two factors: organizational learning and processing smart. The results showed that the two factors statistically significantly positively affected the measurement model. Nonetheless, the experiment had limitations and weaknesses in that such a process has not been tested with secondary students, which was a new target group for the recent research study.

Baum et al. (2015) studied the relationship between the growth of new funding affecting entrepreneurial intelligence development among CEOs and business owners of 22 publishing and graphic enterprises in the United States of America by interviewing and evaluation. The research results and definitions of factors developing entrepreneurial intelligence can be summarized as follows. Three factors including practical intelligence, analytical intelligence, and creative intelligence had a statistically significant positive effect on the experiment model. However, such an experiment had limitations and weaknesses. 1) It was only a study of the CEOs and business owners, which cannot be clearly identified whether and how such statistical significance will differently affect other groups of people with different fields. 2) Such a process has not been tested with secondary students, which was a new target group for the recent research study.

The last relevant study that the researcher conducted a comparative study was by Rae & Carswell (2015), which examined a Life-Story Approach model affecting entrepreneurial intelligence among the population in the United Kingdom by organizing small groups, interviews, as well as workshops by sharing direct experiences in running a business. The research results and definitions of factors developing entrepreneurial intelligence can be summarized as follows. Three factors including risk-taking, leadership, and decision making had a statistically significant positive effect on the experiment model. However, such an experiment had limitations and weaknesses. 1) Such an experiment was suitable for those who have already started a business operation, which cannot be measured and assessed in secondary students since it collected information in terms of perception from the direct experiences of entrepreneurs. 2) Such a process has not been tested with secondary students, which was a new target group for the recent research study.

After that, the 15 relevant studies mentioned above were summarized and analyzed in Table 2.6.1 to present their limitations. As well, common factors and dependent variables expected to affect the development of entrepreneurial intelligence among secondary students were also analyzed. In addition, variables of various research studies related to the principles and conceptual framework of Whole Brain Literacy (WBL) that were to be applied in this recent experiment were analyzed. Thus, it indicated the strengths-weaknesses of the relevant studies to analyze and synthesize the variables which were likely to mainly affect this experiment, as shown in Table 2.5. below.

Table 2.5 An analysis of the relationship between limitations of factors-variables in various relevant research studies which might affect entrepreneurial intelligence development on the principles and conceptual framework of Whole Brain Literacy (WBL)

Year	Autor	Number of Variables	Population	Definition of Entrepreneurial Intelligence and characteristics	An analysis of dependent variables based on WBL			
					I-C	I-PU	I-E	I-PR
2021	Syaifullah et.al	3	Undergraduate students	Interpersonal skill				✓
				Creative skill			✓	
				Innovative skill			✓	
2020	Elia et al.	4	Business owners	Digital actor	✓			
				Digital activities		✓		
				Digital motivation				✓
				Digital organization				✓
2018	Caserio	3	Start-ups	Proactive	✓			
				Innovativeness			✓	
				Risk-taking	✓			
2018	Miao et al.	4	Business owners	Job performance	✓			
				Leadership	✓			
				Physical health		✓		
				Mental health				✓
2018	Baum et al.	3	Entrepreneurs and business CEOs	Communicated vision				✓
				Self-efficacy		✓		
				Goal	✓			

Table 2.5 An analysis of the relationship between limitations of factors-variables in various relevant research studies which might affect entrepreneurial intelligence development on the principles and conceptual framework of Whole Brain Literacy (WBL) (continued)

Year	Autor	Number of Variables	Population	Definition of Entrepreneurial Intelligence and characteristics	An analysis of dependent variable base on WBL			
					I-C	I-PU	I-E	I-PR
2017	Tiwari	4	Undergraduate students	Emotional intelligence				✓
				Self-efficacy		✓		
				Attitude toward becoming a social entrepreneur				✓
				Social entrepreneurial intentions				✓
2017	Oosthuizen	4	Not specified	Contextual intelligence	✓			
				Inspired Intelligence			✓	
				Emotional intelligence				✓
				Physical intelligence		✓		
2016	Zampetakis et al.	4	Undergraduate students	Emotional Intelligence				✓
				Creativity			✓	
				Proactive	✓			
				Attitude/mindset				✓
2015	Envick	4	General people	Passion				✓
				Vision			✓	
				Courage				✓
				Utilization of emotion				✓

Table 2.5 An analysis of the relationship between limitations of factors-variables in various relevant research studies which might affect entrepreneurial intelligence development on the principles and conceptual framework of Whole Brain Literacy (WBL) (continued)

Year	Autor	Number of Variables	Population	Definition of Entrepreneurial Intelligence and characteristics	An analysis of dependent variables base on WBL			
					I-C	I-PU	I-E	I-PR
2015	Mortana et al.	2	18-35 years old	Self-regulation		✓		
				Utilization of emotion				✓
2015	Demirel	8	SMEs	Mathematical intelligence	✓			
				Bodily intelligence		✓		
				Spatial intelligence			✓	
				Linguistic intelligence				✓
				Musical intelligence			✓	
				Social Intelligence				✓
				Naturalistic intelligence			✓	
				Intrapersonal intelligence		✓		
2015	Bahadori	4	Undergraduate students	Self-emotional appraisal				✓
				Others' emotional appraisal				✓
				Regulation of emotion				✓
				Use of emotion				✓

Table 2.5 An analysis of the relationship between limitations of factors-variables in various relevant research studies which might affect entrepreneurial intelligence development on the principles and conceptual framework of Whole Brain Literacy (WBL) (continued)

Year	Autor	Number of Variables	Population	Definition of Entrepreneurial Intelligence and characteristics	An analysis of dependent variables based on WBL			
					I-C	I-PU	I-E	I-PR
2015	Azma & Mostafapour	2	Business executive managers	Organization learning				✓
				Processing of smart			✓	
2015	Baum et al.	3	Business CEOs and Business Owners	Practical intelligence		✓		
				Analytical intelligence	✓			
				Creative intelligence			✓	
2015	Rae & Carswell	3	General people	Risk-taking	✓			
				Leadership	✓			
				Decision making	✓			
The total number of related factors		54						

According to Table 2.5., 15 relevant research studies and the relationship of dependent factors based on the principles and conceptual framework of brain functions of Whole Brain Literacy (WBL) can be summarized and explained as follows:

1) The study by Syaifullah et al. (2021) uses three dependent variables expected to affect the development of entrepreneurial intelligence. The population is undergraduate students. The dependent variables are analyzed and compared based on the principles of Whole Brain Literacy (WBL) that there are only two aspects of brain functions:1) the anterior right brain (I-Explore: I-E) involved in the development of creativity and imagination and 2) the posterior right brain (I-Preserve: I-PR) involved the development of emotional and social dimensions. Thus, it is considered to be

ineffective in developing the brain to cover all four aspects and four dimensions according to the Whole Brain Literacy. Also, this model has never been tried on secondary students before.

2) The study by Elia et al. (2020) uses four dependent variables expected to affect entrepreneurial intelligence development. The population used in the experiment includes business owners. The dependent variables are analyzed and compared based on the principles of Whole Brain Literacy (WBL) that there are only three aspects of brain functions that were used: 1) the anterior right brain (I-Explore: I-E) involved in the development of creativity and imagination, 2) the posterior right brain (I-Preserve: I-PR) involved in the development of emotional and social dimensions, and 3) the posterior left brain (I-Pursue: I-PU) involved in movement and self-control. Therefore, it is considered to be ineffective in developing the brain to cover all four aspects according to the Whole Brain Literacy. Also, this model has never been tried on secondary students before.

3) The study by Caerio (2018) uses three dependent variables expected to affect entrepreneurial intelligence development. The population in the experiment includes start-uppers. The dependent variables are analyzed and compared based on the principles of Whole Brain Literacy (WBL) that there are only two aspects of brain functions that were used: 1) the anterior right brain (I-Explore: I-E) involved in the development of creativity and imagination and 2) the anterior left brain (I-Control: I-C) involved in the development of analytical and logical thinking. Therefore, it is considered to be ineffective in developing the brain to cover all four aspects and four dimensions according to the Whole Brain Literacy. Also, this model has never been tried on secondary students before.

4) The study by Miao et al. (2018) uses four dependent variables expected to affect entrepreneurial intelligence development. The population in the experiment includes people aged 18-35 years. The dependent variables are analyzed and compared based on the principles of Whole Brain Literacy (WBL) that there are only three aspects of brain functions used: 1) the posterior left brain (I-Pursue: I-PU) involved in the development of movement and self-control, 2) the posterior right brain (I-Preserve: I-PR) involved in the development of emotional and social dimensions, and 3) the

anterior left brain (I-Control: I-C) involved in the development of analytical and logical thinking. Therefore, it is considered to be ineffective in developing the brain to cover all four aspects and four dimensions according to the Whole Brain Literacy. Also, this model has never been tried on secondary students before.

5) The study by Baum et al. (2018) uses three dependent variables expected to affect entrepreneurial intelligence development. The population in the experiment includes business CEOs and entrepreneurs. The dependent variables are analyzed and compared based on the principles of Whole Brain Literacy (WBL) that there are only three aspects of brain functions that were used: 1) the posterior right brain (I-Preserve: I-PR) involved in the development of emotional and social dimensions, 2) the posterior left brain (I-Pursue: I-PU) involved in the development of movement and self-control, 3) the anterior left brain (I-Control: I-C) involved in the development of analytical and logical thinking. However, this model has never been tested on secondary students before.

6) The study by Tiwari (2017) uses four dependent variables expected to affect entrepreneurial intelligence development. The population in the experiment includes undergraduate students. The dependent variables are analyzed and compared based on the principles of Whole Brain Literacy (WBL) that there are only two aspects of brain functions used: 1) the posterior right brain (I-Preserve: I-PR) involved in the development of emotional and social dimensions and 2) the posterior left brain (I-Pursue: I-PU) involved in the development of movement and self-control. Therefore, it is considered to be ineffective in developing the brain to cover all four aspects and four dimensions according to the Whole Brain Literacy. Also, this model has never been tried in secondary students before.

7) The study by Oosthuizen (2017) uses four dependent variables expected to affect entrepreneurial intelligence development. However, the model was only proposed, and it was not tried in any population. The dependent variables are analyzed and compared based on the principles of Whole Brain Literacy (WBL) that there are all four aspects of brain functions used: 1) the posterior right brain (I-Preserve: I-PR) involved in the development of emotional and social dimensions, 2) the posterior left brain (I-Pursue: I-PU) involved in the development of movement and self-control, 3) the

anterior right brain (I-Explore: I-E) involved in the development of creativity and imagination, and 4) the anterior left brain (I-Control: I-C) involved in the development of analytical and logical thinking. Nonetheless, this research study is only just a principle and framework proposal. It has never been tested with a real population, and more importantly, it has never been tried on secondary students before.

8) The study by Zampetakis et al. (2016) uses four dependent variables expected to affect entrepreneurial intelligence development. The population in the experiment includes undergraduate students. The dependent variables are analyzed and compared based on the principles of Whole Brain Literacy (WBL) that there are only three aspects of brain functions used: 1) the posterior right brain (I-Preserve: I-PR) involved in the development of emotional and social dimensions, 2) the anterior right brain (I-Explore: I-E) involved in the development of creativity and imagination, 3) the anterior left brain (I-Control: I-C) involved in the development of analytical and logical thinking. However, this model has never been tested on secondary students before.

9) The study by Envick (2015) uses three dependent variables expected to affect entrepreneurial intelligence development. The population in the experiment includes general people. The dependent variables are analyzed and compared based on the principles of Whole Brain Literacy (WBL) that there are only two aspects of brain functions used: 1) the anterior right brain (I-Explore: I-E) involved in the development of creativity and imagination and 2) the posterior right brain (I-Preserve: I-PR) involved in the development of emotional and social dimensions. Therefore, it is considered to be ineffective in developing the brain to cover all four aspects and four dimensions according to the Whole Brain Literacy. Also, this model has never been tried on secondary students before.

10) The study by Mortana et al. (2015) uses two dependent variables expected to affect entrepreneurial intelligence development. The population in the experiment includes people aged 18-35 years. The dependent variables are analyzed and compared based on the principles of Whole Brain Literacy (WBL) that there are only two aspects of brain functions used: 1) the posterior right brain (I-Preserve: I-PR) involved in the development of emotional and social dimensions and 2) the posterior left brain (I-Pursue: I-PU) involved in the development of movement and self-control.

Therefore, it is considered to be ineffective in developing the brain to cover all four aspects and four dimensions according to the Whole Brain Literacy. Also, this model has never been tried on secondary students before.

11) The study by Demirel (2015) uses eight dependent variables expected to affect entrepreneurial intelligence development. The population in the experiment includes SME groups. The dependent variables are analyzed and compared based on the principles of Whole Brain Literacy (WBL) that there are all four aspects of brain functions used: 1) the posterior right brain (I-Preserve: I-PR) involved in the development of emotional and social dimensions, 2) the posterior left brain (I-Pursue: I-PU) involved in the development of movement and self-control, 3) the anterior right brain (I-Explore: I-E) involved in the development of creativity and imagination, and 4) the anterior left brain (I-Control: I-C) involved in the development of analytical and logical thinking. However, the model has never been tried on secondary students before.

12) The study by Bahadori (2015) uses four dependent variables expected to affect entrepreneurial intelligence development. The population in the experiment includes undergraduate students. The dependent variables are analyzed and compared based on the principles of Whole Brain Literacy (WBL) there is only one aspect of brain functions used: the posterior right brain (I-Preserve: I-PR) involved in the development of emotional and social dimensions. However, the model has never been tried on secondary students before.

13) The study by Azma & Mostafapour (2015) uses two dependent variables expected to affect entrepreneurial intelligence development. The population in the experiment includes business executive managers. The dependent variables are analyzed and compared based on the principles of Whole Brain Literacy (WBL) that there are only two aspects of brain functions used: 1) the anterior right brain (I-Explore: I-E) involved in the development of creativity and imagination and 2) the posterior right brain (I-Preserve: I-PR) involved in the development of emotional and social dimensions. Therefore, it is considered to be ineffective in developing the brain to cover all four aspects and four dimensions according to the Whole Brain Literacy. Also, this model has never been tried on secondary students before.

14) The study by Baum et al. (2015) uses three dependent variables

expected to affect entrepreneurial intelligence development. The population in the experiment includes business CEOs and business owners. The dependent variables are analyzed and compared based on the principles of Whole Brain Literacy (WBL) that there are only three aspects of brain functions used: 1) the posterior left brain (I-Pursue: I-PU) involved in the development of movement and self-control, 2) the anterior right brain (I-Explore: I-E) involved in the development of creativity and imagination, 3) the anterior left brain (I-Control: I-C) involved in the development of analytical and logical thinking. However, this model has never been tested on secondary students before.

15) The study by Rae & Carswell (2015) uses three dependent variables expected to affect entrepreneurial intelligence development. The population in the experiment includes general people. The dependent variables are analyzed and compared based on the principles of Whole Brain Literacy (WBL) that there is only one aspect of brain functions that were used: the anterior left brain (I-Control: I-C) involved in the development of analytical and logical thinking. However, this model has never been tested on secondary students before.

From the analysis of 15 relevant research studies from 2015-2021 based on the principles of Whole Brain Literacy (WBL) mentioned above, it can be summarized as follows:

1) There has been no study on entrepreneurial intelligence development among secondary students.

2) There has been no study on entrepreneurial intelligence development based on the principles and conceptual framework of Whole Brain Literacy (WBL).

3) There has been no study on entrepreneurial intelligence development using factors that cover 4 aspects and 4 dimensions based on the Whole Brain Literacy.

4) Of 15 research studies, it was found that there were 11 high-frequency factors and dependent variables out of 54, which have previously been used by researchers in experiments and statistically significantly affect the development of entrepreneurial intelligence development. They can be classified according to the principles of brain functions as follows:

1) Leadership: the function of the anterior left brain (I-Control: I-C) related to the development of analytical and logical thinking.

2) Planning skill: the function of the anterior left brain (I-Control: I-C)

related to the development of analytical and logical thinking.

3) Proactive skill: the function of the anterior left brain (I-Control: I-C) related to the development of analytical and logical thinking.

4) self-behavioral regulation: the function of the posterior left brain (I-Pursue: I-PU) related to the development of movement and self-control.

5) Risk management: the function of the posterior left brain (I-Pursue: I-PU) related to the development of movement and self-control.

6) Creativity: the function of the anterior right brain (I-Explore: I-E) related to the development of creativity and imagination.

7) Innovativeness: the function of the anterior right brain (I-Explore: I-E) related to the development of creativity and imagination.

8) Visionary: the function of the anterior right brain (I-Explore: I-E) related to the development of creativity and imagination.

9) Risk-taking: the function of the anterior right brain (I-Explore: I-E) related to the development of creativity and imagination.

10) Interpersonal: the function of the posterior right brain (I-Preserve: I-PR) related to the development of emotional and social dimensions.

11) Emotional regulation: the function of the posterior right brain (I-Preserve: I-PR) related to the development of emotional and social dimensions.

Then, the above factors from the analysis of relevant research were used to define the definitions and factors in this recent experiment. They were combined with 16 factors from the principles and conceptual framework of Whole Brain Literacy (WBL), which was considered the largest number of experimental factors ever studied. Compared with the relevant research studies (where the most experimental factors found were only eight factors by Demirel (2015)), the factors can be shown in Table 2.6 as follows.

Table 2.6 Factors and variables from the analysis of research studies related to the principles of Whole Brain Literacy (WBL)

Whole Brain Literacy (WBL)	Human Brain functions	The definitions of factors and dependent variables	Sources of dependent variables
The anterior left brain (I-Control: I-C)	Related to the development of Analytical and Logical thinking	1) Leadership	An analysis of relevant research
		2) Planning skill	An analysis of relevant research
		3) Proactive skill	An analysis of relevant research
		4) Analytical thinking	An addition from WBL theory
The posterior left brain (I-Pursue: I-PU)	Related to the development of Movement and Self-control	5) Self-behavioral regulation	An analysis of relevant research
		6) Risk-management	An analysis of relevant research
		7) Punctuality	An addition from WBL theory
		8) Organizational skill	An addition from WBL theory
The anterior right brain (I-Explore: I-E)	Related to the development of Creativity and Imagination	9) Creativity	An analysis of relevant research
		10) Innovativeness	An analysis of relevant research
		11) Visionary	An analysis of relevant research
		12) Risk-taking	An analysis of relevant research

Table 2.6 Factors and variables from the analysis of research studies related to the principles of Whole Brain Literacy (WBL) (continued)

Whole Brain Literacy (WBL)	Human Brain functions	The definitions of factors and dependent variables	Sources of dependent variables
The posterior right brain (I-Preserve: I-PR)	Related to the development of Emotional and Social Dimensions	13) Interpersonal	An analysis of relevant research
		14) Emotional regulation	An analysis of relevant research
		15) Communicational skill	An addition from WBL theory
		16) Team building	An addition from WBL theory

According to Table 2.6, the researcher presented dependent variables and summarized the definitions of specific factors expected to affect the development and be an indicator of entrepreneurial intelligence that cover brain functions based on the principles and conceptual framework of Whole Brain Literacy (WBL) as follows.

1) There were four relevant factors related to the development of analytical and logical thinking or the function of the anterior left brain (I-Control: I-C) including leadership, planning skill, proactive skill, and analytical thinking.

2) There are four relevant factors related to the development of movement and self-control or the function of the posterior left brain (I-Pursue: I-PU) including self-behavioral regulation, risk management, punctuality, and organizational skill.

3) There are four relevant factors related to the development of creativity and imagination or the function of the anterior right brain (I-Explore: I-E) including creativity, innovativeness, visionary, and risk-taking.

4) There are four relevant factors related to the development of emotional and social dimensions or the function of the posterior right brain (I-Preserve: I-PR) including interpersonal, emotional regulation, communicational skill, and team building.

2.7 Definitions and Characteristics of Variables Expected to Affect the Entrepreneurial Intelligence Development Proposed in This Recent Study

From an analysis of various factors related to the development of entrepreneurial intelligence from 15 relevant research studies in section 2.6, the 16 prominent variables expected to affect entrepreneurial intelligence development among secondary students were determined. The researcher has further studied the specific characteristics of each type of variable from relevant research. They can be summarized and explained according to the principles of brain functions and classified as follows.

Group 1: Anterior left brain function (I-Control: I-C) - the development of analytical and logical thinking

1) Characteristics of Leadership

Perry (2024) defined 18 characteristics of leadership including 1) drive, 2) resilience, 3) integrity, 4) a desire to learn, 5) self-awareness, 6) confidence, 7) positivity, 8) realism, 9) creativity, 10) communication skills, 11) listening skills, 12) empathy, 13) decision-making, 14) strategic mindset, 15) an eye for talent, 16) the ability to motivate, 17) the ability to delegate, and 18) professional expertise.

The Centre for Creative Leadership (2023) defined the characteristics of leadership. A total of 10 characteristics were as follows: 1) integrity, 2) delegation, 3) communication, 4) self-awareness, 5) gratitude, 6) learning agility, 7) influence, 8) empathy, 9) courage, and 10) respect.

Stephen et al. (2022) defined 25 characteristics of leadership as follows: 1) integrity, 2) innovative, 3) honesty, 4) active listening, 5) self-confidence, 6) visionary, 7) strong communicator, 8) delegation, 9) decision-making skill, 10) problem-solving skills, 11) fair attitude 12) inquisitiveness, 13) self-motivated, 14) humility, 15) care for others,16) self-discipline, 17) emotional intelligence, 18) passion, 19) resilience,20) accountability,21) supportive, 22) tech-savvy, 23) empathy, 24) learning agility, 25) empowerment.

Kapur (2022) defined six characteristics of leadership: 1) ability to influence others, 2) transparency to an extent, 3) encouragement, 4) value of ethics and integrity, 5) acting decisively, 6) balancing hard truths with optimism.

Eastwood (2019) defined five characteristics of leadership: 1) self-awareness - prioritize personal development, 2) focus on developing others, 3) encouraging strategic thinking - innovation and action, 4) ethical and civic-minded, 5) practicing effective cross-cultural communication.

2) Characteristics of Planning Skill

Lundi (2022) defined seven characteristics of planning skills including 1) task of management, 2) intellectual process, 3) future-oriented, 4) decision-oriented, 5) goal-oriented, 6) forecasting, and 7) pervasive function.

Business Jagons Journal (2022) defined seven characteristics of planning skills: 1) managerial function, 2) goal-oriented, 3) pervasive, 4) continuous process, 5) intellectual process, 6) futuristic, and 7) decision-making.

Rana (2022) defined 10 characteristics of planning skills as follows: 1) primary function of management, 2) focuses on objectives, 3) function of all managers, 4) intellectual process, 5) continuous process, 6) dynamic (flexible), 7) secures efficiency - economy and accuracy, 8) involves forecasting, 9) linking factors, and 10) realistic.

Agarwal (2020) defined nine characteristics of planning skills including 1) focus on goal, 2) primary function, 3) pervasive activity, 4) future-oriented, 5) continuous activity,6) intellectual work, 7) flexibility, 8) efficiency and economy, and 9) actionable.

3) Characteristics of Proactive Skill

Taylor (2023) defined seven characteristics of proactive skills as follows: 1) look for different alternatives of action, 2) accept criticism constructively, 3) use positive language, 4) attitude of self-control, 5) dynamic people, 6) trust in themselves, 7) great problem-solving skills, 8) think long term, 9) perseverant, 10) reach the goals, and 11) aware of their strengths and weaknesses.

Papasotiriou (2022) defined five characteristics of proactive skills: 1) plan for the future, 2) engaged, 3) foresight, 4) prevented, and 5) doer.

Markovich (2022) defined four characteristics of proactive skills: 1) strategic thinking, 2) communication skills, 3) collaborative style, and 4) professional standards.

Ong (2015) defined 10 characteristics of proactive skill as follows: 1) thinking long term, 2) inspiring others, 3) great listeners - communicators, 4) being highly organized, 5) great problem-solving skills, 6) advice and help when required, 7) compassionate - loyal and integrity-filled, 8) calm demeanor, 9) utilize team strengths, and 10) take criticism well.

4) Characteristics of Analytical Thinking Skill

Deepak (2022) defined six characteristics of analytical thinking skills: 1) logical reasoning, 2) critical thinking, 3) research, 4) communication, 5) creativity, and 6) data analysis.

The Peak Performance Center (2022) defined nine characteristics of analytical thinking skills: 1) convergent, 2) linear, 3) deductive, 4) sequential, 5) logical, 6) rational, 7) focused, 8) objective, and 9) systematic.

International Career Institute (2020) defined 17 characteristics of analytical thinking skills including 1) prioritization, 2) growth mindset, 3) multitasking, 4) resourcefulness, 5) design thinking, 6) forecasting, 7) problem-solving, 8) research, 9) brainstorming and ideation, 10) organization, 11) visualization, 12) data mining and metrics interpreting, 13) reporting, 14) creativity, 15) diagnostics, 16) troubleshooting, and 17) theorizing.

Stevens (2018) defined eight characteristics of analytical thinking skills: 1) thinking about the purpose, 2) exposing the questions, 3) gathering information, 4) putting forward the points of view, 5) verifying assumptions, 6) thinking about the implications, 7) the concepts are used to make the inferences, and 8) reasonable.

Demeo (2018) defined 12 characteristics of analytical thinking skills as follows: 1) focused, 2) problem-solving, 3) creative thinking, 4) critical thinking, 5) thinking out of the box, 6) analyzing data, 7) open-mindedness, 8) empathy, 9) communication, 10) synthesis thinking, 11) independence, and 12) self-reliance.

Group 2: Posterior left brain function (I-Pursue: I-PU) - the development of movement and self-control

5) Characteristics of Self-Behavioral Regulation Skill

Cuncic (2023) defined 11 characteristics of self-behavioral regulation skills as follows:1) act in accordance with their values, 2) calm themselves when upset, 3) cheer themselves when feeling down, 4) maintain open communication, 5) persist through difficult times, 6) put forth their best effort, 7) remain flexible and adapting to situations, 8) see the good in others, 9) stay clear about their intentions, 10) take control of situations when necessary, and 11) view challenges as opportunities.

Thompson (2022) defined four characteristics of self-behavioral regulation skills: 1) self-awareness, 2) persistence, 3) adaptability, and 4) optimism.

Felton (2022) defined five characteristics of self-behavioral regulation skills including 1) regulating reactions based on negative emotions such as frustration, anger, and embarrassment, 2) calming down when something exciting or upsetting happens, 3) focusing on a task, 4) control impulses, and 5) ability to behave in certain situations and get along with other people.

Bridgett et al. (2015) defined eight characteristics of self-behavioral regulation skill: 1) necessary - effective, 2) appropriate and balanced, 3) implementable and maintainable, 4) lawful, 5) consistent, 6) simple - clear and accessible, 7) well-founded and well-discussed, 8) relevant and up-to-date.

6) Characteristics of Risk Management Skill

Patrizio (2023) defined 12 characteristics of risk management skills as follows: 1) analytical, 2) problem-solving, 3) people management and leadership, 4) relationship-building, 5) financial knowledge, 6) regulation knowledge, 7) business understanding, 8) ability to quantify risks, 9) ability to choose mitigation strategy, 10) strategic thinking, 11) adaptability, and 12) mathematics.

Avila et al.(2020) defined seven characteristics of risk management skills as follows: 1) knowledge and understanding of regulations, 2) analytical skills, 3) strategic thinking, 4) financial knowledge, 5) communication skills, 6) problem-solving skills, 7) ability to work under pressure.

Thanomwan et al. (2017) defined nine characteristics of risk management skills including 1) analytical risk assessment skills, 2) problem-solving, 3) strategic thinking, 4) financial knowledge and skills, 5) regulation, 6) ability to build relationships, 7) working under pressure, 8) adaptable to new concerns and changing environments, and 9) management and leadership skills.

Caldas (2016) defined 10 characteristics of risk management skills: 1) financial acumen, 2) analytical skills and an eye for detail, 3) industry and market knowledge, 4) ability to endure and work under stress, 5) technical - negotiation - ability to influence people, 6) good communication and presentation skills, 7) holding academic credentials in finance and risk, 8) strategic thinking capability, 9) endurance to regulation, and 10) networking ability.

7) Characteristics of Punctuality Skill

Krause (2023) defined five characteristics of punctuality skills including 1) always setting an alarm, 2) checking the routine, 3) doing as much prepping as possible, 4) mapping the trip out, planning for off-peak travel, and 5) being realistic with your schedule.

Rosenberg (2022) defined six characteristics of punctuality skills: 1) have everything ready the night before, 2) keep your essentials near the door, 3) create a staging area near the door, 4) anticipate delays before they happen, 5) commit yourself to be 15 minutes early for everything, and 6) overestimate the time it will take to get there.

Eliason (2015) defined nine characteristics of punctuality skills as follows: 1) give buffer time for themselves, 2) stay organized, 3) be realistic about how long things take, 4) comfortable with extra time while waiting, 5) wake up early, 6) sleep well, 7) do not procrastinate, 8) not rushed, 9) cannot stand it when late.

Kajidori (2015) defined five characteristics of punctuality skills: 1) respect, 2) deadlines, 3) team-centered goals, 4) credibility, and 5) professionalism.

8) Characteristics of Organizational Skill

Miles (2023) defined 10 characteristics of organizational skills: 1) time management, 2) communication, 3) setting goals, 4) delegation, 5) working under pressure, 6) self-motivation, 7) analytical thinking, 8) attention to detail, 9) decision-making, and 10) strategic planning.

Zane (2023) defined 11 characteristics of organizational skills: 1) time management, 2) physical organization, 3) mental organization, 4) communication, 5) delegation, 6) self-motivation, 7) prioritizing, 8) planning, 9) collaboration, 10) goal-setting, and 11) flexibility

Doyle (2023) defined 22 characteristics of organizational skills: 1) administrative, 2) assessment, 3) attention to detail, 4) concision, 5) coordination,

6) creative thinking, 7) documentation, 8) effectiveness, 9) handling details, 10) identifying problems, 11) identifying resources, 12) managing appointments, 13) Microsoft Office Proficiency,14) policy enforcement, 15) prioritization, 16) productivity, 17) situational assessment, 18) task analysis, 19) task assessment, 20) task resolution, 21) workflow analysis, and 22) workflow management.

European Union (2020) defined 10 characteristics of organizational skills as follows: 1) collaboration, 2) communication, 3) teamwork, 4) delegation, 5) planning, 6) prioritizing, 7) mental organizational skills, 8) physical organization, 9) time management, and 10) work-life balance.

Group 3: Anterior right brain function (I-Explore: I-E) - the development of creativity and imagination

9) Characteristics of Creativity

Pearce (2023) defined 27 characteristics of creativity including 1) new ideas innovation, 2) positive attitude, 3) fearlessness, 4) pre-conscious system, 5) new result orientation, 6) universal, 7) environment approval, 8) originality, 9) human power, 10) strong motivation and determination, 11) flexibility, 12) study – think, 13) new idea combination, 14) natural or acquired, 15) creating a new method, 16) a sense of intense curiosity, 17) motivating the heart, 18) brain activity, 19) genetic, 20) ask questions, 21) generate new ideas, 22) acknowledge faults, 23) practice thinking from zero, 24) goal-oriented, 25) alter the mind, 26) learning continuously, and 27) devoid of ego.

Cherry (2023) defined 10 characteristics of creativity: 1) energetic and focused, 2) smart, 3) playful and disciplined, 4) realistic and imaginative, 5) extrovert and introverted, 6) proud and modest, 7) masculine and feminine, 8) conservative and rebellious, 9) passionate and objective, and 10) sensitive and joyful.

Chakma (2022) defined 20 characteristics of creativity as follows: 1) emphasizes the newness, 2) often associated with giftedness, 3) spontaneous, 4) special aptitude, 5) does not involve a single trait, 6) novel to society and individual, 7) expressed in many ways, 8) can be measured, 9) both a product and a process, 10) involves divergent thinking, 11) natural endowment, 12) do not affect creativity, 13) independent of any drugs or drinks, 14) achievement are not correlated, 15) includes dynamic thinking, 16) involves curiosity, 17) leads towards useful results, 18) Leads to go beyond the existing environment,19) keeps harmony with abnormal and relevant thinking, 20) develops the ability to see the problem from a new point of view.

Muller (2018) defined five characteristics of creativity as follows: 1) flexibility, 2) a sense of intense curiosity, 3) a positive attitude, 4) strong motivation and determination, and 5) fearlessness.

10) Characteristics of Innovativeness

James (2023) defined 10 characteristics of innovativeness as follows: 1) valuing innovation, 2) encouraging risk-taking, 3) teaching others, 4) starting somewhere, 5) looking for patterns everywhere, 6) staying positive, 7) incentivizing innovation, 8) being a team player, 9) connecting and collaborating, and 10) valuing a culture of innovation.

Wu et al. (2020) defined 10 characteristics of innovativeness: 1) doing things differently, 2) highly productive, 3) sustaining active, 4) complexity, 5) diversity, 6) leadership, 7) taking higher risks, 8) effective change management, 9) not afraid to break with the norm, 10) contribute new ideas.

Hassi (2019) defined 12 characteristics of innovativeness: 1) continuous reflection, 2) unattached exploration, 3) iterating between abstract and concrete thinking, 4) action-oriented, 5) opportunity-focused, 6) mental resilience, 7) intellectual humility, 8) courage, 9) sensitivity towards uncertainties, 10) designing valuable experiments, 11) extracting learning, and 12) implementing learning and idea adaptation.

Poirier (2017) defined five characteristics of innovativeness: 1) relative advantage, 2) complexity - simplicity, 3) tri-ability, 4) observe - ability, and 5) compatibility.

11) Characteristics of Visionary

Jeffrey (2024) defined 10 characteristics of visionary including 1) inspirational, 2) emotionally intelligent, 3) open-minded, 4) imaginative, 5) resolute, 6) persistent, 7) collaborative, 8) bold, 9) magnetic, and 10) optimistic.

Lucas (2021) defined three characteristics of a visionary as follows: 1) risk-taking, 2) listening, and 3) taking responsibility.

Smith (2021) defined seven characteristics of visionary: 1) perseverance and determination, 2) resourcefulness, 3) patience and understanding, 4) risk-taking, 5) accountability, 6) open-mindedness, and 7) emotional intelligence.

Karwan (2021) defined five characteristics of a visionary: 1) good communication skills, 2) charismatic leader with interest in others, 3) chief organizer building a foundation, 4) intelligent risk taker, and 5) strategic business planner.

12) Characteristics of Risk-Taking Skill

Gupta (2024) defined eight characteristics of risk-taking including 1) a lower level of fear than most people, 2) a disproportionate amount of testosterone, 3) creators - not observers, 4) incredibly curious about why things are the way they are, 5) promotion-focused, 6) surround themselves with like-minded risk-takers, 7) believe that anything is possible, and 8) can shake off and even embrace failure.

Rostron (2024) defined two characteristics of risk-taking: 1) tenacious and 2) no fear of embarrassment.

Gupta & Vaidya (2023) defined four characteristics of risk-taking as follows: 1) market fluctuations interest them, 2) adaptive to changes, 3) gambling against the odds, and 4) learners.

Brown (2022) defined 12 characteristics of risk-taking: 1) comfortable being uncomfortable, 2) gambling, 3) getting in trouble, 4) a person of action, 5) knowing what you want, 6) trusting your gut, 7) naturally curious, 8) brush off failures, 9) won't settle for the way things are, 10) decisive, 11) passionate, and 12) self-confident.

Sica (2017) defined seven characteristics of risk-taking: 1) passion, 2) resilience, 3) flexibility, 4) trust your instinct, 5) management skills, 6) ambitious hungry, and 7) knowledge.

Group 4: The posterior right brain function (I-Preserve: I-PR) - the development of emotions and social dimensions

13) Characteristics of Interpersonal Skill

Doyle (2022) defined eight characteristics of interpersonal skills as follows: 1) teamwork, 2) communication, 3) conflict management, 4) empathy, 5) leadership, 6) listening, 7) negotiation, and 8) positive attitude.

Herrity (2022) defined nine characteristics of interpersonal skills: 1) active listening, 2) teamwork, 3) responsibility, 4) dependability, 5) leadership, 6) motivation, 7) flexibility, 8) patience, and 9) Empathy.

Duszynski (2022) defined 10 characteristics of interpersonal skills: 1) communication, 2) conflict resolution, 3) decision making, 4) leadership, 5) relationship building, 6) Mediation, 7) problem-solving, 8) teamwork - collaboration, 9) negotiation, and 10) listening.

Veljanovska (2018) defined 15 characteristics of interpersonal skills: 1) self-confidence, 2) verbal communication, 3) non-verbal communication, 4) positive attitude, 5) empathy, 6) listening skills, 7) openness to feedback, 8) reliability, 9) respectfulness, 10) negotiation skills, 11) conflict resolution, 12) assertiveness, 13) collaboration, 14) leadership skills, and 15) sense of humor.

14) Characteristics of Emotional Regulation Skill

Lebow and Casabianca (2022) defined five characteristics of emotional regulation as follows: 1) calm your nervous system, 2) consider accepting how you feel, 3) consider practicing mindfulness, 4) engage in stress management, and 5) consider therapy.

Klynn (2021) defined five characteristics of emotional regulation: 1) creating space, 2) noticing what you feel, 3) naming what you feel, 4) accepting the emotion, and 5) practicing mindfulness.

Wilms (2020) defined four characteristics of emotional regulation: 1) avoid conflict, 2) keep up appearances, 3) make others feel better, and 4) influence others.

Chowdhury (2019) defined five characteristics of emotional regulation: 1) self-awareness, 2) mindful awareness, 3) emotional intelligence, 4) adaptability, and 5) self-compassion.

15) Characteristics of Communication Skill

Amadebai (2022) defined 10 characteristics of communication skills as follows: 1) emotion management, 2) ability to focus, 3) learning to listen, 4) avoiding making judgments, 5) providing feedback, 6) non-verbal communication, 7) assertiveness, 8) empathy, 9) mediative and open-minded, and 10) persuasion.

Jouany & Martic (2022) defined five characteristics of communication skills:1) listening, 2) straight talking, 3) non-verbal communication, 4) stress management, and 5) emotion control.

Maiti (2021) defined seven characteristics of communication skills: 1) clear, 2) correct, 3) complete, 4) concise, 5) concrete, 6) coherent, and 7) courteous.

Thomas (2016) defined eight characteristics of communication skills: 1) active listening, 2) emotional awareness, 3) recognizing barriers, 4) keeping it simple, 5) specific, 6) focusing on the here and now, 7) knowing when NOT to speak, and 8) timely and complete.

16) Characteristics of Team Building Skill

Penn (2022) defined four characteristics of team-building skills as follows: 1) setting clear objectives, 2) commitment of team members, 3) lines of communication, and 4) a definitive decision-making process.

Lukic (2022) defined 10 characteristics of team building skills as follows: 1) setting a clear direction, 2) open and honest communication, 3) support for risk-taking and change, 4) defined roles, 5) mutual accountability, 6) open communication, 7) a common goal, 8) a melting pot of differing opinions, 9) close collaboration, and 10) trust above everything.

Schoultz (2017) defined 10 characteristics of team building skills: 1) clear direction, 2) open and honest communication, 3) support risk-taking and change, 4) defined roles, 5) mutually accountable, 6) communicating freely, 7) common goals, 8) encourage differences in opinions, 9) collaboration, and 10) team trust.

Hogarty (2022) defined nine characteristics of team building skills: 1) good communication, 2) individual talent, 3) team sense of belonging, 4) strong leadership, 5) clear structure, 6) achievable goals, 7) feedback, 8) positive attitude, and 9) solution-focused teams.

From the above 67 relevant research and 529 sub-variables used in research, it was found that there were variables and sub-factors which have repetitive frequencies and were factors that were clearly defined that they had an effect on the entrepreneurial intelligence development. Thus, the research has summarized the definition of characteristics of various factors according to the principles and concepts of Whole Brain Literacy (WBL), as shown in Table 2.7

Table 2.7 Definitions of characteristics related to the development of entrepreneurial intelligence according to the Whole Brain Literacy (WBL) proposed in this recent research

Whole Brain Literacy (WBL)	**Human Brain functions**	**Definition of factors and dependent variables**	**Characteristics**
Anterior left brain lobe I-Control (I-C)	The development of analytical and logical thinking	1) Leadership	1.1 Integrity
			1.2 Decision-making
			1.3 Resolute
			1.4 Encourage
		2) Planning skill	2.1 Goal-oriented
			2.2 Flexibility
			2.3 Efficiency
			2.3 Forecasting
		3) Proactive skill	3.1 Perseverance
			3.2 Inspire others
			3.3 Collaborative
			3.4 Strategic thinking
		4) Analytical Thinking	4.1 Reasonable
			4.2 Systematic
			4.3 Data analyzing
			4.4 Concentrate

Table 2.7 Definitions of characteristics related to the development of entrepreneurial intelligence according to the Whole Brain Literacy (WBL) proposed in this recent research (continued)

Whole Brain Literacy (WBL)	**Human Brain functions**	**Definition of factors and dependent variables**	**Characteristics**
Posterior left brain lobe I-Pursue (I-PU)	The development of movement and self-control	5) Self-behavioral regulation	5.1 Focus on the task
			5.2 Patience
			5.3 Consistency
			5.4 Persistence
		6) Risk-reduction	6.1 Financial skill
			6.2 Business idea
			6.3 Marketing knowledge
			6.4 Work under pressure
		7) Punctuality	7.1 Preparative
			7.2 Scheduling
			7.3 Deadlines
			7.4 Time management
		8) Organizational skill	8.1 Concision
			8.2 Policy enforcement
			8.3 Prioritizing
			8.4 Workflow analysis

Table 2.7 Definitions of characteristics related to the development of entrepreneurial intelligence according to the Whole Brain Literacy (WBL) proposed in this recent research (continued)

Whole Brain Literacy (WBL)	**Human Brain functions**	**Definition of factors and dependent variables**	**Characteristics**
Anterior right brain lobe I-Explore (I-E)	The development of creativity and imagination	9) Creativity	9.1 Positive attitude
			9.2 Passionate
			9.3 Curiosity
			9.4 Self-motivation
		10) Innovativeness	10.1 Think out of the box
			10.2 Adaptation
			10.3 Opportunity focused
			10.4 Experimental
		11) Visionary	11.1 Open-minded
			11.2 Synthesis
			11.3 Analytic
			11.4 Seeking the future
		12) Risk-taking	12.1 Self-confidence
			12.2 Embrace failure
			12.3 Believe possibility
			12.4 Fearless

Table 2.7 Definitions of characteristics related to the development of entrepreneurial intelligence according to the Whole Brain Literacy (WBL) proposed in this recent research (continued)

Whole Brain Literacy (WBL)	**Human Brain functions**	**Definition of factors and dependent variables**	**Characteristics**
Posterior right brain lobe I-Preserve (I-PR)	The development of emotional and social dimensions	13) Interpersonal	13.1 Active listening
			13.2 Conflict management
			13.3 Sense of humor
			13.4 Respectfulness
		14) Emotional regulation	14.1 Humility
			14.2 Empathy
			14.3 Courteous
			14.4 Kindness
		15) Communicational skill	15.1 Negotiate
			15.2 Persuasion
			15.3 Influence others
			15.4 Cleared goal
		16) Team building	16.1 Sincerity
			16.2 Common goal
			16.3 Provided feedback
			16.4 Defined role

From Table 2.7, can be summarized and explained that based on the principles and concepts of Whole Brain Literacy (WBL) for the learner development in entrepreneurial intelligence, the researcher found 16 dependent variables and classified 64 characteristics. Thus, the findings were used as a conceptual framework for the steps of an experiment.

1) I-Control (I-C): the anterior left brain involves in the development of analytical and logical thinking. It consists of four factors and 16 characteristics as follows.

1.1 Leadership: integrity, decision-making, resolute, encourage

1.2 Planning skill: goal-oriented, flexible, efficient, forecasting

1.3 Proactive skill: perseverance, inspiring others, collaborative, strategic thinking

1.4 Analytical thinking: reasonable, systematic, data analyzing, concentrate

2) I-Pursue (I-PU): the posterior left brain involves in the development of movement and self-control. It consists of four factors and 16 characteristics as follows:

2.1 Self-behavioral regulation: focus on a task, patience, consistency, persistence

2.2 Risk-reduction: financial skill, business idea, marketing knowledge, work under pressure

2.3 Punctuality: preparative, scheduling, deadlines, time management

2.4 Organizational skill: concision, policy enforcement, prioritizing, workflow analysis

3) I-Explore (I-E); the anterior right brain involves in the development of creativity and imagination. It consists of four factors and 16 characteristics as follows:

3.1 Creativity: positive attitude, passionate, curiosity, self-motivation

3.2 Innovativeness: think out of the box, adaptation, opportunity, focused, experimental

3.3 Visionary: open-minded, synthesis, analytic, seeking the future

3.4 Risk-taking: self-confidence, embracing failure, believe possibility, fearless

4) I-Preserve (I-PR): the posterior right brain involves in the development of emotions and social dimensions. It consists of four factors and 16 characteristics as follows:

4.1 Interpersonal: active listening, conflict management, sense of humor, respectfulness

4.2 Emotional regulation: humility, empathy, courteous, kindness

4.3 Communicational skill: negotiate, persuade, influence others, clear goal

4.4 Team building: sincerity, common goal, provided feedback, defined role

2.8 Digital Entrepreneurship (DE) and Digital Intelligence (DI)

2.8.1 Definitions and Factors Affecting the Learner Development of Digital Entrepreneurship

Soltanifar and Edin (2021) explained and summarized the meaning of digital entrepreneurship as the application of future technology for business development and enhancement. It aimed at five prominent factors: 1) mobile computing, 2) Cloud computing, 3) social media, 4) the Internet of Things (IoT), and 5) big data.

Moreover, it was found that Nulaw (2020) analyzed the definition of digital entrepreneurship as the use of digital technology to create new business opportunities, which had a faster, easier, and more convenient transaction with consumers in terms of communication and financial transactions. Five factors used included 1) mobile computing, 2) Cloud computing, 3) social media, 4) the Internet of Things (IoT), and 5) big data.

According to the study, the OECD (2019) defined factors affecting the development of digital business in the future, which consisted of six factors related to digital entrepreneurship:1) big data and AI, 2) digital platform, 3) IoT, 4) FinTech, 5) Cloud computing, and 6) blockchain and LTDs.

Chen et al. (2019) described three factors affecting the development of digital entrepreneurship: 1) artificial intelligence (AI), 2) internet of things (IoT), and 3) visual reality (VR).

Likewise, the researcher discovered that Bruno and Canina (2019) discussed factors affecting the potential of digital entrepreneurship, which should consist of three promoting factors including artificial intelligence (AI), internet of things (IoT), and visual reality (VR).

Furthermore, O'Dea (2019) explained the attributes that can enhance the performance of digital entrepreneurship with a total of five factors: 1) mobile computing, 2) Cloud computing, 3) social media, 4) the Internet of Things (IoT), and 5) big data.

Valacich and Schneider (2018) described the characteristics of digital entrepreneurship that building a business in the future consisted of five important implications corresponding to the future direction and the indicators of modern businesses including 1) mobile computing, 2) Cloud computing, 3) social media,

4) the internet of things (IoT), and 5) big data.

Similarly, OECD (2018) classified seven factors related to digital entrepreneurship which corresponded to the direction of the world's economy: 1) the Internet of Things (IoT), 2) next-generation wireless networks (5G and beyond), 3) the Cloud computing, 4) big data analytics, 5) artificial intelligence (AI), 6) blockchain, and 7) quantum computing.

In addition, Arnasorn (2017) discussed the overview of digital entrepreneurship as the creation of new services and new products by using digital information and technology for decision-making and creating strategies to predict market directions and finance, such as Cloud computing and applications - software. It aimed to reduce business costs and increase production, data safety, and financial potential.

Also, European Commission (2015) defined digital entrepreneurship as those who improve, apply, and develop business operations, business models, as well as modern social contexts by using digital technology to drive economic and social values. It consisted of elements such as particularly social, big data, mobile and Cloud solutions.

From the above 19 relevant research studies, the relationship related to factors affecting the learner development of digital entrepreneurship can be summarized and analyzed as shown in Table 2.8.

Table 2.8 The conclusion of factors related to the learner development of digital entrepreneurship

No.	Year	Authors/Variables	Factors related to the development of digital entrepreneurship
1	2021	Soltanifar and Edin (5)	1) Mobile computing 2) Cloud computing 3) Social media 4) The internet of things (IoT) 5) Big data

Table 2.8 The conclusion of factors related to the learner development of digital entrepreneurship (continued)

No.	Year	Authors/Variables	Factors related to the development of digital entrepreneurship
2	2020	Nulaw (5)	1) Mobile computing 2) Cloud computing 3) Social media 4) The Internet of Things (IoT) 5) Big data
3	2019	OECD (6)	1) Big data and AI 2) Digital platform 3) IoT 4) FinTech 5) Cloud computing 6) Blockchain and LTDs
4	2019	Chen et al. (3)	1) Artificial intelligence (AI) 2) Internet of Things (IoT) 3) Visual reality (VR)
5	2019	Bruno and Canina (3)	1) Artificial intelligence (AI) 2) Internet of Things (IoT) 3) Visual reality (VR)

Table 2.8 The conclusion of factors related to the learner development of digital entrepreneurship (continued)

No.	Year	Authors/Variables	Factors related to the development of digital entrepreneurship
6	2019	O'Dea (5)	1) Mobile computing 2) Cloud computing 3) Social media 4) The Internet of Things (IoT) 5) Big data
7	2018	Valacich and Schneider (5)	1) Mobile computing 2) Cloud computing 3) Social media 4) The Internet of Things (IoT) 5) Big data
8	2018	OECD (7)	1) Internet of Things (IoT) 2) Next-generation wireless networks (5G and beyond) 3) Cloud computing 4) Big data analytics 5) Artificial intelligence (AI) 6) Blockchain 7) Quantum computing
9	2017	Arnason (2)	1) Cloud computing 2) Applications – software

Table 2.8 The conclusion of factors related to the learner development of digital entrepreneurship (continued)

No.	Year	Authors/Variables	Factors related to the development of digital entrepreneurship
10	2015	European Commission (4)	1) Particularly social 2) Big data 3) Mobile phone technology 4) Cloud solutions

2.8.2 Digital Intelligence (DI)

According to the study, it was found that in 2023, the International Society for Technology in Education or ISTE set a model for measuring and evaluating the digital intelligence of future digital citizens as having the ability to use the Internet in management, control, self-regulation, and literacy to be a norm of the appropriate use of technology, having responsibility, learning to wisely and safely utilize technology. Digital citizens have to be aware of the opportunities and risks in the digital world and understand their rights and responsibilities online so that learners can demonstrate their understanding of social, cultural, and human issues related to information technology and behave ethically according to the laws. All of these are essential learning skills in the 21st century for learners to become full-fledged digital citizens (ISTE, 2023).

Digital intelligence is a comprehensive conceptual framework of technical, cognitive, and social thinking grounded in moral values that empower individuals to face digital challenges. Digital intelligence has three levels, eight aspects, and 24 competencies consisting of knowledge, skills, attitudes, and values. This research discussed the eight skills of digital intelligence at the digital citizen level. This is the ability to use digital technology and media in a secure, responsible, and ethical manner as follows:

1) Digital Citizen Identity defined that “Digital citizen identity refers to the an to create and maintain an individual’s good identity both online and in the real world.

A good identity is how digital media users build a positive online self-image in terms of thoughts, feelings, and actions. They have discretion in sending and receiving news and expressing opinions, have empathy for other users on social media, and are responsible for any actions. Digital citizens do not commit illegal and unethical acts online such as copyrights, bullying, or online hate speech".

2) Screen Time Management defined that "Screen time management is the ability to regulate oneself and effectively allocate time to use digital and technological devices, as well as social media and online games with self-responsibility. They are able to manage time using digital devices, as well as control to achieve a balance between the online world and the real world. Also, it is an ability to be aware of the dangers and health of spending too much screen time and the negative effects of digital media addictions".

3) Cyber Bullying Management defined that "Cyberbullying management is the ability to protect oneself, and have immunity for wisely dealing with cyberbullying situations or the use of the Internet as a tool or channel for harassment, seduction, and bullying on the Internet and social media. The target group is usually ranged from children to teenagers. Cyberbullying is similar to other forms of bullying, but it is done through online or via social media such as texting messages via mobile phones. A bully might be a classmate, a well-known person on social media, or a stranger. Mostly, a doer knows the person who is being bullied. The most common form of bullying is gossiping, accusing, threatening, or using hate speeches, online sexual harassment, impersonation, blackmail, scams, or creating social groups to attack a particular person".

4) Cyber Security Management defined that "Cyber security management is the ability to survey, monitor, protect, and secure data in the network. Data is protected by building a strong security system to prevent data breaches or online attacks and having skills to keep personal data safe in the online world. Cyber self-security is to protect digital devices, stored data, and personal data from damage, loss, or data breach from malicious people in the cyber world".

5) Privacy Management defined that "Privacy management is the ability to deal with one's own privacy and that of others, shared online information, digital

sharing, and the management of personal information protection such as sharing information via digital devices and identity theft. People must have the ability to use a device or protect their own information, as well as conceal various information on websites to maintain individual privacy. Online privacy is a right to protect users' personal information and privacy in the online world, as well as discretion to protect the personal and confidential information of others".

6) Critical Thinking defined that "Critical thinking is an ability of a person to determine whether a person should believe, should not believe, should do, or should not do based on rational thinking and an ability to distinguish correct and incorrect information, useful and dangerous information, suspicious and reliable online information when using the Internet. They are aware of useful content and information literacy, are able to analyze and evaluate data from a variety of sources and understand various deceptive patterns in digital media such as fake news, fake websites, photo manipulation, misinformation, etc".

7) Digital Footprints defined that "Digital footprints are an ability to understand the nature of the digital world that will always leave a trace of information. The digital footprint may have an impact on real life. Thus, people should understand the potential consequences so that they can manage their digital life responsibly. Digital footprints such as email registration, posting messages or images, and files of works, when sent to the cyber world, will leave traces of the user's personal information. It allows other people to follow and identify personal information".

And also 8) Digital Empathy defined that "Digital empathy and positive relationship with others are an ability to understand others, respond to the needs of others, express compassion and kindness to others in the digital world appropriately, and have good interactions with those who are around such as parents, teachers, friends both online and in real life, not judge others based on online information only, and be a voice for those in need in the online world".

It can be seen that digital intelligence at a digital citizen level is an important skill for students and general people to communicate in the online world. It includes digital citizen identity, screen time management, cyberbullying management, cyber security management, privacy management, critical thinking, digital footprints, and digital empathy. If an individual has all 8 skills and abilities, that person will have the ability to use the Internet for management, self-regulation, and literacy to be a norm of the appropriate use of technology and learning to wisely and safely utilize technology.

Additionally, it was also found that DQ Institute (2018), a global public-private cooperation with the World Economic Forum (2018) aiming to ensure that the youth in all countries are educated with quality digital citizenship skills, defined digital intelligence as an intelligence analysis that incorporates technology to point out what aspects of life need to be ready in the future. In the basic model, DQ has been divided into 8 groups with 8 important things as follows:

1) Digital identity: an ability to create and utilize an online and offline identity with respect to one's identity

2) Digital use: an ability to use technology in a balanced way and citizenship, which is a respect of time and place

3) Digital safety: an ability to understand and manage various digital risks by using technology responsibly and ethically

4) Digital security: an ability to recognize, avoid, and deal with various digital threats to protect information, devices, and systems

5) Digital emotional intelligence: an ability to recognize, understand, and emotionally express through interaction on digital channels

6) Digital communication: an ability to communicate with others using technology

7) Digital literacy: an ability to search, read, analyze, distinguish, create, apply, and exchange information, media, and technology

8) Digital rights: an ability to understand and promote human rights as well as technology laws

2.8.3 A Conclusion of the Relationship between Digital Entrepreneurship and Digital Intelligence

From the relevant research mentioned in sections 2.8.1 and 2.8.2, the researcher found the relationship between digital entrepreneurial and digital intelligence, both independent and dependent variables, which will be presented as factors used in this recent research study. It was revealed that variables presented in the experiment outnumbered those of all studies from 2015 to 2021. Factors related to the development of this research can be summarized in Table 2.9.

Table 2.9 The relationship between digital entrepreneurial and digital intelligence

No.	Independent Variables and Characteristics of digital entrepreneurship (learning topics)	Dependent variables of digital intelligence (measurement and evaluation)	Remark
1	Cloud computing	Digital identity	
2	Artificial intelligence (AI)	Digital use	
3	Internet of Things (IoT)	Digital safety	
4	Visual reality (VR)	Digital security	
5	Big data	Digital emotional intelligence	
6	Blockchain	Digital communication	
7	FinTech	Digital literacy	
8	Social media	Digital rights	

According to Table 2.9, it can be summarized and explained that factors and topics related to the development of digital entrepreneurship of learners, or independent variables, comprise eight factors: 1) Cloud computing, 2) artificial intelligence (AI), 3) internet of things (IoT), 4) visual reality (VR), 5) big data, 6) blockchain, 7) FinTech, and 8) social media.

Moreover, the dependent variables which can measure the learner development of digital intelligence include eight characteristics: 1) digital identity, 2) digital use, 3) digital safety, 4) digital security, 5) digital emotional intelligence, 6) digital communication, 7) digital literacy, and 8) digital rights.

2.9 A Conclusion of the Digital Entrepreneurial Intelligence Model (DEI Model)

According to the study of relevant principles and theories, the researcher can summarize factors expected to affect the learner development of digital entrepreneurial intelligence (DEI), which were used in the experiment in this recent research, by comparing independent variables and dependent variables with the learning theory of Whole Brain Literacy (WBL), as illustrated in Table 2.10.

Table 2.10 A conclusion of variables and factors presented in the experiment and the learner development of digital entrepreneurial intelligence (DEI) based on the principles and theory of Whole Brain Literacy (WBL)

Types of variables	**Names of factors used in the experiment**	**The characteristics of factors**	**The principle of Whole Brain Literacy (WBL)**			
Independent variables (x)			I-C	I-PU	I-E	I-PR
Digital Entrepreneurship (x1) 8 variables	Cloud computing	-				✓
	Artificial intelligence (AI)	-				✓
	Internet of Things (IoT)	-			✓	
	Creative Social Media	-			✓	
	Big data	-	✓			
	Blockchain	-		✓		
	FinTech	-	✓			
	Digital Business Laws	-		✓		

Table 2.10 A conclusion of variables and factors presented in the experiment and the learner development of digital entrepreneurial intelligence (DEI) based on the principles and theory of Whole Brain Literacy (WBL) (continued)

Types of variables	**Names of factors used in the experiment**	**The characteristics of factors**	**The principle of Whole Brain Literacy (WBL)**			
Independent variables (x)			I-PU	I-E	I-PR	I-C
Entrepreneurship (x2) 4 variables	Business idea and operation	Type of business Business survey Business comparison			✓	
	Marketing Plan	Social media marketing Youtube, Facebook TikTok, Instagram (IG) Business logo designing 3D designing				✓
	Financial plan	Business plan Business Budget Financial plan Business law	✓			
	Business project	Project base learning Start business project Business production		✓		

Table 2.10 A conclusion of variables and factors presented in the experiment and the learner development of digital entrepreneurial intelligence (DEI) based on the principles and theory of Whole Brain Literacy (WBL) (continued)

Types of variables	Names of factors used in the experiment	The characteristics of factors	The principle of Whole Brain Literacy (WBL)			
			I-C	I-PU	I-E	I-PR
Dependent variables (y)						
Digital Intelligence (y1) 8 variables	Digital identity	-			✓	
	Digital use	-			✓	
	Digital safety	-		✓		
	Digital security	-		✓		
	Digital emotional intelligence	-				✓
	Digital communication	-				✓
	Digital literacy	-		✓		
	Digital rights	-		✓		
Entrepreneurial Intelligence (y2) 16 variables 64 sub-variables	Leadership	Integrity	✓			
		Decision-making	✓			
		Resolute	✓			
		Encourage	✓			
	Planning skill	Goal-oriented	✓			
		Flexibility	✓			
		Efficiency	✓			
		Forecasting	✓			
	Proactive skill	Perseverance	✓			
		Inspire others	✓			
		Collaborative	✓			
		Strategic thinking	✓			

Table 2.10 A conclusion of variables and factors presented in the experiment and the learner development of digital entrepreneurial intelligence (DEI) based on the principles and theory of Whole Brain Literacy (WBL) (continued)

Types of variables	**Names of factors used in the experiment**	**The characteristics of factors**	**The principle of Whole Brain Literacy (WBL)**			
			I-C	I-PU	I-E	I-PR
Entrepreneurial Intelligence (y2) 16 variables 64 sub-variables	Analytical thinking	Reasonable	✓			
		Systematic	✓			
		Data analyzing	✓			
		Concentrate	✓			
	Self-behavioral regulation	Focus on task		✓		
		Patience		✓		
		Consistency		✓		
		Persistence		✓		
	Risk-reduction	Financial skill		✓		
		Business idea		✓		
		Marketing knowledge		✓		
		Work under pressure		✓		
	Punctuality	Preparative		✓		
		Scheduling		✓		
		Deadlines		✓		
		Time management		✓		
	Organizational skill	Concision		✓		
		Policy enforcement		✓		
		Prioritizing		✓		
		Workflow analysis		✓		

Table 2.10 A conclusion of variables and factors presented in the experiment and the learner development of digital entrepreneurial intelligence (DEI) based on the principles and theory of Whole Brain Literacy (WBL) (continued)

Types of variables	**Names of factors used in the experiment**	**The characteristics of factors**	**The principle of Whole Brain Literacy (WBL)**			
			I-C	I-PU	I-E	I-PR
Entrepreneurial Intelligence (y2) 16 variables 64 sub-variables	Creativity	Positive attitude			✓	
		Passionate			✓	
		Curiosity			✓	
		Self-motivation			✓	
	Innovativeness	Think out of the box			✓	
		Adaptation			✓	
		Opportunity focused			✓	
		Experimental			✓	
	Visionary	Open-minded			✓	
		Synthesis			✓	
		Analytic			✓	
		Seeking for the future			✓	
	Risk-taking	Self-confidence			✓	
		Embrace failure			✓	
		Believe possibility			✓	
		Fearless			✓	
	Interpersonal	Active listening				✓
		Conflict management				✓
		Sense of humor				✓
		Respectfulness				✓
	Emotional regulation	Humility				✓
		Empathy				✓
		Courteous				✓
		Kindness				✓

Table 2.10 A conclusion of variables and factors presented in the experiment and the learner development of digital entrepreneurial intelligence (DEI) based on the principles and theory of Whole Brain Literacy (WBL) (continued)

Types of variables	Names of factors used in the experiment	The characteristics of factors	The principle of Whole Brain Literacy (WBL)			
			I-C	I-PU	I-E	I-PR
Entrepreneurial Intelligence (y2) 16 variables 64 sub-variables	Communicational skill	Negotiation				✓
		Persuasion				✓
		Influence others				✓
		Cleared goal				✓
	Team Building	Sincerity				✓
		Common goal				✓
		Provided feedback				✓
		Defined role				✓

From Table 2.10, it can be summarized and described the factors used in the experiment are divided into dependent variables, which consist of two variables and 12 sub-variables, as well as independent variables, which consist of two variables and 72 sub-variables. The details were as follows.

Group 1: Dependent variables: two variables and 12 sub-variables with details below

1) Digital entrepreneurship includes eight variables: Cloud computing, artificial intelligence (AI), internet of things (IoT), visual reality (VR), big data, blockchain, FinTech, and social media.

2) Entrepreneurship consists of four variables including business idea and operation, marketing plan, financial plan, and business project.

Group 2: Independent variables: two variables and 72 sub-variables with details below

1) Digital intelligence consists of eight variables: digital identity, digital use,

digital safety, digital security, digital emotional intelligence, digital communication, digital literacy, and digital rights.

2) Entrepreneurship intelligence consists of 16 variables and 64 sub-variables as follows:

2.1 Leadership: integrity, decision-making, resolute, encourage

2.2 Planning skill: goal-oriented, flexible, efficient, forecasting

2.3 Proactive skill: perseverance, inspiring others, collaborative, strategic thinking

2.4 Analytical thinking: reasonable, systematic, data analyzing, concentrate

2.5 Self-behavioral regulation: focus on a task, patience, consistency, persistence

2.6 Risk-reduction: financial skill, business idea, marketing knowledge, work under pressure

2.7 Punctuality: preparative, scheduling, deadlines, time management

2.8 Organizational skill: concision, policy enforcement, prioritizing, workflow analysis

2.9 creativity: positive attitude, passionate, curiosity, self-motivation

2.10 Innovativeness: think out of the box, adaptation, opportunity focused, experimental

2.11 Visionary: open-minded, synthesis, analytic, seeking the future

2.12 Risk-taking: self-confidence, embracing failure, believe possibility, fearless

2.13 Interpersonal: active listening, conflict management, sense of humor, respectfulness

2.14 Emotional regulation: humility, empathy, courteous, kindness

2.15 Communication skill: negotiation, persuasion, influencing others, clearing the goal

2.16 Team building: sincerity, common goal, provided feedback, defined role.

CHAPTER 3

RESEARCH METHODOLOGY

In this research study, the primary objective was to explore the factors that positively influence the development of digital entrepreneurial intelligence (DEI) among secondary students, based on the theories and principles related to Whole Brain Literacy (WBL). Once these influential factors were identified, the researcher designed a learning model. To ensure the research achieved its intended objective, a research methodology had been established, consisting of seven key details and steps.

1) Research Design
2) Population and Sample
3) Research Variables
4) Research Hypotheses
5) Research Instruments
6) Data Collection Procedure
7) Chapter Summary

3.1 Research Design

In this study, a Mixed-Methods Research (MMR) was employed involving a group of secondary students from Montfort College Secondary Section, Chiang Mai. The experiment took place within the Montfort Junior Entrepreneurial Track (M-JET) Project. This initiative was also integrated with the Business Studies course with the course code OC30204, as well as Home Economics with the course code OC32102 (an additional elective subject according to the 2018 core curriculum), throughout the academic year 2021-2023. The research design was divided into three distinct scopes: 1) survey research, 2) correlational research, and 3) experimental research. The research design framework, depicting these three scopes of the research experiment, is illustrated in Figure 3.1

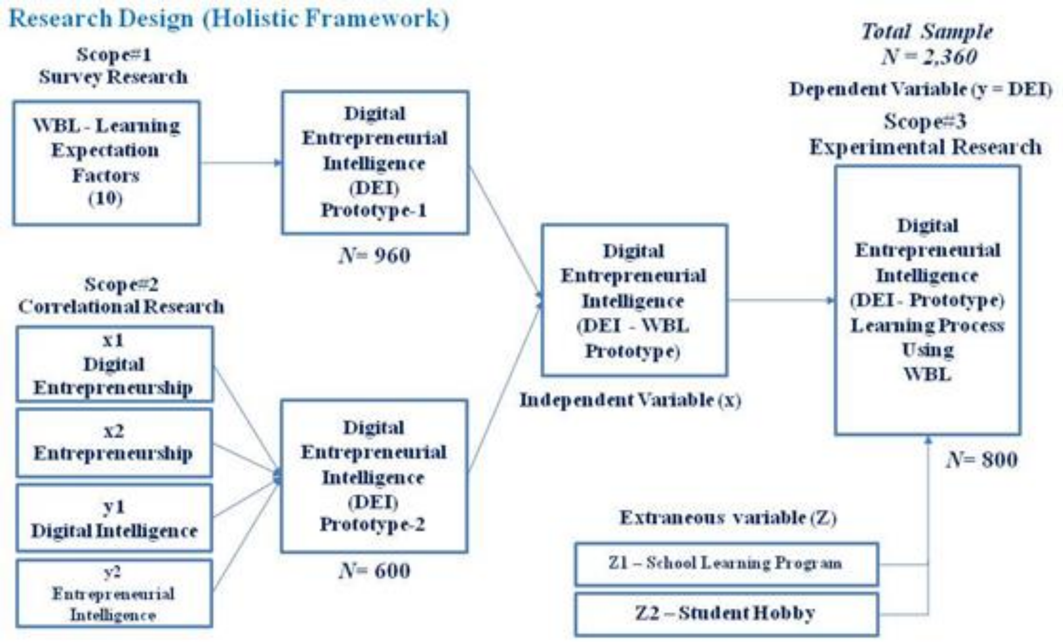


Figure 3.1 Research Design Framework

From Figure 3.1, the research design framework of this study can be outlined as follows: In Step 1, or Scope 1, the researcher analyzed the relationship between the needs and expectations of a sample population regarding on the learning management model for entrepreneurship. The sample comprised a total of 960 individuals, including 300 secondary students, 300 alumni, 300 parents, and 10 national and global entrepreneurs. A four-choice questionnaire based on WBL principles, containing 10 factors potentially impacting DEI, was utilized. The aim was to construct a DEI Prototype-1 aligned with WBL principles for developing DEI among secondary students.

Moving to Step 2, or Scope 2, the researcher examined the correlation of two independent variables: digital entrepreneurial intelligence and entrepreneurship, expected to influence the dependent variables—digital intelligence and entrepreneurial intelligence. A four-choice questionnaire was employed to collect data, and the analysis followed the principles of correlational research to study the relationship between independent and dependent variables among a sample population of 600 secondary school students. The objective was to construct a DEI Prototype-2 consistent with WBL principles for developing DEI among secondary students.

Finally, in Step 3, or Scope 3, the DEI Prototype-1 and DEI Prototype-2 were utilized to design the DEI – WBL Prototype, aimed at creating a prototype learning management or the DEI development. This prototype was then implemented in an experimental research experiment involving a sample population of secondary students, divided into a control group of 400 individuals and an experimental group of 400 individuals. Data collection involved administering a four-choice questionnaire before and after the experiment to identify statistical significance between the independent and dependent variables influencing DEI. Furthermore, the results were analyzed according to the principles of WBL, specifically the 4 Human Brain Functions, to understand how the designed DEI - WBL Prototype impacted the brain function of the sample population.

The various steps designed within the research design Framework can be explained as follows.

1) Scope 1: Survey Research (DEI Prototype-1)

In the first scope, the researcher designed a survey research approach to analyze quatitative data obtained from questionnaires involving alumni, parents, teachers, and co-administrators in Montfort College Secondary Section, Chiang Mai. Additionally, insights were gathered through Whole Brain Literacy (WBL) analysis from accomplished national and global businesspeople and entrepreneurs. The objective was to collect statistical data and detailed descriptive information regarding various factors, variables, and expectations which might have effects and relationships with the independent variables—digital entrepreneurship and entrepreneurship—and the dependent variables—digital intelligence (DI) and entrepreneurial intelligence (EI). The ultimate goal was to create and design DEI Prototype-1, a framework for organizing teaching and learning styles and enhancing the development of digital entrepreneurial intelligence (DEI) among secondary students. This scope is illustrated in Figure 3.2 as follows.

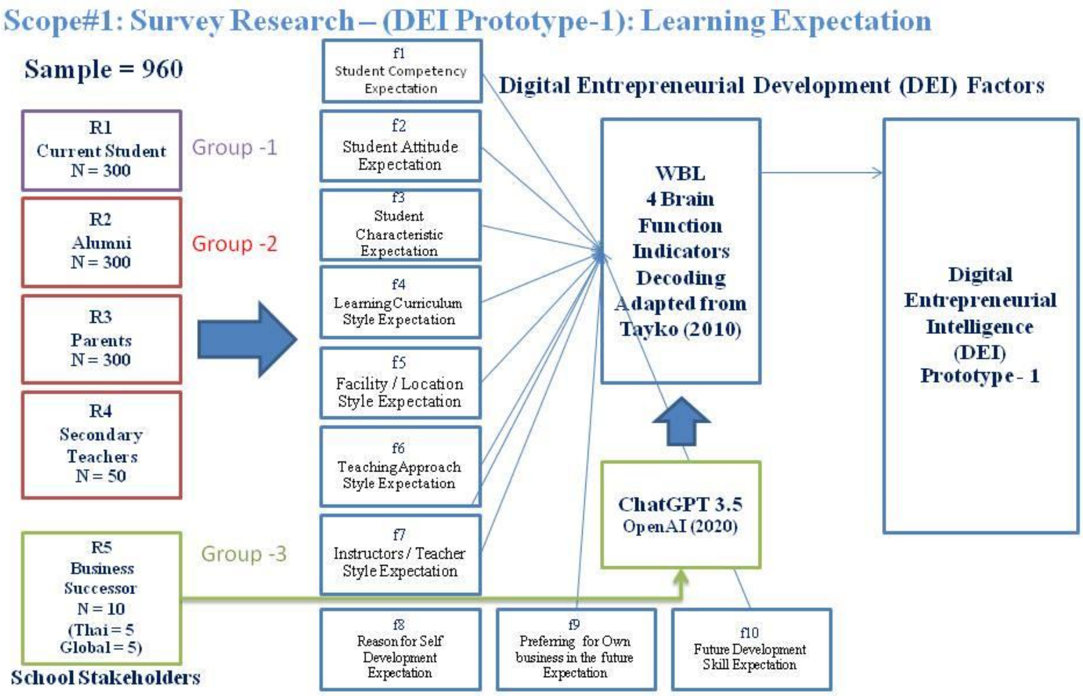


Figure 3.2 Research Scope – 1: Survey Research

2) Scope 2: Correlational Research (DEI Prototype-2)

In the second scope, the research was designed as a correlational study to analyze quantitative data obtained from questionnaires involving a sample group of secondary students at Montfort College Secondary Section, Chiang Mai. The objective was to identify relationships between the independent variables (digital entrepreneurship and entrepreneurship) and the dependent variables (digital intelligence (DI) and entrepreneurial intelligence (EI)) to explore whether any factors exhibited a symmetrical or asymmetrical relationship. Furthermore, the research involved collecting data on extraneous factors to analyze how various daily activities in students' lives, as well as their choice of study programs, may impact the dependent variables. The researcher sought to interpret the results through both explanatory design and prediction design, with the ultimate goal of creating DEI Prototype-2. This prototype aimed to elucidate and predict the relationships among factors contributing to the development of digital entrepreneurial intelligence (DEI) among secondary students. This scope is illustrated in Figure 3.3.

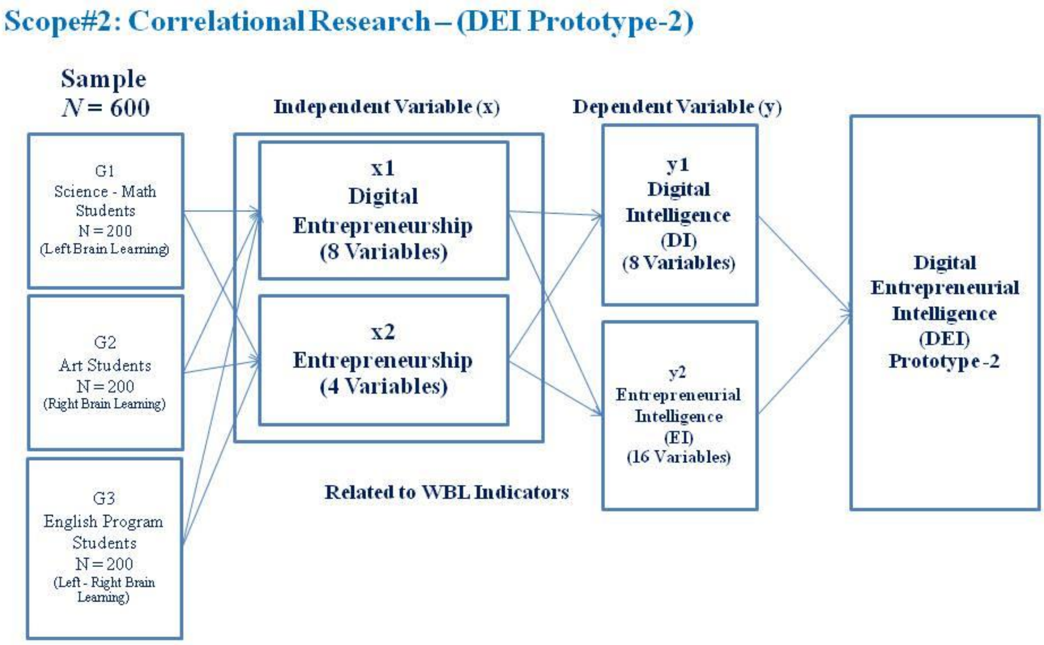


Figure 3.3 Research Scope – 2: Correlational Research

3) Scope 3: Experimental Research (DEI-WBL Prototype)

In the third scope, the researcher focused on conducting experimental research in the form of true experimental research design to analyze both quantitative data and qualitative data obtained from DEI Prototype-1 (survey research) and DEI Prototype-2 (correlational research) in scopes 1 and 2. The aim was to develop a learning process model and the digital entrepreneurial intelligence (DEI) development prototype based on WBL's principles. The resulting DEI-Prototype was then tested with a sample group of secondary students from Montfort College Secondary Section, Chiang Mai and the secondary students from government school. The experiment was designed with both a control group and an experimental group, measuring results before and after the experiment. The objective was to identify the relationships between the independent variables (digital entrepreneurship and entrepreneurship) and the dependent variables (digital intelligence (DI) and entrepreneurial intelligence (EI)) to explore whether any factors were significant to the DEI- WBL Prototype. This scope is illustrated in Figure 3.4.

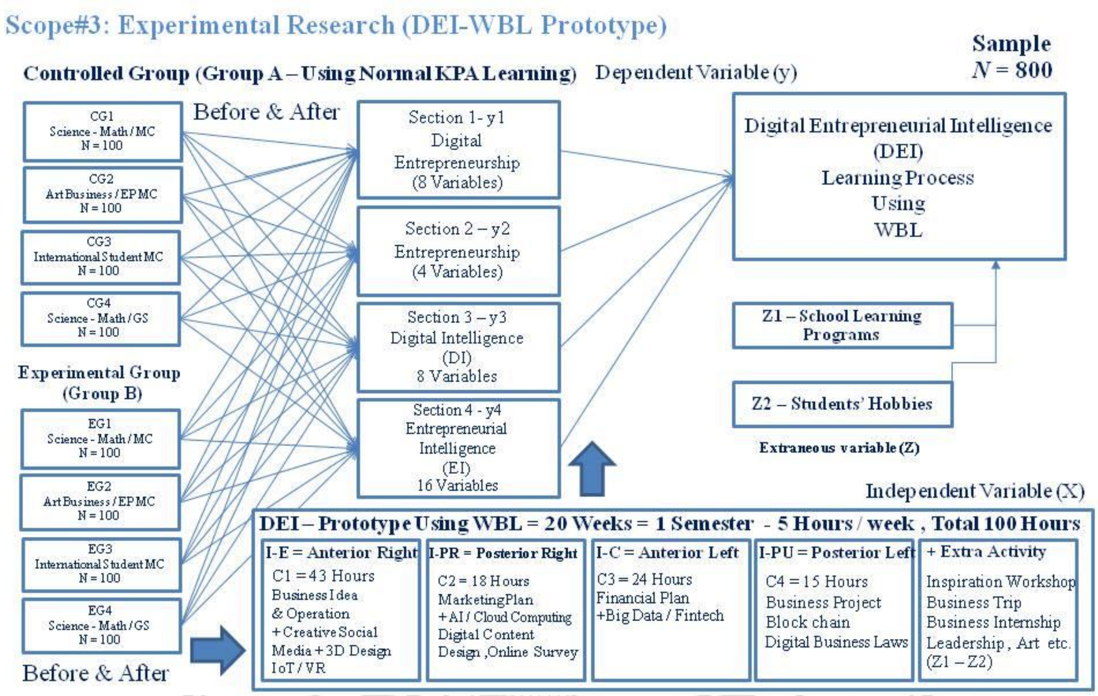


Figure 3.4 Research Scope – 3: Experimental Research (DEI-WBL Prototype)

3.2 Population and Sample

3.2.1 Population

The population for this research comprised secondary students at Montfort College Secondary Section, Chiang Mai, for the academic year 2020. The population was divided into 1,737 male students and 1,459 female students, totaling 3,196 students. Montfort College is a private institution affiliated with the St. Gabriel Foundation of Thailand (a Catholic school) and is part of the Office of the Private Education Commission (OPEC).

3.2.2 Sample

The sample group for this study and experiment was categorized according to the three scopes of the research design framework:

1) Scope 1 - Survey Research: In Scope 1, quatitative data were collected from three groups of stakeholders in the management of Montfort College Secondary Section, Chiang Mai, selected by purposive selection or random assignment including 1) a group of 300 current students, 2) a group of 300 alumni working as businesspeople or entrepreneurs, 3) a group of 300 parents working as businesspeople or entrepreneurs, and 4) a group of 50 teachers related to business, accounting, computers, technology, and home economics, as well as school service participants. Additionally, the personalities of five successful leading businesspeople in Thailand and globally, totaling ten people, were analyzed. The total sample size for Scope 1 was 960.

2) Scope 2 - Correlational Research: In Scope 2, quantitative data were collected from secondary students at Montfort College Secondary Section, Chiang Mai, for the academic year 2021 from three classrooms: 1) 200 students studying Sciences-Mathematics Program (Thai language curriculum) with 80 percent of the subjects focusing on teaching methods that engage students' left-brain functions, emphasizing logic and reasoning based on WBL principles, 2) 200 students studying Language Arts Program (Thai language curriculum) with 80 percent of the subjects focusing on teaching methods that emphasize right-brain functions in language, society, and aesthetics, according to WBL principles, and 3) 200 students from English Program (English language curriculum) with 95 percent of the subjects being taught in English. The total sample size was 600 students selected by purposive selection or random assignment to investigate whether different study programs have an impact on the development of students' digital entrepreneurial intelligence.

3) Scope 3 - Experimental Research: In Scope 3, both quantitative and qualitative data were collected before and after the experiment. The sample group consisted of secondary students at Montfort College, Chiang Mai, for the academic year 2021, selecting by using purposive selection or random assignment. The sample was divided into two groups as follows:

3.2.2.1 Control group with a total number of 400 people

1) Control Group CG1 consisted of 100 students studying the Sciences-Mathematics Program (English language curriculum), utilizing a teaching and learning model based on the principles of Bloom's Taxonomy (3 Learning Domains - KPA).

2) Control Group CG2 comprised 100 students studying Language Arts-Business Program (English language curriculum), employing a teaching and learning model based on the principles of Bloom's Taxonomy (3 Learning Domains - KPA).

3) Control Group CG3 included 100 students studying an International school Program (English language curriculum), adopting a teaching and learning model based on the principles of Bloom’s Taxonomy (3 Learning Domains - KPA). However, this group emphasized teaching styles and activities comparable to the curriculum of international high schools taught in Thailand.

4) Control Group CG4 consisted of 100 students studying Sciences-Mathematics Program (Government school), employing a teaching and learning model based on the principles of Bloom’s Taxonomy (3 Learning Domains - KPA) (these students were under the government School in Chaing Rai Province).

3.2.2.2 Experimental group with a total number of 400 people

1) Experimental Group EG1 consisted of 100 students studying the Sciences-Mathematics Program (English language curriculum), using a teaching and learning model based on WBL 4 human brain functions.

2) Experimental Group EG2 included 100 students studying the Arts – Business Program (English language curriculum), using a teaching and learning model based on the principles of WBL 4 human brain functions.

3) Experimental Group EG3 consisted of 100 students studying in the International school Program (English language curriculum), using a teaching and learning model based on the principles of WBL 4 human brain functions. However, this group emphasized teaching styles and activities comparable to the curriculum of international high schools taught in Thailand.

4) Experimental Group EG4 comprised 100 students studying Sciences-Mathematics Program (Government school), employing a teaching and learning model based on the principles of WBL 4 human brain functions (these students were under the government School in Chaing Rai Province).

Therefore, it can be concluded that the sample group used in all three scopes of this experiment consisted of 960 people in Scope 1, 600 people in Scope 2, and 800 people in Scope 3. The total number of samples used in this experimental study was 2,360 people, representing 72.61 percent of the total population of 3,250 people, who were secondary students at Montfort College Secondary Section, Chiang Mai.

The number of samples used in this experiment, Adam (2021) was applied the Yamane's technique, and described as follows: the total population was 3,250 people. To achieve a random sample with a 4 percent margin of error and a 96 percent confidence level, a sample size of not less than 517 people was required. Yamane's method for calculating the number of samples was as follows:

$$n = \frac{N}{1 + Ne^2} \qquad (3.1)$$

Where;

n = sample size

N = total population (3,196 people)

e = error value used in the research (4% = 0.04)

The calculation method can be expressed as follows;

$$n = \frac{3{,}196}{1 + (3{,}196)(0.04)^2} \qquad (3.2)$$

Consequently, n equals 522.76 or approximately 523 people.

Hence, it can be concluded that the number of sample groups employed in scopes 1, 2, and 3, comprised a sample size of not less than 523 people (with a 4 percent margin of error and a 96 percent confidence level). This aligned with Yamane's principle for determining the number of experimental and research samples.

Also the research statistics are used to analyze the data in this study are as follows

2) Pearson's Correlation Coefficient (r)

Turney (2023), defined that "the Pearson correlation coefficient represents the relationship between the two variables, measured on the same interval or ratio scale. It measures the strength of the relationship between the two continuous variables are as follows".

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

Where;

r	=	Pearson Coefficient
n	=	number of pairs of the stock
$\sum xy$	=	sum of products of the paired stocks
$\sum x$	=	sum of the x scores
$\sum y$	=	sum of the y scores
$\sum x^2$	=	sum of the squared x scores
$\sum y^2$	=	sum of the squared y scores

3) Multiple Regression Analysis (MRA)

Darlington & Hayes (2016), concluded that " Multiple linear regression (MLR), also known simply as multiple regression, is a statistical technique that uses several explanatory variables to predict the outcome of a response variable. The goal of multiple linear regression is to model the linear relationship between the explanatory (independent) variables and response (dependent) variables. In essence, multiple regression is the extension of ordinary least-squares (OLS) regression because it involves more than one explanatory variable". The multiple linear regression equation is as follows:

$$y_i=\beta_0+\beta_1 x_{i1}+\beta_2 x_{i2}+...+\beta_p x_{ip}+\epsilon$$

where, for i = n observations:

y_i	=	dependent variable
x_i	=	explanatory variables
β_0	=	y-intercept (constant term)
β_p	=	slope coefficients for each explanatory variable
ϵ	=	the model's error term (also known as the residuals)

4) One – Way ANOVA (F-Test)

Gajendrakar (2024), summarized that " One-Way ANOVA is a statistical method used to compare the mean value of samples to check whether they are significantly different. Also, the method uses only one independent variable. The calculation method involves the comparison of means from independent groups using F-distribution. In other words, it is the comparison between the group variance and within the group variance", the one-way ANOVA formula are as follows: F-statistics or F-ratio:

$$F = MSB/MSW$$

Where;

F = coefficient of ANOVA

MSB = mean sum of squares between the groups

MSW = mean sum of squares within groups

5) Multiple Comparisons (LSD Test)

Moore et al. (2023), explained that " The Least Significant Difference (LSD) test is derived from the t-test we studied earlier. Specifically, it uses the t-test for differences between means to determine the minimum difference necessary for those two means to be significantly different". The numerator in the original equation for the t-value is replaced by the LSD:

$$LSD_{A,B} = t_{0.05/2.DFW}\sqrt{MSW(1/n_A + 1/n_B)}$$

Where;

t = critical value from the t-distribution table

MSw = mean square within, obtained from the results of your ANOVA test

n = number of scores used to calculate the means.

3.3 Research Variables

In this research study, the researcher identified research variables based on the theory and principles of Whole Brain Literacy (WBL). These variables can be described as follows:

3.3.1 Independent Variables (x)

The experiment incorporated two independent variables: digital entrepreneurship and entrepreneurship, illustrated in Table 3.1.

Table 3.1 The independent variables in this experiment

Types of Variables	**Name of the Factors Used in the Experiment**	**Specific Features of Factors**	**The Principles of Whole Brain Literacy (WBL)**			
Independent variables (x)			I-C	I-PU	I-E	I-PR
Digital entrepreneurship (x1) 8 variables	x101 = Big data		✓			
	x102 = FinTech		✓			
	x103 = Blockchain	-		✓		
	x104 = Digital business laws	-		✓		
	x105 = Internet of Things (IoT)	-			✓	
	x106 = Creative social media	-			✓	
	x107 = Artificial intelligence (AI)	-				✓
	x108 = Cloud computing	-				✓
Entrepreneurship (x2) 4 variables	x201 = Business idea and operation	Type of business Business survey Business comparison Design thinking			✓	

Table 3.1 The independent variables in this experiment (continued)

Types of Variables	Name of the Factors Used in the Experiment	Specific Features of Factors	The Principles of Whole Brain Literacy (WBL)			
Independent variables (x)			I-C	I-PU	I-E	I-PR
	x202 = Marketing plan	Social media marketing YouTube, Facebook TikTok, Instagram (IG) Business logo Designing 3D designing				✓
	x203 = Financial plan	Business plan Business Budget Financial plan Business law	✓			

Table 3.1 The independent variables in this experiment (continued)

Types of Variables	**Name of the Factors Used in the Experiment**	**Specific Features of Factors**	**The Principles of Whole Brain Literacy (WBL)**			
Independent variables (x)			I-C	I-PU	I-E	I-PR
	x204 = Business project	Project-based learning Business project Business production Storytelling Branding Networking Automation		✓		

3.3.2 Dependent Variables (y)

The experiment incorporated two dependent variables: digital intelligence and entrepreneurial intelligence, illustrated in Table 3.2.

Table 3.2 The dependent variables in this experiment

Types of Variables	**Name of the Factors Used in the Experiment**	**Specific Features of the Factors**	**The Principles of Whole Brain Literacy (WBL)**			
Dependent variables (y)			I-C	I-PU	I-E	I-PR
Digital Intelligence (y1) 8 variables	y101 = Digital identity	-			✓	
	y102 = Digital use	-			✓	
	y103 = Digital safety	-		✓		
	y104 = Digital Security	-		✓		
	y105 = Digital emotional intelligence	-				✓
	y106 = Digital communication	-				✓

Table 3.2 The dependent variables in this experiment (continued)

Types of Variables	**Name of the Factors Used in the Experiment**	**Specific Features of the Factors**	**The Principles of Whole Brain Literacy (WBL)**			
	Dependent variables (y)		I-C	I-PU	I-E	I-PR
	y107 = Digital literacy	-	✓			
	y108 = Digital rights	-	✓			
Entrepreneurial intelligence (y2) 16 main variables 64 sub-variables	y2001 = Leadership	Integrity	✓			
		Decision-making	✓			
		Resolute	✓			
		Encourage	✓			
	y2002 = Planning skill	Goal-oriented	✓			
		Flexibility	✓			
		Efficiency	✓			
		Forecasting	✓			
Entrepreneurial intelligence (y2) 16 main variables 64 sub-variables	y2003 =Proactive skill	Perseverance	✓			
		Inspire others	✓			
		Collaborative	✓			
		Strategic thinking	✓			
	y2004 =Analytical thinking	Reasonable	✓			
		Systematic	✓			
		Data analyzing	✓			
		Concentrate	✓			

Table 3.2 The dependent variables in this experiment (continued)

Types of Variables	Name of the Factors Used in the Experiment	Specific Features of the Factors	The Principles of Whole Brain Literacy (WBL)			
Dependent variables (y)			I-C	I-PU	I-E	I-PR
Entrepreneurial intelligence (y2) 16 main variables 64 sub-variables	y2005 = Self-behavioral regulation	Focus on task		✓		
		Patience		✓		
		Consistency		✓		
		Persistence		✓		
	y2006 = Risk-reduction	Financial skill		✓		
		Business idea		✓		
		Marketing knowledge		✓		
		Work under pressure		✓		
	y2007 = Punctuality	Preparative		✓		
		Scheduling		✓		
		Deadlines		✓		
		Time management		✓		
Entrepreneurial intelligence (y2) 16 main variables 64 sub-variables	y2008 = Organizational skill	Concision		✓		
		Policy enforcement		✓		
		Prioritizing		✓		
		Workflow analysis		✓		

Table 3.2 The dependent variables in this experiment (continued)

Types of Variables	**Name of the Factors Used in the Experiment**	**Specific Features of the Factors**	**The Principles of Whole Brain Literacy (WBL)**			
	Dependent variables (y)		I-C	I-PU	I-E	I-PR
	y2009 = Creativity	Positive attitude			✓	
		Passionate			✓	
		Curiosity			✓	
		Self-motivation			✓	
	y2010 = Innovativeness	Think out of the box			✓	
		Adaptation			✓	
		Opportunity focused			✓	
		Experimental			✓	
	y2011 = Visionary	Open-minded			✓	
		Synthesis			✓	
		Analytic			✓	
		Seeking for the future			✓	

Table 3.2 The dependent variables in this experiment (continued)

Types of Variables	**Name of the Factors Used in the Experiment**	**Specific Features of the Factors**	**The Principles of Whole Brain Literacy (WBL)**			
	Dependent variables (y)		I-C	I-PU	I-E	I-PR
Entrepreneurial intelligence (y2) 16 main variables 64 sub-variables	y2012 = Risk-taking	Self-confidence			✓	
		Embrace failure			✓	
		Believe possibility			✓	
		Fearless			✓	
	y2013 = Interpersonal	Active listening				✓
		Conflict management				✓
		Sense of humor				✓
		Respectfulness				✓
	y2014 = Emotional regulation	Humility				✓
		Empathy				✓
		Courteous				✓
		Kindness				✓
	y2015 = Communicational skill	Negotiate				✓
		Persuasion				✓
		Influence others				✓
		Cleared goal				✓

Table 3.2 The dependent variables in this experiment (continued)

Types of Variables	Name of the Factors Used in the Experiment	Specific Features of the Factors	The Principles of Whole Brain Literacy (WBL)			
Dependent variables (y)			I-C	I-PU	I-E	I-PR
	y2016 = Team building	Sincerity				✓
		Common goal				✓
		Provided feedback				✓
		Defined role				✓

3.3.3 Controlled Variables

The controlled variables in this experiment included 1) a student sample consisting of students currently enrolled at the secondary school level, 2) an alumni sample who had graduated from Montfort College Secondary Section, 3) a parental sample comprising parents of students currently enrolled at Montfort College Secondary Section, and 4) teacher sample enlisting regular teachers appointed to instruct students at Montfort College Secondary Section. All of the sample groups were those with active involvement, interest, or stakeholder status at Montfort College Secondary Section, Chiang Mai, throughout the academic years 2021-2023.

3.3.4 Extraneous Variables (z)

Extraneous variables in this research might impact the dependent variable, digital entrepreneurial intelligence (DEI). Moreover, these factors were not the primary focus of the researcher’s study and included 1) selection of school learning programs at the secondary school level. and 2) student’s hobbies as well as post-school activities.

3.4 Research Hypotheses

Based on the research design framework (significance level at 0.05 margin of error – P<0.05), six hypotheses were raised in this study:

H1: *The school learning programs have a significant impact on the Digital Entrepreneurial Intelligence (DEI) of secondary students in Montfort College Secondary School.*

H2: *Students' hobbies have a significant impact on the Digital Entrepreneurial Intelligence (DEI) of secondary students in Montfort College Secondary School.*

H3: *Thailand's Basic Education Core Curriculum using Bloom's Taxonomy has significant impact on the Digital Entrepreneurial Intelligence (DEI) of secondary students in Montfort College Secondary School.*

H4: *International School Program Curriculum using Bloom's Taxonomy has a significant impact on the Digital Entrepreneurial Intelligence (DEI) of secondary students in Montfort College Secondary School.*

H5: *Whole Brain Literacy (WBL) has a significant impact on the Digital Entrepreneurial Intelligence (DEI) of secondary students in Montfort College Secondary School.*

H6: *The Digital Entrepreneurial Intelligence (DEI) Prototype using Whole Brain Literacy (WBL) has a significant impact on the Digital Entrepreneurial Intelligence (DEI) of secondary students in Montfort College Secondary School.*

3.5 Research Instruments

In this research, the researcher planned and outlined the process for collecting various instruments used in the research. This process can be summarized as follows:

3.5.1 Scope 1: Survey Research (DEI Prototype-1)

The instrument and data collection within Scope 1, survey research (DEI Prototype-1), involved the gathering of quatitative data. This was aimed at understanding the factors and expectations influencing the development of Digital Entrepreneurial Intelligence (DEI) among secondary students. In this scope, data were collected in three parts:

Part 1.1: Information from 300 secondary students at Montfort College Secondary Section: A questionnaire was utilized to gather data on the needs and expectations regarding teaching and learning styles, as well as the development of students' entrepreneurial skills. The goal was to comprehend the relationship between various factors, aligning with the principles of WBL Human Brain Functions (Tayko, 2015). The questionnaire comprised two sets of questions:

Section 1) General information of respondents, including gender, education level, study programs, parents' occupations, etc.

Section 2) Information about needs and expectations regarding teaching and learning styles and entrepreneurial skills across 10 aspects. These aspects included 1) competency expectations, 2) attitude expectations, 3) personality expectations, 4) curriculum organization expectations, 5) learning location expectations, 6) learning style expectations, 7) expectations regarding lecturers, 8) expectations for the development of entrepreneurial skills, 9) future business expectations, and 10) expectations for the development of future skills. The questionnaire design involved categorizing responses into four options, with each option aligning with the four aspects of human brain functioning in WBL, as illustrated in Table 3.3.

Table 3.3 The interpretation of questionnaire options according to WBL principles

Questionnaire options	Brain Function Position	WBL	Brain Function
A	Anterior left brain lobe	I-Control / I-C	The development of analytical and logical thinking
B	Posterior left brain lobe	I-Pursue / I-PU	The development of movement and self-control
C	Anterior right brain lobe	I-Explore / I-E	The development of creativity and imagination
D	Posterior right brain lobe	I-Preserve / I-PR	The development of emotional and social dimensions

The instrument used for data collection in Part 1.1 was analyzed for content validity or the Index of Item Objective Congruence (IOC - Rovinelli & Hambleton's technique) by five experts with an expertise in the development of WBL skills (a minimum of 5 years of experience in teaching and learning management). The results revealed that the questionnaire attained an IOC value of 0.84, indicating a validity value of 84 percent. This aligned with the acceptance criteria outlined by Rowinelli and Hambleton's technique.

Subsequently, the instrument underwent testing with a pilot test group comprising 50 secondary students to assess its reliability using the Cronbach alpha procedure developed by Nunnally's technique. The findings demonstrated an α value of 0.952, corresponding to a reliability level of 95.2 percent, suggesting very good reliability.

Part 1.2: Information from Montfort College alumni, parents, and teachers: Information was gathered from a diverse group comprising 300 Montfort College alumni, 300 parents, as well as 50 teachers and school administrators involved in business studies, home academics, accounting, economics, computer, and technology—totaling 650 individuals. Data were collected by questionnaires with three sections and 11 items as follows:

Section 1) General information of the respondents, including age, education level, social role, occupation, type of business, duration in the business, and the current value of the maintained business

Section 2) Information about needs and expectations regarding teaching and learning styles and entrepreneurial skills across 10 aspects. These aspects included 1) competency expectations, 2) attitude expectations, 3) personality expectations, 4) curriculum organization expectations, 5) learning location expectations, 6) learning style expectations, 7) expectations regarding lecturers, 8) expectations for the development of entrepreneurial skills, 9) future business expectations, and 10) expectations for the development of future skills. The questionnaire design involved categorizing responses into four options, with each option aligning with the four aspects of human brain functioning in WBL

Section 3) Additional suggestions

Moreover, the instrument used for data collection in Part 1.2 was analyzed for content validity or the Index of Item Objective Congruence (IOC - Rowinelli & Hambleton's technique) by five experts with expertise in the development of WBL skills (a minimum of 5 years of experience in teaching and learning management). The results revealed that the questionnaire attained an IOC value of 0.92, indicating a validity value of 92 percent. This aligned with the acceptance criteria outlined by Rowinelli and Hambleton’s technique.

After that, the questionnaire was analyzed for its reliability using the principles of Kendall Correlation or Two-Way Analysis of Variance (Two-Way ANOVA). Five interviewers conducted interviews with the same experimental group of 50 people, repeated twice. Then, the results of every set of interviews were analyzed for correlation coefficient. The results indicated a correlation coefficient of 0.866 or a reliability value of 86.6 percent, suggesting good reliability.

Part 1.3: Data were collected from a sample of 10 successful entrepreneurs: 5 global and 5 national (from Thailand). The data collection and analysis process can be divided into two steps. The first step involved utilizing ChatGPT 3.5 (OpenAI, 2020) to analyze and identify specific characteristics of the entrepreneurs in five areas: personality, thinking, character, vision, and lifestyle goals. After that, in the second step, the variables and factors obtained from the ChatGPT 3.5 analysis were used to perform a WBL relationship analysis. The instrument for data collection was adapted from the WBL 4 Human Brain Function Indicators Decoding Manual (Tayko, 2015). This manual included four indicators, totaling 95 variables. These variables were categorized according to the principles of WBL Human Brain Functions during the analysis, aiming to classify variables and factors within the sample group. The objective was to unveil the relationships between ChatGPT 3.5 data that aligned with the principles of WBL. Subsequently, the frequency of each indicator was determined, and the results from the survey questionnaires were presented as percentages within each aspect. The indicators are classified in Table 3.4.

Table 3.4 The indicators using the WBL 4 Human Brain Function Indicators Decoding Manual (Tayko, 2015)

No.	**WBL Function and the Skills Needed to Conduct a Prototypical Model**	**Define Keyword Decode from the Interview Skills – Qualifications – Characteristics Prominently Displayed**	**Total Indicators**
1	Posterior left brain lobe Movement and self-control I-Pursue = I-PU	Regulations = U01	**22**
		Quality = U02	
		Risk reduction = U03	
		Timing = U04	
		Policy = U05	
		Forming = U06	
		Sequential = U07	
		Organizing = U08	
		Detailed = U09	
		Prioritized = U10	
		Focused = U11	
		Ordered = U12	
		Tasking = U13	
		Tradition = U14	
		Reliable = U15	
		Punctuality = U16	
		Decision = U17	
		Action = U18	
		Result = U19	
		Productive = U20	
		Completion = U21	
		Permission = U22	

Table 3.4 The indicators using the WBL 4 Human Brain Function Indicators Decoding Manual (Tayko, 2015) (continued)

No.	WBL Function and the Skills Needed to Conduct a Prototypical Model	Define Keyword Decode from the Interview Skills – Qualifications – Characteristics Prominently Displayed		Total Indicators
2	Anterior left brain lobe Analytical and logical thinking I–Control = I-C	Efficiency	= C01	**23**
		Finance	= C02	
		Performance	= C03	
		Logic	= C04	
		Analysis	= C05	
		Quantitative	= C06	
		Quantify	= C07	
		Realistic	= C08	
		Direction	= C09	
		Goal	= C10	
		Objective	= C11	
		Number	= C12	
		Systematic	= C13	
		Rational	= C14	
		Theoretical	= C15	
		Methodology	= C16	
		Control	= C17	
		Commitment	= C18	
		Critical	= C19	
		Evaluation	= C20	
		Leading	= C21	
		Proactive	= C22	
		Planning	= C23	

Table 3.4 The indicators using the WBL 4 Human Brain Function Indicators Decoding Manual (Tayko, 2015) (continued)

No.	WBL Function and the Skills Needed to Conduct a Prototypical Model	Define Keyword Decode from the Interview Skills – Qualifications – Characteristics Prominently Displayed	Total Indicators
3	Posterior right brain lobe Emotional and social dimensions I-Preserve = I-PR	Training = R01	**24**
		Team = R02	
		Relationship = R03	
		Community = R04	
		Communication = R05	
		Culture = R06	
		Recognition = R07	
		Feeling = R08	
		Emotional = R09	
		Interpersonal = R10	
		Support others = R11	
		Spiritual = R12	
		Sensitive = R13	
		Sharing = R14	
		Giving = R15	
		Expressive = R16	
		Cooperative = R17	
		Collaborative = R18	
		Conversational = R19	
		Linguistic = R20	
		Compromise = R21	
		Synergies = R22	
		Connection-network = R23	
		Faith = R24	

Table 3.4 The indicators using the WBL 4 Human Brain Function Indicators Decoding Manual (Tayko, 2015) (continued)

No.	**WBL Function and the Skills Needed to Conduct a Prototypical Model**	**Define Keyword Decode from the Interview Skills – Qualifications – Characteristics Prominently Displayed**		**Total Indicators**
4	Anterior right brain lobe Creativity and imagination I-Explore = I-E	Competition	= E01	**26**
		Future trend	= E02	
		Flexibility	= E03	
		Visionary	= E04	
		Long term	= E05	
		Innovation	= E06	
		Choice	= E07	
		Optional	= E08	
		Holistic	= E09	
		Intuitive idea	= E10	
		Integration	= E11	
		Synthesizing	= E12	
		Infer	= E13	
		Speculation	= E14	
		Creativity	= E15	
		Conceptualizing	= E16	
		Taking risk	= E17	
		Bends the rules	= E18	
		Curious	= E19	
		Difference	= E20	
		Novelty	= E21	
		Imagination	= E22	

Table 3.4 The indicators using the WBL 4 Human Brain Function Indicators Decoding Manual (Tayko, 2015) (continued)

No.	WBL Function and the Skills Needed to Conduct a Prototypical Model	Define Keyword Decode from the Interview Skills – Qualifications – Characteristics Prominently Displayed	Total Indicators
		Big picture = E23	
		Possible option = E24	
		Think out of the box = E25	
		Open-minded = E26	
		Total Indicators	**95**

The instrument used for data collection in Part 1.3 was indicated for content validity or the Index of Item Objective Congruence (IOC - Rowinelli & Hambleton's technique) by five experts with an expertise in the development of WBL skills (a minimum of 5 years of experience in teaching and learning management). The results indicated that the questionnaire achieved an IOC value of 0.951, corresponding to a validity value of 95.1 percent. These findings met the validity standards established by Rowinelli & Hambleton's technique.

Subsequently, the instrument underwent testing with a pilot test group comprising 50 secondary students to assess its reliability using the Cronbach alpha procedure developed by Nunnally's technique. The findings demonstrated an α value of 0.962, corresponding to a reliability level of 96.2 percent, suggesting a very good level.

3.5.2 Scope 2: Correlational Research (DEI Prototype-2)

The data collection in Scope 2, correlational research (DEI Prototype-2), was quantitative and focused on secondary students. The sample comprised 600 students divided into three sample groups: 200 in the Sciences-Mathematics Program, 200 in the Language Arts Program, and 200 in the Arts - Business Program. The aim was to explore the relationship between two independent variables, digital entrepreneurship (x1) and entrepreneurship (x2), which might impact two dependent variables: digital intelligence (y1) and entrepreneurial intelligence (y2). The instrument for data collection consisted of three parts:

Part 2.1: Data collection of two types of independent variables: The first type, digital entrepreneurship (x1), comprised eight independent variables: Cloud computing, artificial intelligence (AI), Internet of Things (IoT), digital business laws, big data, Blockchain, FinTech, and creative social media. The data were collected through a questionnaire divided into two sections. Section 1 included questions about personal information, while Section 2 consisted of a set of closed-ended questionnaires with a choice of answers. The questionnaire, with a total of 40 questions, adopted a four-choice format based on Likert's scale: Strongly Agree = 4, Agree = 3, Disagree = 2, and Strongly Disagree = 1. The results of each question were then indicated to determine the average and percentage, and the findings are presented in Table 3.5.

Table 3.5 The indicator of the digital entrepreneurship variable in the questionnaire using the principles of the WBL 4 Human Brain Function Indicators Decoding Manual (Takyo, 2015)

No.	**Independent Variables in the Experiment**	**Number of Questions (items)**	**The Principles of WBL**			
			I-C	**I-PU**	**I-E**	**I-PR**
1	x101 = Big data	5	✓			
2	x102 = FinTech	5	✓			
3	x103 = Block chain	5		✓		
4	x104 = Digital business laws	5		✓		
5	x105 = Internet of Things (IoT)	5			✓	
6	x106 = Creative social media	5			✓	
7	x107 = Artificial intelligence (AI)	5				✓

Table 3.5 The indicator of the digital entrepreneurship variable in the questionnaire using the principles of the WBL 4 Human Brain Function Indicators Decoding Manual (Takyo, 2015) (continued)

No.	**Independent Variables in the Experiment**	**Number of Questions (items)**	**The Principles of WBL**			
			I-C	**I-PU**	**I-E**	**I-PR**
8	x108 = Cloud computing	5				✓
	Total	**40**				

The instrument used for data collection in Part 2.1 for the first independent variable was indicated for content validity or the Index of Item Objective Congruence (IOC - Rowinelli & Hambleton’s technique) by five experts with expertise in the development of WBL skills (a minimum of 5 years of experience in teaching and learning management). The results indicated that the questionnaire achieved an IOC value of 0.87, corresponding to a validity value of 87 percent. These findings met the validity standards established by Rowinelli & Hambleton′ s technique.

Subsequently, the instrument underwent testing with a pilot test group comprising 50 secondary students to assess its reliability using the Cronbach alpha procedure developed by Nunnally’s technique. The findings demonstrated an α value of 0.901, corresponding to a reliability level of 90.1 percent, suggesting a very good level.

The second independent variable, entrepreneurship (x2), comprised four independent variables: business idea and operation, marketing plan, financial plan, and business project. The instrument for data collection was a test set adapted from the Entrepreneurship and Small Business (ESB) Test by the MBA Research and Curriculum Center, USA, and the European Commission’s ENTRECOMP Framework (2017).

This test was divided into two sections: Section 1, which collected personal information, and Section 2, which included 20 closed-ended questions or multiple-choice exams with four options. Subsequently, the results of each question were analyzed to determine the percentage based on the principles of WBL Human Brain Function. The indicator is presented in Table 3.6.

Table 3.6 The indicator of the entrepreneurship variable in the test, utilizing the principles of the WBL 4 Human Brain Function Indicators Decoding Manual (Tayko, 2015)

No.	Independent Variables in the Experiment	Number of Questions (items)	The Principles of WBL			
			I-C	I-PU	I-E	I-PR
1	x201 = Business idea and operation	5			✓	
2	x202 = Marketing plan	5				✓
3	x203 = Financial plan	5	✓			
4	x204 = Business project	5		✓		
	Total	**20**				

The instrument used for data collection in Part 2.1 for the second independent variable was analyzed for content validity or the Index of Item Objective Congruence (IOC- Rowinelli & Hambleton's technique) by five experts with expertise in the development of WBL skills (a minimum of 5 years of experience in teaching and learning management). The results indicated that the questionnaire achieved an IOC value of 0.85, corresponding to a validity value of 85 percent. These findings met the validity standards established by Rowinelli & Hambleton's technique.

Then, the instrument underwent testing with a pilot test group comprising 50 secondary students to assess its reliability using the Cronbach alpha procedure developed by Nunnally's technique. The findings demonstrated an α value of 0.894, corresponding to a reliability level of 89.4 percent, suggesting a very good level.

Part 2.2: Data of two dependent variables were collected. The first one, digital intelligence (y1), comprised eight variables: digital identity, digital use, digital safety, digital security, digital emotional intelligence, digital communication, digital literacy, and digital rights. The data were collected by a questionnaire which was adapted from the Digital Intelligence Quotient Questionnaire developed by King Mongkut's Institute of Technology Ladkrabang (2020) and the DQ Framework (2018). The questionnaire was divided into two sections. Section 1 included questions about personal information, while Section 2 consisted of a set of closed-ended questions with a choice of answers. The questionnaire, with a total of 40 items, adopted a four-choice format based on Likert’s scale: Strongly Agree = 4, Agree = 3, Disagree = 2, and Strongly Disagree = 1. The results of each question were then indicated to determine the percentage based on the principle of WBL four Human Brain Functions presented in Table 3.7.

Table 3.7 The indicator of the digital intelligence variable in the questionnaire using the principle of the WBL 4 Human Brain Function Indicators Decoding Manual (Tayko, 2015)

No.	Independent Variables in the Experiment	Number of Questions (items)	The principles of WBL			
			I-C	I-PU	I-E	I-PR
1	y101 = Digital identity	5			✓	
2	y102 = Digital use	5			✓	
3	y103 = Digital safety	5		✓		
4	y104 = Digital security	5		✓		
5	y105 = Digital emotional intelligence	5				✓
6	y106 = Digital communication	5				✓
7	y107 = Digital literacy	5	✓			
8	y108 = Digital rights	5	✓			
	Total	**40**				

The instrument used for data collection in Part 2.2 for the first dependent variable was indicated for content validity or the Index of Item Objective Congruence (IOC - Rowinelli & Hambleton's technique) by five experts with expertise in the development of WBL skills (a minimum of 5 years of experience in teaching and learning management). The results indicated that the questionnaire achieved an IOC value of 0.88, corresponding to a validity value of 88 percent. These findings met the validity standards established by Rowinelli & Hambleton's technique.

Then, the instrument underwent testing with a pilot test group comprising 50 secondary students to assess its reliability using the Cronbach alpha procedure developed by Nunnally's technique. The findings demonstrated an α value of 0.923, corresponding to a reliability level of 92.3 percent, suggesting a very good level.

The second dependent variable, entrepreneurial intelligence (y2), comprised 16 independent variables: leadership, planning skill, proactive skill, analytical thinking, self-behavioral regulation, risk-reduction, punctuality, organizational skill, creativity, innovativeness,visionary,risk-taking,interpersonal,emotionalregulation,communicational skill, and team building. Data were collected by a questionnaire which was adapted from the EntreComp: The Entrepreneurship Competence Framework (2016) from the European Union. The questionnaire was divided into two sections. Section 1 included questions about personal information, while Section 2 consisted of a set of closed-ended questions with a choice of answers. The questionnaire, with a total of 64 items, adopted a four-choice format based on Likert's scale: Strongly Agree = 4, Agree = 3, Disagree = 2, and Strongly Disagree = 1. The results of each question were then indicated to determine the percentage based on the principle of WBL four Human Brain Functions presented in Table 3.8

Table 3.8 The indicator of entrepreneurial intelligence variable in the questionnaire using the principle of WBL 4 Human Brain Function Indicators Decoding Manual (Tayko, 2015)

No.	Independent Variables in the Experiment	Number of Questions (items)	The principles of WBL			
			I-C	I-PU	I-E	I-PR
1	Leadership	4	✓			
2	Planning skill	4	✓			
3	Perseverance	4	✓			
4	Analytical thinking	4	✓			
5	Self-behavioral regulation	4		✓		
6	Risk-reduction	4		✓		
7	Work under pressure	4		✓		
8	Time management	4		✓		
9	Creativity	4			✓	
10	Innovativeness	4			✓	

Table 3.8 The indicator of entrepreneurial intelligence variable in the questionnaire using the principle of WBL 4 Human Brain Function Indicators Decoding Manual (Tayko, 2015) (continued)

No.	**Independent Variables in the Experiment**	**Number of Questions (items)**	**The principles of WBL**			
			I-C	**I-PU**	**I-E**	**I-PR**
11	Visionary	4			✓	
12	Passionate	4			✓	
13	Interpersonal	4				✓
14	Emotional regulation	4				✓
15	Communicational skill	4				✓
16	Team building	4				✓
	Total	**64**				

The instrument used for data collection in Part 2.2 for the second dependent variable was indicated for content validity or the Index of Item Objective Congruence (IOC - Rowinelli & Hambleton's technique) by five experts with expertise in the development of WBL skills (a minimum of 5 years of experience in teaching and learning management). The results indicated that the questionnaire achieved an IOC value of 0.91, corresponding to a validity value of 91 percent. These findings met the validity standards established by Rowinelli & Hambleton's technique.

Then, the instrument underwent testing with a pilot test group comprising 50 secondary students to assess its reliability using the Cronbach alpha procedure developed by Nunnally's technique. The findings demonstrated an α value of 0.954, corresponding to a reliability level of 95.4 percent, suggesting a very good level.

3.5.3 Scope 3: Experimental Research (DEI – WBL Prototype)

Data collection in Scope 3, experimental research (DEI- WBL Prototype), involved gathering data from experimental research in both quantitative and qualitative data. Data were collected from secondary students at Montfort College Secondary Section, totaling 800 individuals, with 400 in the control group and 400 in the experimental group. The data collection process can be described in two steps:

Part 3.1: Data were collected before and after the experiment from 400 people of the control group (Group A), divided into four subgroups: Control Group 1 (CG1): 100 secondary students studying Sciences-Mathematics Program with a English language curriculum, Control Group 2 (CG2): 100 secondary students studying Arts-Business Program (English language curriculum), Control Group 3 (CG3): 100 secondary students studying English Program (enrolled in the International School Learning Approach), and Control Group 4 (CG4): 100 secondary students studying Science-Mathematics Program with a Thai language curriculum, from Government School (Chaing Rai Province), which is an educational institute under the government. All four control groups followed a learning style based on measurement and evaluation principles, according to Bloom's Taxonomy and 3 Learning Domains (KPA) Evaluation theory.

Part 3.2: Data were collected before and after the experiment from 400 people of the experimental group (Group B), divided into four subgroups: Experimental Group 1 (EG1): 100 secondary students studying Sciences-Mathematics Program with a English language curriculum, Experimental Group 2 (EG2): 100 secondary students studying Arts-Business Program (English language curriculum), Experimental Group 3 (EG3): 100 secondary students studying English Program, (enrolled in the International School Learning Approach), and Experimental Group 4 (EG4): 100 secondary students studying Science-program, Thai language course, from Government School (Chaing Rai Province), which is a secondary educational institution under the government. These four experimental groups followed a learning style based on measurement and evaluation principles, adhering to the theory of Whole Brain Literacy – WBL 4 Human Brain Functions (Tayko, 2015).

Data were collected from both sample groups, the control and experimental groups, focusing on four types of variables. The first part, digital entrepreneurship, consisted of eight variables: Cloud computing, artificial intelligence (AI), Internet of Things (IoT), digital business laws, big data, Blockchain, FinTech, and creative social media. The second part, entrepreneurship consisted of four variables: Business and operation, marketing plan, financial plan, business project. And the third part, digital intelligence consisted of eight variables: digital identity, digital use, digital safety, digital security, digital, emotional intelligence, digital communication, digital literacy and digital rights. Also the fourth part, entrepreneurial intelligence consisted of 16 variables: leadership, planning skill, perseverance, analytical thinking, self-behavioral regulation, risk-reduction, work under pressure, time management, creativity, innovativeness, visionary, passionate, interpersonal, emotional regulation, communicational skill and teambuilding skill. The data were collected by a questionnaire which was divided into three sections. Section 1 included questions about personal information, while Section 2 consisted of a set of closed-ended questions with a choice of answers. The questionnaire, with a total of 36 items, adopted a four-choice format based on Likert's scale: Strongly Agree = 4, Agree = 3, Disagree = 2, and Strongly Disagree = 1. Also Section 3 data were collected from student hobby. The results of each question were then indicated to determine the percentage based on the principle of WBL Human Brain Functions presented in Table 3.9.

The instrument used for data collection in Part 3 for the second dependent variable was indicated for content validity or the Index of Item Objective Congruence (IOC - Rowinelli & Hambleton's technique) by five experts with expertise in the development of WBL skills (a minimum of 5 years of experience in teaching and learning management). The results indicated that the questionnaire achieved an IOC value of 0.950, corresponding to a validity value of 95 percent. These findings met the validity standards established by Rowinelli & Hambleton's technique.

Then, the instrument underwent testing with a pilot test group comprising 50 secondary students to assess its reliability using the Cronbach alpha procedure developed by Nunnally's technique. The findings demonstrated an α value of 0.951, corresponding to a reliability level of 95.1 percent, suggesting a very good level.

Table 3.9 The indicator of digital entrepreneurship variable in the questionnaire using the principle of WBL 4 Human Brain Function Indicators Decoding Manual (Tayko, 2015)

No.	Independent Variables in the Experiment	Number of Questions (items)	The principles of WBL			
			I-C	I-PU	I-E	I-PR
	Section 1: Digital Entrepreneurship (8 items)					
1	y101 = Big data	1	✓			
2	y102 = FinTech	1	✓			
3	y103 = Block chain	1		✓		
4	y104 = Digital business laws	1		✓		
5	y105 = Internet of Things (IoT)	1			✓	
6	y106 = Creative social media	1			✓	
7	y107 = Artificial intelligence (AI)	1				✓
8	y108 = Cloud computing	1				✓
	Total	8				
	Section 2: Digital Entrepreneurship (4 items)					
1	y201 = Business and operation	1			✓	
2	y202 = Marketing plan	1				✓
3	y203 = Financial plan	1	✓			
4	y204 = Business project	1		✓		
	Total	4				

Table 3.9 The indicator of digital entrepreneurship variable in the questionnaire using the principle of WBL 4 Human Brain Function Indicators Decoding Manual (Tayko, 2015) (continued)

No.	**Independent Variables in the Experiment**	**Number of Questions (items)**	**The principles of WBL**			
			I-C	**I-PU**	**I-E**	**I-PR**
	Section 3: Digital Entrepreneurship (8 items)					
1	y301 = Digital identity	1			✓	
2	y302 = Digital use	1			✓	
3	y303 = Digital safety	1		✓		
4	y304 = Digital security	1		✓		
5	y305 = Digital emotional intelligence	1				✓
6	y306 = Digital communication	1				✓
7	y307 = Digital literacy	1	✓			
8	y308 = Digital rights	1	✓			
	Total	8				
	Section 4: Digital Entrepreneurial Intelligence (16 items)					
1	y401 = Leadership	1	✓			
2	y402 = Planning skill	1	✓			
3	y403 = Perserverance	1	✓			
4	y404 = Analytical thinking	1	✓			
5	y405 = Self – behavioral regulation	1		✓		
6	y406 = Risk-reduction	1		✓		
7	y407 = Work under pressure	1		✓		
8	y408 = Time management	1		✓		
9	y409 = Creativity	1			✓	

Table 3.9 The indicator of digital entrepreneurship variable in the questionnaire using the principle of WBL 4 Human Brain Function Indicators Decoding Manual (Tayko, 2015) (continued)

No.	**Independent Variables in the Experiment**	**Number of Questions (items)**	**The principles of WBL**			
			I-C	**I-PU**	**I-E**	**I-PR**
	Section 4: Digital Entrepreneurial Intelligence (16 items)					
10	y410 = Innovativeness	1			✓	
11	y411 = Visionary	1			✓	
12	y412 = Passionate	1			✓	
13	y413 = Interpersonal	1				✓
14	y414 = Emotional regulation	1				✓
15	y415 = Communication skill	1				✓
16	y416 = Teambuilding	1				✓
	Total	16				

From the information from part 3.5, the instruments for data collection in all three scopes in this research can be summarized and classified as shown in Table 3.10

Table 3.10 The summary of research instruments in all three scopes

No.	Scope	Part	Data Type	Technique and Tools	Concept	Content Validity (IOC)	Cronbach Alpha	Sample
1	1 Survey Research (DEI Prototype-1)	1.1	Quatitative	Survey Questionnaire WBL 4 Choices Analysis	WBL and Business Learning Expectations	0.840	0.952	300 students
2	1 Survey Research (DEI Prototype-1)	1.2	Quatitative	Survey Questionnaire WBL 4 Choices Analysis	WBL and Business Learning Expectations	0.920	0.866	300 alumni 300 parents 50 Teachers (650)

Table 3.10 The summary of research instruments in all three scopes (continued)

No.	Scope	Part	Data Type	Technique and Tools	Concept	Content Validity (IOC)	Cronbach Alpha	Sample
3	1 Survey Research (DEI Prototype-1)	1.3	Quatitative	ChatGPT 3.5 WBL Decoding Manual Analysis	WBL Tayko (2015)	0.951	0.962	5 global entrepreneurs 5 Thai entrepreneurs (10)
4	2 Correlational Research (DEI Prototype-2)	2.1	Quatitative	Survey Questionnaire 4 Rating Scales	Digital Entrepreneur ship (DE) and Tayko (2015)	0.870	0.901	600 Students

Table 3.10 The summary of research instruments in all three scopes (continued)

No.	**Scope**	**Part**	**Data Type**	**Technique and Tools**	**Concept**	**Content Validity (IOC)**	**Cronbach Alpha**	**Sample**
5	2 Correlational Research (DEI Prototype-2)	2.2	Quatitative	Entrepreneurship and Small Business ESB Examination 4 Multiple Choices	Entrepreneur ESB Deca INC Test (2019) and Tayko (2015)	0.850	0.894	600 Students
6	2 Correlational Research (DEI Prototype-2)	2.3	Quatitative	Digital Intelligence (DI) Questionnaire 4 Rating Scale	Digital Intelligence Quotient Framework (2018)	0.880	0.923	600 Students

Table 3.10 The summary of research instruments in all three scopes (continued)

No.	Scope	Part	Data Type	Technique and Tools	Concept	Content Validity (IOC)	Cronbach Alpha	Sample
7	2 Correlational Research (DEI Prototype-2)	2.4	Quatitative	Entrepreneurial Intelligence (EI) Questionnaire 4 Rating Scale	Entre Comp Framework (2016)	0.910	0.954	600 Students
8	2 Correlational Research (DEI Prototype-2)	2.5	Quatitative	Open - Ended Survey Questionnaire	School Learning Program and Student's hobbies	-	-	600 Students
9	3 Experimental Research (DEI-Prototype)	3.1	Qualitative & Quantitative	Survey Questionnaire 4 Rating Scales Pre – Post Test	DEI – WBL Prototype and Tayko (2015)	0.950	0.951	800 Students

3.6 Data Collection Procedure

The data collection procedure in this research was divided into three scopes, and each scope was described as follows:

3.6.1 Scope 1 – Survey Research (DEI-Prototype-1)

Table 3.11 The summary of the data collection procedure in Scope 1, survey research (DEI-Prototype-1)

Part	Data Type / Process	Sample	Tools and Techniques	Data / Output
1.1	Quatitative data Data were collected from secondary students at Montfort College Secondary Section using purposive selection or random assignment.	300 students	Survey questionnaire with four choices that is related to WBL 4 Human Brain Functions	10 factors related to expectations and needs for teaching and learning digital entrepreneurship of secondary students at Montfort College 1) Student competency 2) Student attitude 3) Student characteristic 4) Learning curriculum style 5) Facility/location style 6) Teaching approach style 7) Instructor/teacher style 8) Reason for self-development 9) Preferring to own a business in the future 10) Future development skill

Table 3.11 The summary of the data collection procedure in Scope 1, survey research (DEI-Prototype-1) (continued)

Part	Data Type / Process	Sample	Tools and Techniques	Data / Output
1.2	Qualitative data Data were collected from stakeholders of Montfort College Secondary Section, Chiang Mai.	300 alumni 300 parents 50 teachers (650)	Survey questionnaire with four choices that is related to WBL 4 Human Brain Functions	10 factors related to expectations and needs for teaching and learning digital entrepreneurship of secondary students at Montfort College 1) Student competency 2) Student attitude 3) Student characteristic 4) Learning curriculum style 5) Facility/location style 6) Teaching approach style 7) Instructor/teacher style 8) Reason for self-development 9) Preferring to own a business in the future 10) Future development skill

Table 3.11 The summary of the data collection procedure in Scope 1, survey research (DEI-Prototype-1) (continued)

Part	Data Type / Process	Sample	Tools and Techniques	Data / Output
1.3	Qualitative data Data were analyzed from the personality traits of successful global and Thai business people. Data were gathered from various sources such as interviews or publications.	5 Global 5 Thai (10)	ChatGPT 3.5 WBL Decoding Manual Analysis	Results of analysis and classification of WBL 4 Brain Function Indicators from a group of leading successful global and Thai models
	Total sample group	**960**		

3.6.2 Scope 2 – Correlational Research (DEI-Prototype-2)

Table 3.12 The summary of the data collection procedure in Scope 2, correlational research (DEI-Prototype-2)

Part	Data Type / Process	Sample	Tools and Techniques	Data / Output
2.1	Quatitative data (Independent variable / x1) Data were collected from secondary students at Montfort College Secondary Section, Chiang Mai, using purposive selection or random assignment.	200 students studying Sciences-Mathematics Program (Thai language curriculum) 200 students studying Arts Language Program (Thai language curriculum) 200 students studying English Program (English language curriculum) (600)	Survey questionnaire with a 4 rating scale that is related to WBL 4 Human Brain Functions	8 factors that influence the development of digital entrepreneurship (DE) among secondary students at Montfort Colleg 1) Big Data 2) FinTech 3) Block Chain 4) Digital Business Laws 5) Internet of Thing 6) Creative Social Media 7) Artificial Intelligence (AI) 8) Cloud Computing

Table 3.12 The summary of the data collection procedure in Scope 2, correlational research (DEI-Prototype-2) (continued)

Part	Data Type / Process	Sample	Tools and Techniques	Data / Output
2.2	Quatitative data (Independent variable / x2)	The same sample group as in 2.1 (600)	Survey questionnaire with a 4 rating scale that is related to WBL 4 Human Brain Functions	4 factors which influence the development of entrepreneurship among secondary students at Montfort College 1) Business idea and business operation 2) Marketing plan 3) Financial plan 4) Business project
2.3	Quatitative data (Dependent variable/ y1)	The same sample group as in 2.1 (600)	Survey questionnaire with a 4 rating scale that is related to WBL 4 Human Brain Functions	8 factors that influence the development of digital intelligence (DI) among secondary students at Montfort College 1) Digital identity 2) Digital use 3) Digital safety 4) Digital security 5) Digital emotional intelligence 6) Digital communication 7) Digital literacy 8) Digital righ

Table 3.12 The summary of the data collection procedure in Scope 2, correlational research (DEI-Prototype-2) (continued)

Part	Data Type / Process	Sample	Tools and Techniques	Data / Output
2.4	Quatitative data (Dependent variable / y2)	The same sample group as in 2.1 (600)	Survey questionnaire with 4 rating scale that is related to WBL 4 Human Brain Functions	16 factors that influence the development of entrepreneurial intelligence (EI) among secondary students at Montfort College 1) Leadership 2) Planning skill 3) Proactive skill 4) Analytical thinking 5) Self-behavioral regulation 6) Risk reduction 7) Punctuality 8) Organizational skill 9) Creativity 10) Innovativeness 11) Visionary 12) Risk-taking 13) Interpersonal 14) Emotional regulation 15) Communicational skill 16) Team Building *** 16 variables, 64 indicators
	Total Sample group	**600**		

3.6.3 Scope 3 – Experimental Research (DEI WBL-Prototype)

The data collection procedure in Scope 3 focused on gathering factors expected to influence the development of digital entrepreneurial intelligence (DEI) from the specified sample groups—Prototype-1 and Prototype-2. Subsequently, these factors were analyzed and developed into the DEI WBL-Prototype following the principles and steps for developing learners' Whole Brain Literacy (WBL). This process comprised a total of 5 steps. To execute the experiment, two sample groups were utilized. The first group, a control group, consisted of 400 individuals. This group could be further divided into four subgroups: Control Group 1 (CG1): 100 secondary students studying Sciences-Mathematics Program with a English language curriculum, Control Group 2 (CG2): 100 secondary students studying Arts-Business Program (English language curriculum), Control Group 3 (CG3): 100 secondary students studying English Program (enrolled in the International School Learning Approach), and Control Group 4 (CG4): 100 secondary students studying Sciences-Mathematics Program with a Thai language curriculum, from Government School (Chaing Rai Province), which is an educational institute under the government. All four control groups followed a learning style based on measurement and evaluation principles, according to Bloom's Taxonomy and 3 Learning Domains (KPA) Evaluation theory.

In addition, the second group, an experimental group, consisted of 400 individuals. This group was also divided into four subgroups: Experimental Group 1 (EG1): 100 secondary students studying Sciences-Mathematics Program with a English language curriculum, Experimental Group 2 (EG2): 100 secondary students studying Arts-Business Program (English language curriculum), Experimental Group 3 (EG3): 100 secondary students studying English Program (enrolled in the International School Learning Approach), and Experimental Group 4 (EG4): 100 secondary students studying Sciences-Mathematics Program with a Thai language curriculum, from Government School (Chaing Rai Province), which is a secondary educational institution under the government. These four experimental groups followed a learning style based on measurement and evaluation principles, adhering to the theory of Whole Brain Literacy – Four Human Brain Functions (Tayko, 2015). Data were collected before and after organizing the DEI WBL-Prototype activities.

In this experiment, the researcher structured it as the Montfort Junior Entrepreneur Track (M-JET) Project, consisting of 5 periods per week for a duration of 20 weeks, equivalent to one semester. Additionally, there were extra-curricular activities related to entrepreneurial experience training, amounting to an additional 20 hours. In total, the DEI WBL-Prototype course encompassed 120 hours. This specific subject was organized as a special project conducted on Saturdays, and its details can be summarized and presented in Table 3.13 as follows:

Table 3.13 DEI WBL-Prototype design process following the principles and steps for developing learners' Whole Brain Literacy (WBL)

Week	**Number of hours**	**Activity / Process**	**WBL**	**Brain Function**
1-9 (9)	43	Business idea and business operation Creative Social media 3D Printing IoT, VR	I-Explore (I-E) Anterior right brain function	The development of creativity and imagination
10-12 (3)	18	Marketing Plan AI, Cloud Computing Digital content design Online survey	I-Preserve (I-PR) Posterior right brain function	The development of emotional and social dimensions
13-17 (5)	24	Financial plan Big data FinTech	I-Control (I-C) Anterior left brain function	The development of analytical and logical thinking
18-20 (3)	15	Business project Social media Blockchain Digital Business Laws	I-Pursue (I-PU) Posterior left brain function	The development of movement and self-control

Table 3.13 DEI WBL-Prototype design process following the principles and steps for developing learners' Whole Brain Literacy (WBL) (continued)

Week	Number of hours	Activity / Process	WBL	Brain Function
After school	20	Extra activity Inspiration workshop Business trip Business internship Leadership Arts, music, etc.	4 Human brain functions IE + IPR+IC+IPU	Holistic approach
Total	**120**			

Table 3.14 The summary of the data collection procedure in Scope 3, experimental research (DEI WBL-Prototype)

Part	Data Type / Process	Sample	Tools and Techniques	Data / Output
3.1	Qualitative data Data were collected from secondary students at Montfort College Secondary Section using purposive selection or random assignment	800 students studying Sciences-Mathematics Program 200 students studying Art – Business Program studying English Program 200 students studying the International Approach	Survey questionnaire with a 4 rating scale that is related to WBL 4 Human Brain Functions	Part1: 8 factors that influence the development of digital entrepreneurship (DE) among secondary students at Montfort College 1) Big Data 2) FinTech 3) Block Chain 4) Digital Business Laws 5) Internet of Thing 6) Creative Social Media

Table 3.14 The summary of the data collection procedure in Scope 3, experimental research (DEI WBL-Prototype) (continued)

Part	Data Type / Process	Sample	Tools and Techniques	Data / Output
3.1	Qualitative data Data were collected from secondary students at Montfort College Secondary Section using purposive selection or random assignment	200 students studying Sciences-Mathematics Program Government School (800)	Survey questionnaire with a 4 rating scale that is related to WBL 4 Human Brain Functions	7) Artificial Intelligence (AI) 8) Cloud Computing <u>Part 2:</u> 4 factors which influence the development of entrepreneurship among secondary students at Montfort College 1) Business idea and business operation 2) Marketing plan 3) Financial plan 4) Business project <u>Part 3:</u> 8 factors that influence the development of digital intelligence (DI) among secondary students at Montfort College 1) Digital identity 2) Digital use 3) Digital safety 4) Digital security

Table 3.14 The summary of the data collection procedure in Scope 3, experimental research (DEI WBL-Prototype) (continued)

Part	Data Type / Process	Sample	Tools and Techniques	Data / Output
3.1	Qualitative data Data were collected from secondary students at Montfort College Secondary Section using purposive selection or random assignment		Survey questionnaire with a 4 rating scale that is related to WBL 4 Human Brain Functions	5) Digital emotional intelligence 6) Digital communication 7) Digital literacy 8) Digital rights Part 4: 17 factors that influence the development of entrepreneurial intelligence (EI) Among secondary students at Montfort College 1) Leadership 2) Planning skill 3) Preseverance 4) Analytical thinkin 5) Self-behavioral regulation 6) Risk reduction

Table 3.14 The summary of the data collection procedure in Scope 3, experimental research (DEI WBL-Prototype) (continued)

Part	Data Type / Process	Sample	Tools and Techniques	Data / Output
3.1	Qualitative data Data were collected from secondary students at Montfort College Secondary Section using purposive selection or random assignment		Survey questionnaire with a 4 rating scale that is related to WBL 4 Human Brain Functions	7) Work under pressue 8) Time management 9) Creativity 10) Innovativeness 11) Visionary 12) Passionate 13) Interpersonal 14) Emotional regulation 15) Communicational skill 16) Team Building *** 16 variables, 64 indicators
3.2		800 students	Survey questionnaire	17) Students'hobbies which are expected to affect entrepreneurial intelligence (EI)
	Total Sample Group	**800**		

3.7 Chapter Summary

The researcher subsequently analyzed the gathered data utilizing a statistical calculation program such as SPSS for data interpretation. The outcomes of research instruments and datasets can be illustrated in Table 3.1

Table 3.15 The research instruments and datasets

Scope Part	Research Methodology	Research Question	Research Objective	Research Hypothesis	Instrument	Sample	Results
1	Survey Research DEI Prototype -1	Q3	Obj1	-	-	Total 960	-
1.1	Quatitative				Survey Questionnaire WBL 4 Choices	300	Expectations and needs for learning management in students' digital entrepreneurship
1.2	Quatitative				Survey Questionnaire WBL 4 Choices	650	Factors and skills influencing students' success in learning digital entrepreneurial intelligence (DEI)

Table 3.15 The research instruments and datasets (continued)

Scope Part	Research Methodology	Research Question	Research Objective	Research Hypothesis	Instrument	Sample	Results
1.3	Quatitative				ChatGPT 3.5 WBL Decoding Manual Analysis	10	Personality traits, characteristics, and specific qualities of an entrepreneur
2	Correlational Research DEI Prototype -2	Q3	Obj1	-	-	Total 600	-
2.1	Quatitative				Survey Questionnaire with Rating Scales	600	The relationship between digital entrepreneurship (DE), the independent variable (x1), and secondary students

Table 3.15 The research instruments and datasets (continued)

Scope Part	Research Methodology	Research Question	Research Objective	Research Hypothesis	Instrument	Sample	Results
2.2	Quatitative				Entrepreneurship and Small Business (ESB) Examination 4 Multiple Choices	600	The relationship between entrepreneurship, the independent variable (x2), and secondary students
2.3	Quatitative				Questionnaire with 4 Rating Scales	600	The relationship between digital intelligence (DI), the dependent variable (y1), and secondary students.
2.4	Quatitative				Questionnaire with 4 Rating Scales	600	The relationship between entrepreneurial intelligence (EI), the dependent variable (y2), and secondary students

Table 3.15 The research instruments and datasets (continued)

Scope Part	Research Methodology	Research Question	Research Objective	Research Hypothesis	Instrument	Sample	Results
3	Experimental DEI- WBL Prototype	Q1 Q2 Q4 Q5 Q6	Obj2 Obj3 Obj4 Obj5	H1 H2 H3 H4 H5 H6		Total 800	
3.1	Qualitative and quantitative				Survey Questionnaire with Rating Scales	800	The relationship between digital entrepreneurship (DE), the independent variable (y1), entrepreneurship (y2), digital intelligence (DI) (y3), entrepreneurial intelligence (EI) (y4) and secondary students
3.2	Qualitative and quantitative				Open-Ended Questionnaire	800	The relationship between student learning programs and students' hobby

CHAPTER 4

RESULTS AND ANALYSIS

4.1 Chapter Overview

Chapter 4 presents the results and analysis of data obtained from the sample population following the design outlined in the research methodology. Data results at each step of the research related to the development of digital entrepreneurial intelligence (DEI) are divided into three sections:

1) Demographic profile of the research respondents

2) Findings and analysis

3) Chapter summary

This chapter presents the research results according to the scopes defined in Chapter 3. The results can be organized into the following three scopes:

1) Scope 1 – Data: Survey Research (Prototype-1)

In the first scope, the researcher designed a survey research approach to analyze qualitative data obtained from questionnaires and interviews involving alumni, parents, teachers, and co-administrators in Montfort College Secondary Section, Chiang Mai. Additionally, Whole Brain Literacy (WBL) was analyzed from accomplished national and global entrepreneurs. The objective was to collect statistical data and detailed descriptive information regarding various factors, variables, and expectations which might have effects and relationships with the independent variables—digital entrepreneurship and entrepreneurship—and the dependent variables—digital intelligence (DI) and entrepreneurial intelligence (EI). The ultimate goal was to create and design Prototype-1, a framework for organizing teaching and learning styles and enhance the development of digital entrepreneurial intelligence (DEI) among secondary students.

2) Scope 2 – Data: Correlational Research (Prototype-2)

In the second scope, the research was designed as a correlational study to analyze quantitative data obtained from questionnaires involving a sample group of secondary students at Montfort College Secondary Section, Chiang Mai. The objective was to identify relationships between the independent variables—digital entrepreneurship and entrepreneurship—and the dependent variables—digital intelligence (DI) and entrepreneurial intelligence (EI) to explore whether any factors exhibited a symmetrical or asymmetrical relationship. The researcher sought to interpret the results through both explanatory design and prediction design, with the ultimate goal of creating Prototype-2. This prototype aimed to elucidate and predict the relationships among factors contributing to the development of digital entrepreneurial intelligence (DEI) among secondary students.

3) Scope 3 – Data: Experimental Research (DEI – WBL Prototype)

In the third scope, the researcher focused on conducting experimental research in the form of true experimental research design to analyze both quantitative data and qualitative data obtained from Prototype-1 (survey research) and Prototype-2 (correlational research) in Scopes 1 and 2. The aim was to develop a learning process model and the digital entrepreneurial intelligence (DEI) development prototype based on WBL's principles. Furthermore, the research involved collecting data on extraneous factors to analyze how various daily activities in students' lives, as well as their choice of study programs, may impact the dependent variables. The resulting DEI-Prototype was then tested with a sample group of secondary students from Montfort College Secondary Section, Chiang Mai, as well as from the government school. The experiment was designed with both a control group and an experimental group, measuring results before and after the experiment. The objective was to identify the relationships between the independent variables—digital entrepreneurship and entrepreneurship—and the dependent variables—digital intelligence (DI) and entrepreneurial intelligence (EI) to explore whether any factors were significant to the DEI-Prototype.

4.2 Demographic Profile of the Research Respondents

4.2.1 Demographic Profile of Scope 1: Survey Research (DEI Prototype-1)

The data on the sample population within Scope 1 was divided into three parts: 1) data from 300 secondary students at Montfort College School Secondary Section; 2) data from a group of 650 stakeholders in the management of Montfort College Secondary Section, comprising 300 alumni, 300 parents, and 50 teachers and administrators; and 3) data from a group of 10 entrepreneurs, including 5 individuals at the national level and 5 at the global level. The data from the population sample in each section can be further categorized as follows:

Section 1.1: Personal information was collected from 300 secondary students at Montfort College Secondary Section. Data was collected using a questionnaire about expectations and needs on digital entrepreneurship (DE) learning management. Personal information was collected anonymously and included five aspects: 1) current grade level, 2) study program, 3) gender, 4) age, and 5) parents' occupations. The data can be presented in Table 4.1.

Table 4.1 The personal information of the population sample for section 1.1, which was collected using questionnaires regarding expectations and needs on digital entrepreneurship (DE) learning management of secondary students at Montfort College Secondary Section

No.	Data type of sample population Total N = 300	The number (people)	Percent (%)
G1	**Students**		
1	**Grade level**		
1.1	Grade 7	50	16.70 %
1.2	Grade 8	50	16.70 %
1.3	Grade 9	50	16.70 %
1.4	Grade 10	50	16.70 %
1.5	Grade 11	50	16.70 %
1.6	Grade 12	50	16.70 %

Table 4.1 The personal information of the population sample for section 1.1, which was collected using questionnaires regarding expectations and needs on digital entrepreneurship (DE) learning management of secondary students at Montfort College Secondary Section (continued)

No.	Data type of sample population Total N = 300	The number (people)	Percent (%)
2	**Student learning program**		
2.1	Science-Mathematics with a Thai program	100	33.30 %
2.2	Science-Mathematics with an English program (EP)	100	33.30 %
2.3	Art-Language with a Thai program	20	6.70 %
2.4	Art-Mathematics with a Thai program	20	6.70 %
2.5	Art-Music with a Thai program	10	3.30 %
2.6	Art-Business with an English program (EP)	50	16.70 %
3	**Gender**		
3.1	Male	170	56.70 %
3.2	Female	130	43.30 %
4	**Age**		
4.1	12 – 13 years	50	16.70 %
4.2	13 – 14 years	50	16.70 %
4.3	14 – 15 years	50	16.70 %
4.4	15 – 16 years	50	16.70 %
4.5	16 – 17 years	50	16.70 %
4.6	Above 17 years	50	16.70 %
5	**Parents' occupation**		
5.1	Civil servant	52	17.30 %
5.2	State enterprise employee	45	15.00 %
5.3	Teacher/ lecturer/ academics/ educational personnel	64	21.30 %

Table 4.1 The personal information of the population sample for section 1.1, which was collected using questionnaires regarding expectations and needs on digital entrepreneurship (DE) learning management of secondary students at Montfort College Secondary Section (continued)

No.	Data type of sample population Total N = 300	The number (people)	Percent (%)
5.4	Business owner	100	33.30 %
5.5	Politician	12	4.00 %
5.6	Farmer	9	3.00 %
5.7	Employee	15	5.00 %
5.8	Not specified	3	1.00 %

Section 1.2: Information was collected from a group of 650 stakeholders involved in the management of Montfort College Secondary Section, which consisted of 300 alumni, 300 parents, and 50 teachers and administrators (representing 26.31 percent of Montfort College's 190 teachers) who had connections to business and entrepreneurial careers. The data collection tool was a questionnaire about factors and skills influencing success in digital entrepreneurial intelligence (DEI) learning management among secondary students. Personal information was collected anonymously and included four aspects: 1) gender, 2) age, 3) education level, and 4) type of business. The data can be presented in Table 4.2.

Table 4.2 The personal information of the population sample for section 1.2, which was collected using a questionnaire regarding factors and skills influencing digital entrepreneurship intelligence (DEI) learning management among secondary students

No.	Data type of sample population Total N = 650	The number (People)	Percent (%)
G2.1	**Alumni** (N = 300)		
1	**Gender**		
1.1	Male	197	65.70 %
1.2	Female	103	34.30 %

Table 4.2 The personal information of the population sample for section 1.2, which was collected using a questionnaire regarding factors and skills influencing digital entrepreneurship intelligence (DEI) learning management among secondary students (continued)

No.	**Data type of sample population** Total N = 650	**The number (People)**	**Percent (%)**
2	**Business experience**		
2.1	0 – 5 years	15	5.00 %
2.2	5 – 10 years	125	41.70 %
2.3	11 – 15 years	134	44.70 %
2.4	More than 15 years	26	8.60 %
3	**Education level**		
3.1	Associate degree	0	0.00 %
3.2	Bachelor degree	184	61.30 %
3.3	Master degree	100	33.40 %
3.4	Doctor degree	15	5.00 %
3.5	Not specified	1	0.30 %
4	**Type of business**		
4.1	Manufacturing business	24	8.00 %
4.2	Service business	225	75.00 %
4.3	Commercial business	51	17.00 %
G2.2	**Parents** (N = 300)		
1	**Gender**		
1.1	Male	174	58.00 %
1.2	Female	126	42.00 %
2	**Business experience**		
2.1	0 – 5 years	15	5.00 %
2.2	5 – 10 years	58	19.40 %
2.3	11 – 15 years	127	42.30 %
2.4	More than 15 years	100	33.30 %

Table 4.2 The personal information of the population sample for section 1.2, which was collected using a questionnaire regarding factors and skills influencing digital entrepreneurship intelligence (DEI) learning management among secondary students (continued)

No.	Data type of sample population Total N = 650	The number (People)	Percent (%)
3	**Education level**		
3.1	Associate degree	4	1.40 %
3.2	Bachelor degree	212	70.70 %
3.3	Master degree	82	27.30 %
3.4	Doctor degree	2	0.60 %
3.5	Not specified	0	0.00 %
4	**Type of business**		
4.1	Manufacturing business	38	12.70 %
4.2	Service business	190	63.30 %
4.3	Commercial business	72	24.00 %
G2.3	**Teachers and administrators** (N = 50)		
1	**Gender**		
1.1	Male	18	36.00 %
1.2	Female	32	64.00 %
2	**Business experience**		
2.1	0 – 5 years	3	6.00 %
2.2	5 – 10 years	12	24.00 %
2.3	11 – 15 years	25	50.00 %
2.4	More than 15 years	10	20.00 %
3	**Education level**		
3.1	Associate degree	0	0.00 %
3.2	Bachelor degree	33	66.00 %
3.3	Master degree	15	30.00 %
3.4	Doctor degree	2	4.00 %

Table 4.2 The personal information of the population sample for section 1.2, which was collected using a questionnaire regarding factors and skills influencing digital entrepreneurship intelligence (DEI) learning management among secondary students (continued)

No.	**Data type of sample population** Total N = 650	**The number (People)**	**Percent (%)**
3.5	Not specified	0	0.00 %

Section 1.3: Data was collected from a group of five successful leading entrepreneurs at the global level and five at the national level, all of whom were involved in business and entrepreneurial careers. The data collection tool used was the Whole Brain Literacy (WBL) Decoding Manual (Human Brain Function Indicators), based on the WBL Indicators Test (Tayko, 2015). This analysis aimed to identify factors that influence success in business and entrepreneurship.

The researcher referenced a Forbes Thailand (2022) survey that ranked the world's most successful entrepreneur in 2022 based on the value of their assets. The researcher selected five individuals as models for business analysis. Their names are presented in Table 4.3 as follows:

Table 4.3 The rankings and information of global successful entrepreneurs in 2022

Ranking	**Name of business**	**Name of entrepreneur**	**Asset values**	**Type of business**
1	Tesla and SpaceX	Elon Musk	\$2.19 billion	Electric cars and spacecraft
2	Amazon	Jeff Bezos	\$1.71 billion	E-commerce
3	Louis Vuitton	Bernard Arnault	\$1.58 billion	Fashion and cosmetics
4	Microsoft	Bill Gates	\$1.29 billion	Technology and software
5	Google	Larry Page	\$1.11 billion	Technology and software

In addition, according to a Forbes Thailand (2022) survey, which ranked successful Thai entrepreneurs in 2022 based on the value of their assets, the researcher selected 5 individuals as models for business analysis. Their names are presented in Table 4.4 as follows:

Table 4.4 The rankings and information of successful Thai entrepreneurs in 2022

Ranking	Name of business	Name of entrepreneur	Asset values	Type of business
1	CP Group	Dhanin Chearavanont	9.41 billion THB	Complete food production
2	Central Group	Tos Chirathivat	6.70 billion THB	Mall
3	Thai Beverage	Charoen Sirivadhanabhakdi	5.17 billion THB	Food and drinks
4	Gulf Energy Development	Sarath Ratanavadi	1.66 billion THB	Energy
5	Bangkok Dusit Medical Services (BDMS) and Bangkok Airway	Prasert Prasarttong-Osoth	1.08 billion THB	Hospital and Aviation

4.2.2 Demographic Profile of Scope 2: Correlational Research (DEI Prototype-2)

The data on the sample population in Scope 2 was divided into three parts: 1) data from 200 students studying the Science-Mathematics, (Thai program), 2) data from 200 students studying the Art-Language (Thai program), and 3) data from 200 students studying the English program. The total sample population consisted of 600 individuals.

The tools used to collect data included four questionnaires: 1) a questionnaire on the development of digital entrepreneurship (DE) to assess the relationship with the independent variable x1, 2) a questionnaire on the development of entrepreneurship to assess the relationship with the independent variable x2, 3) a questionnaire on the development of digital intelligence (DI) to assess the relationship with the dependent variable y1, and 4) a questionnaire on the development of entrepreneurial intelligence (EI) to assess the relationship with the dependent variable y2. The questionnaires also collected additional demographic information, including the sex of the sample population. The information can be presented as shown in Table 4.5.

Table 4.5 Personal information of sample population in Scope 2 obtained from the questionnaires on digital entrepreneurship (DE), entrepreneurship, digital intelligence (DI), and entrepreneurial intelligence (EI) of secondary students at Montfort College Secondary Section

No.	Data type of sample population Total N = 600	The number (people)	Percent (%)
1	**Education level**		
1.1	Grade 7	100	16.60 %
1.2	Grade 8	100	16.60 %
1.3	Grade 9	100	16.60 %
1.4	Grade 10	100	16.60 %
1.5	Grade 11	100	16.60 %
1.6	Grade 12	100	16.60 %
2	**Gender**		
2.1	Male	375	62.50 %
2.2	Female	225	37.50 %

4.2.3 Demographic Profile of Scope 3: Experimental Research (DEI – WBL Prototype)

Data on the sample size of the population in Scope 3 was divided into two parts: data from the control group of 400 individuals and data from the experimental group of 400 individuals. The sample included 200 students studying the Science-Mathematics (Thai program), 200 students studying the Art-Business (English program), 200 students studying international program, and 200 students studying the Science-Mathematics (Thai program) (the government school). In total, the sample population comprised 800 individuals.

The tools used to collect data included four questionnaires: 1) a questionnaire on the development of digital entrepreneurship (DE), 2) a questionnaire on the development of entrepreneurship, 3) a questionnaire on the development of digital intelligence (DI), and 4) a questionnaire on the development of entrepreneurial intelligence (EI). The information can be presented as shown in Table 4.6.

Table 4.6 Personal information of sample population in Scope 3 obtained from the questionnaires on digital entrepreneurship (DE), entrepreneurship, digital intelligence (DI), and entrepreneurial intelligence (EI) of secondary students at Montfort College Secondary Section

No.	**Data type of sample population Total N = 800**	**The number (people)**	**Percent (%)**
CG.1	**The control group** (N = 400)		
1	**Grade**		
1.1	Grade 7	65	16.25 %
1.2	Grade 8	65	16.25 %
1.3	Grade 9	65	16.25 %
1.4	Grade 10	65	16.25 %
1.5	Grade 11	70	17.50 %
1.6	Grade 12	70	17.50 %
2	**Gender**		
2.1	Male	224	56.00 %
2.2	Female	176	44.00 %
EG.1	**The experimental group** (N = 400)		
1	**Grade**		
1.1	Grade 7	65	16.25 %
1.2	Grade 8	65	16.25 %
1.3	Grade 9	65	16.25 %
1.4	Grade 10	65	16.25 %
1.5	Grade 11	70	17.50 %
1.6	Grade 12	70	17.50 %

Table 4.6 Personal information of sample population in Scope 3 obtained from the questionnaires on digital entrepreneurship (DE), entrepreneurship, digital intelligence (DI), and entrepreneurial intelligence (EI) of secondary students at Montfort College Secondary Section (continued)

No.	Data type of sample population Total N = 800	The number (people)	Percent (%)
2	**Gender**		
2.1	Male	208	52.00 %
2.2	Female	192	48.00 %

The population data used in conducting this research from Section 4.2 can be summarized as a total of 2,360 individuals across all three scopes, which can be shown in Table 4.7 as follows:

Table 4.7 A summary of personal information of the sample population in this research across all three scopes obtained from the questionnaires of the development of digital entrepreneurial intelligence (DEI)

No.	Data type of sample population Total N = 2,360	The number (people)	Percent (%)
1	Gender		
1.1	Male	1,376	58.30%
1.2	Female	984	41.70%
2	Number of secondary students who responded to the questionnaires	1,700	72.03 %
3	Number of parents who responded to the questionnaires	300	12.71 %
4	Number of alumni who responded to the questionnaires	300	12.71 %
5	Number teachers, administrators, educational personnel, and entrepreneurs who responded to the questionnaires	60	2.54 %

Table 4.7 A summary of personal information of the sample population in this research across all three scopes obtained from the questionnaires of the development of digital entrepreneurial intelligence (DEI) (continued)

No.	**Data type of sample population** **Total N = 2,360**	**The number (people)**	**Percent (%)**
6	Business type of non-student respondents (alumni = 300, parents = 300, entrepreneurs = 10)	610	
6.1	Manufacturing	62	10.16 %
6.2	Service	415	68.03 %
6.3	Commercial	133	21.80 %
7	Education levels of the respondents (parents = 300 , alumni = 300 , teachers and administrators = 50)	650	
7.1	Associate degree	4	0.61 %
7.2	Bachelor degree	429	66.00 %
7.3	Master degree	197	30.30 %
7.4	Doctor degree	19	2.92 %
7.5	Not specified	1	0.15 %
8	Parents' occupation	1,700	
8.1	Civil servant	358	21.05 %
8.2	State enterprise employee	336	19.76 %
8.3	Teacher/ lecturer/ academics/ educational personnel	348	20.47 %
8.4	Business owner	463	27.23 %
8.5	Politician	69	4.05 %
8.6	Farmer	35	2.05 %
8.7	Employee	78	4.58 %
8.8	Not specified	13	0.76 %

4.3 Findings

4.3.1 Questionnaire Data Scope 1 Survey Research (DEI Prototype-1): Group 1 (300 Secondary Students)

In Part 1 of the questionnaire from Group 1, data was collected and compiled from 300 secondary students at Montfort College to analyze statistical values related to expectations and needs on digital entrepreneurship (DE) learning management. The data covered 10 factors as follows: Factor 1 (F1) student competency expectations, Factor 2 (F2) student attitude expectations, Factor 3 (F3) student characteristic expectations, Factor 4 (F4) learning curriculum style expectations, Factor 5 (F5) facility/location style expectations, Factor 6 (F6) teaching approach style expectations, Factor 7 (F7) instructor/teacher style expectations, Factor 8 (F8) reasons for self-development expectations, Factor 9 (F9) preference for owning a business in the future, and Factor 10 (F10) future skill development expectations.

The questionnaire data from Part 1, Group 1, from the sample of 300 secondary students, highlighted expectation factors in digital entrepreneurship (DE) learning management. These 10 factors are detailed in Tables 4.8 to 4.17.

Table 4.8 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 1 (F1) student competency expectations from a sample of 300 secondary students

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Aim to develop the competency to solve systematic problems.	The development of analytical and logical thinking	59	19.70 %
I-PU	Aim to develop the competency to plan work effectively.	The development of movement and self-control	48	16.00 %
I-E	Aim to develop the competency to cultivate creative thinking skills.	The development of creativity and imagination	128	42.70 %

Table 4.8 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 1 (F1) student competency expectations from a sample of 300 secondary students (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-PR	Aim to develop the competency to work collaboratively as a team.	The development of emotional and social dimensions	65	21.70 %
	Total		**300**	**100** %

Table 4.9 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 2 (F2) student attitude expectations from a sample of 300 secondary students

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Aim to develop a logical thinking attitude, understanding cause and effect.	The development of analytical and logical thinking	63	21.00 **%**
I-PU	Aim to develop a thoughtful approach towards policies and work procedures for effective order.	The development of movement and self-control	44	14.70 **%**
I-E	Aim to develop a flexible mindset, adapting seamlessly to varying situations.	The development of creativity and imagination	123	41.00 **%**
I-PR	Aim to develop a thoughtful approach for resolving conflicts within society or organizations.	The development of emotional and social dimensions	70	23.30 **%**
	Total		**300**	**100** %

Table 4.10 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 3 (F3) student characteristic expectations from a sample of 300 secondary students

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Aim to develop a determined and resolute personality.	The development of analytical and logical thinking	56	18.70 %
I-PU	Aim to develop a thorough and diligent work ethic.	The development of movement and self-control	51	17.00 %
I-E	Aim to develop self-confidence.	The development of creativity and imagination	109	36.30 %
I-PR	Aim to develop an interactive personality.	The development of emotional and social dimensions	84	28.00 %
Total			**300**	**100** %

Table 4.11 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 4 (F4) learning curriculum style expectations from a sample of 300 secondary students

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Organized as a workshop or short-term training.	The development of analytical and logical thinking	49	16.30 %

Table 4.11 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 4 (F4) learning curriculum style expectations from a sample of 300 secondary students (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-PU	Organized as a curriculum with courses aligned with the school's regular class schedule.	The development of movement and self-control	58	19.30 %
I-E	Organized as an online learning course conducted outside of regular class hours.	The development of creativity and imagination	112	37.30 %
I-PR	Organized as a onsite club or community course.	The development of emotional and social dimensions	81	27.00 %
Total			**300**	**100** %

Table 4.12 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 5 (F5) facility/location style expectations from a sample of 300 secondary students

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Computer lab or workshop training room	The development of analytical and logical thinking	57	19.00 %
I-PU	Regular classroom in school	The development of movement and self-control	50	16.70 %

Table 4.12 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 5 (F5) facility/location style expectations from a sample of 300 secondary students (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-E	Outdoors settings or locations, such as coffee shops, resorts, department stores, etc.	The development of creativity and imagination	118	39.30 %
I-PR	Meeting rooms with small group breakout areas where students can walk around and interact	The development of emotional and social dimensions	75	25.00 %
Total			**300**	**100** %

Table 4.13 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 6 (F6) teaching approach style expectations from a sample of 300 secondary students

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	A practical teaching style focused on hands-on learning	The development of analytical and logical thinking	50	16.70 %
I-PU	A teaching format centered on lectures or theoretical instruction	The development of movement and self-control	57	19.00 %
I-E	A teaching style that emphasizes experiences from internships or field surveys at real-world work sites	The development of creativity and imagination	109	36.30 %

Table 4.13 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 6 (F6) teaching approach style expectations from a sample of 300 secondary students (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-PR	A teaching style that encourages small group participation and discussion for knowledge exchange with others	The development of emotional and social dimensions	84	28.00 %
	Total		**300**	**100** %

Table 4.14 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 7 (F7) instructor/teacher style expectations from a sample of 300 secondary students

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Provide individual feedback to students in every class	The development of analytical and logical thinking	62	20.70 %
I-PU	Measure and evaluate students' progress periodically	The development of movement and self-control	45	15.00 %
I-E	Present strategies and tips relevant to real events or real-life situations in the classroom.	The development of creativity and imagination	107	35.70 %

Table 4.14 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 7 (F7) instructor/teacher style expectations from a sample of 300 secondary students (continued)

I-PR	Organize small groups for students to engage in group discussions or facilitate specific discussion groups to enhance learning communication.	The development of emotional and social dimensions	86	28.70 %
Total			**300**	**100** %

Table 4.15 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 8 (F8) reasons for self-development style expectations from a sample of 300 secondary students

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	To clearly develop potential and be able to pursue a career in their own business in the future	The development of analytical and logical thinking	57	19.00 %
I-PU	To obtain certificates or educational qualifications to use in further studies	The development of movement and self-control	50	16.70 %
I-E	To create opportunities and career options for the future	The development of creativity and imagination	125	41.70 %

Table 4.15 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 8 (F8) reasons for self-development style expectations from a sample of 300 secondary students (continued)

WBL	**Expectations and needs**	**Human brain functions**	**The number (people)**	**Percent (%)**
I-PR	To meet new people and expand your network for future partnerships or business connections	The development of emotional and social dimensions	68	22.70 **%**
	Total		**300**	**100** %

Table 4.16 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 9 (F9) preferring for own business in the future expectations from a sample of 300 secondary students

WBL	**Expectations and needs**	**Human brain functions**	**The number (people)**	**Percent (%)**
I-C	Real estate investment, stock market, gold trading, bonds, exchange rates, etc.	The development of analytical and logical thinking	45	15.00 %
I-PU	Industry, food production, processing, agriculture, etc.	The development of movement and self-control	62	20.70 %
I-E	Technology and new innovations, etc.	The development of creativity and imagination	121	40.30 %
I-PR	Hotels, restaurants, entertainment, etc.	The development of emotional and social dimensions	72	24.00 %
	Total		**300**	**100** %

Table 4.17 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 10 (F10) future development skill expectations from a sample of 300 secondary students

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Analytical skill, financial skill, proactive skill, leadership skill, etc.	The development of analytical and logical thinking	57	19.00 %
I-PU	Organizational skill, consistence, concision, workflow analysis, etc.	The development of movement and self-control	48	16.00 %
I-E	Creative skill, innovative skill, risk taking management, open-minded skill, etc.	The development of creativity and imagination	121	40.30 %
I-PR	Communication skill, conflict management skill, self emotional regulation, negotiate skill, etc.	The development of emotional and social dimensions	74	24.70 %
Total			**300**	**100** %

According to the information in Tables 4.8-4.17, the average expectations and needs of digital entrepreneurship (DE) learning management from 300 secondary students in Scope 1, Group 1, based on the principles of Whole Brain Literacy (WBL) are shown in Table 4.18 as follows:

Table 4.18 The average and analysis of need and expectation factors for digital entrepreneurship (DE) learning management from a sample of 300 secondary students in Scope 1, Group 1, based on the principles of Whole Brain Literacy (WBL)

WBL	Expectations and needs	Human brain functions	The average number (people)	The average percent (%)
I-C	Analytical skill, financial skill, proactive skill, leadership skill, etc.	The development of analytical and logical thinking	56	18.51 %
I-PU	Organizational skill, consistence, concision, workflow analysis, etc.	The development of movement and self-control	51	17.11 %
I-E	Creative skill, innovative skill, risk taking management, open-minded skill, etc.	The development of creativity and imagination	117	39.09 %
I-PR	Communication skill, conflict management skill, self emotional regulation, negotiate skill, etc.	The development of emotional and social dimensions	76	25.31 %
	Total		**300**	**100 %**

4.3.2 Questionnaire Data Scope 1: Group 2 (650 Alumni, Parents, and Teachers)

In Part 1 of the questionnaire from Group 2, data was collected from three groups of stakeholders who involved in the learning management of Montfort College including Group 2.1: 300 alumni, Group 2.2: 300 parents, as well as Group 2.3: 50 teachers and administrators, totaling 650 people. Data was collected and compiled to analyze statistical values related to factors of expectations and needs on digital entrepreneurship (DE) learning management. The data covered 10 factors as follows: Factor 1 (F1) student competency expectations, Factor 2 (F2) student attitude expectations, Factor 3 (F3) student characteristic expectations, Factor 4 (F4) learning curriculum style expectations, Factor 5 (F5) facility/location style expectations, Factor 6 (F6) teaching approach style expectations, Factor 7 (F7) instructor/teacher style expectations, Factor 8 (F8) reasons for self-development expectations, Factor 9 (F9) preference for owning a business in the future, and Factor 10 (F10) future skill development expectations.

The questionnaire data from Part 1, Group 2.1, from the sample of 300 alumni, highlighted expectation factors in digital entrepreneurship (DE) learning management. These 10 factors are detailed in Tables 4.19 to 4.28.

Table 4.19 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 1 (F1) student competency expectation from a sample of 300 alumni

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Aim to develop the competency to solve systematic problems.	The development of analytical and logical thinking	64	21.30 %
I-PU	Aim to develop the competency to plan work effectively.	The development of movement and self-control	64	21.30 %

Table 4.19 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 1 (F1) student competency expectation from a sample of 300 alumni (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-E	Aim to develop the competency to cultivate creative thinking skills.	The development of creativity and imagination	122	40.70 %
I-PR	Aim to develop the competency to work collaboratively as a team.	The development of emotional and social dimensions	50	16.70 %
	Total		**300**	**100** %

Table 4.20 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 2 (F2) student attitude expectations from a sample of 300 alumni

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Aim to develop a logical thinking attitude, understanding cause and effect.	The development of analytical and logical thinking	74	24.30 **%**
I-PU	Aim to develop a thoughtful approach towards policies and work procedures for effective order.	The development of movement and self-control	54	17.80 **%**
I-E	Aim to develop a flexible mindset, adapting seamlessly to varying situations.	The development of creativity and imagination	116	38.20 **%**

Table 4.20 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 2 (F2) student attitude expectations from a sample of 300 alumni (continued)

I-PR	Aim to develop a thoughtful approach for resolving conflicts within society or organizations.	The development of emotional and social dimensions	56	18.40 **%**
Total			**300**	**100** %

Table 4.21 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 3 (F3) student characteristic expectations from a sample of 300 alumni

WBL	**Expectations and needs**	**Human brain functions**	**The number (people)**	**Percent (%)**
I-C	Aim to develop a determined and resolute personality.	The development of analytical and logical thinking	52	17.30 **%**
I-PU	Aim to develop a thorough and diligent work ethic.	The development of movement and self-control	76	25.30 **%**
I-E	Aim to develop self-confidence.	The development of creativity and imagination	98	32.70 **%**
I-PR	Aim to develop an interactive personality.	The development of emotional and social dimensions	74	24.70 **%**
Total			**300**	**100** %

Table 4.22 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 4 (F4) learning curriculum style expectations from a sample of 300 alumni

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Organized as a workshop or short-term training.	The development of analytical and logical thinking	69	23.00 %
I-PU	Organized as a curriculum with courses aligned with the school's regular class schedule.	The development of movement and self-control	59	19.70 %
I-E	Organized as an online learning course conducted outside of regular class hours.	The development of creativity and imagination	118	39.30 %
I-PR	Organized as a onsite club or community course.	The development of emotional and social dimensions	54	18.00 **%**
Total			**300**	**100** %

Table 4.23 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 5 (F5) facility/location style expectations from a sample of 300 alumni

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Computer lab or workshop training room	The development of analytical and logical thinking	63	21.00 %

Table 4.23 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 5 (F5) facility/location style expectations from a sample of 300 alumni (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-PU	Regular classroom in school	The development of movement and self-control	65	21.70 %
I-E	Outdoors settings or locations, such as coffee shops, resorts, department stores, etc.	The development of creativity and imagination	121	40.30 %
I-PR	Meeting rooms with small group breakout areas where students can walk around and interact	The development of emotional and social dimensions	51	17.00 %
	Total		**300**	**100** %

Table 4.24 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 6 (F6) teaching approach style expectations from a sample of 300 alumni

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	A practical teaching style focused on hands-on learning	The development of analytical and logical thinking	59	19.70 %
I-PU	A teaching format centered on lectures or theoretical instruction	The development of movement and self-control	69	23.00 %

Table 4.24 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 6 (F6) teaching approach style expectations from a sample of 300 alumni (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-E	A teaching style that emphasizes experiences from internships or field surveys at real-world work sites	The development of creativity and imagination	115	38.30 %
I-PR	A teaching style that encourages small group participation and discussion for knowledge exchange with others	The development of emotional and social dimensions	57	19.00 %
Total			**300**	**100** %

Table 4.25 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 7 (F7) instructor/teacher style expectations from a sample of 300 alumni

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Provide individual feedback to students in every class	The development of analytical and logical thinking	62	20.70 **%**
I-PU	Measure and evaluate students' progress periodically	The development of movement and self-control	66	22.00 **%**

Table 4.25 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 7 (F7) instructor/teacher style expectations from a sample of 300 alumni (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-E	Present strategies and tips relevant to real events or real-life situations in the classroom.	The development of creativity and imagination	107	35.70 %
I-PR	Organize small groups for students to engage in group discussions or facilitate specific discussion groups to enhance learning communication.	The development of emotional and social dimensions	65	21.70 %
Total			**300**	**100** %

Table 4.26 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 8 (F8) reasons for self-development style expectations from a sample of 300 alumni

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	To clearly develop potential and be able to pursue a career in their own business in the future	The development of analytical and logical thinking	63	21.00 %
I-PU	To obtain certificates or educational qualifications to use in further studies	The development of movement and self-control	65	21.70 %
I-E	To create opportunities and career options for the future	The development of creativity and imagination	119	39.70 %

Table 4.26 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 8 (F8) reasons for self-development style expectations from a sample of 300 alumni (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-PR	To meet new people and expand your network for future partnerships or business connections	The development of emotional and social dimensions	53	17.70 %
	Total		**300**	**100** %

Table 4.27 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 9 (F9) preferring for own business in the future expectations from a sample of 300 alumni

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Real estate investment, stock market, gold trading, bonds, exchange rates, etc.	The development of analytical and logical thinking	63	21.00 %
I-PU	Industry, food production, processing, agriculture, etc.	The development of movement and self-control	65	21.70 %
I-E	Technology and new innovations, etc.	The development of creativity and imagination	112	37.30 %
I-PR	Hotels, restaurants, entertainment, etc.	The development of emotional and social dimensions	60	20.00 %
	Total		**300**	**100** %

Table 4.28 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 10 (F10) future development skill expectations from a sample of 300 alumni

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Analytical skill, financial skill, proactive skill, leadership skill, etc.	The development of analytical and logical thinking	61	20.30 %
I-PU	Organizational skill, consistence, concision, workflow analysis, etc.	The development of movement and self-control	67	22.30 %
I-E	Creative skill, innovative skill, risk taking management, open-minded skill, etc.	The development of creativity and imagination	104	34.70 %
I-PR	Communication skill, conflict management skill, self emotional regulation, negotiate skill, etc.	The development of emotional and social dimensions	68	22.70 %
Total			**300**	**100** %

According to the information in Tables 4.19 - 4.28, the average expectations and needs of digital entrepreneurship (DE) learning management from 300 alumni in Scope 1 Group 2.1, 300 alumni, based on the principles of Whole Brain Literacy (WBL) are shown in Table 4.29 as follows:

Table 4.29 The average and analysis of need and expectation factors for digital entrepreneurship (DE) learning management from a sample of 300 alumni in Scope 1, Group 2.1 based on the principles of Whole Brain Literacy (WBL)

WBL	Expectations and needs	Human brain functions	The average number (people)	The average percent (%)
I-C	Analytical skill, financial skill, proactive skill, leadership skill, etc.	The development of analytical and logical thinking	63	21.00 %
I-PU	Organizational skill, consistence, concision, workflow analysis, etc.	The development of movement and self-control	65	21.67 %
I-E	Creative skill, innovative skill, risk taking management, open-minded skill, etc.	The development of creativity and imagination	133	37.73 %
I-PR	Communication skill, conflict management skill, self emotional regulation, negotiate skill, etc.	The development of emotional and social dimensions	59	19.60 %
Total			**300**	**100 %**

Moreover, the questionnaire data from Part 1, Group 2.2, from the sample of 300 parents, highlighted expectation factors in digital entrepreneurship (DE) learning management. These 10 factors are detailed in Tables 4.30 to 4.39.

Table 4.30 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 1 (F1) student competency expectation from a sample of 300 parents

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Aim to develop the competency to solve systematic problems.	The development of analytical and logical thinking	57	19.00 %
I-PU	Aim to develop the competency to plan work effectively.	The development of movement and self-control	55	18.30 %
I-E	Aim to develop the competency to cultivate creative thinking skills.	The development of creativity and imagination	127	42.30 %
I-PR	Aim to develop the competency to work collaboratively as a team.	The development of emotional and social dimensions	61	20.30 %
Total			**300**	**100** %

Table 4.31 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 2 (F2) student attitude expectations from a sample of 300 parents

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Aim to develop a logical thinking attitude, understanding cause and effect.	The development of analytical and logical thinking	56	18.70 %
I-PU	Aim to develop a thoughtful approach towards policies and work procedures for effective order.	The development of movement and self-control	56	18.70 %

Table 4.31 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 2 (F2) student attitude expectations from a sample of 300 parents (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-E	Aim to develop a flexible mindset, adapting seamlessly to varying situations.	The development of creativity and imagination	132	44.00 %
I-PR	Aim to develop a thoughtful approach for resolving conflicts within society or organizations.	The development of emotional and social dimensions	56	18.70 %
	Total		**300**	**100** %

Table 4.32 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 3 (F3) student characteristic expectations from a sample of 300 parents

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Aim to develop a determined and resolute personality.	The development of analytical and logical thinking	50	16.70 %
I-PU	Aim to develop a thorough and diligent work ethic.	The development of movement and self-control	62	20.70 %
I-E	Aim to develop self-confidence.	The development of creativity and imagination	119	39.70 %

Table 4.32 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 3 (F3) student characteristic expectations from a sample of 300 parents (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-PR	Aim to develop an interactive personality.	The development of emotional and social dimensions	68	22.70%
	Total		**300**	**100** %

Table 4.33 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 4 (F4) learning curriculum style expectations from a sample of 300 parents

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Organized as a workshop or short-term training.	The development of analytical and logical thinking	54	18.00 %
I-PU	Organized as a curriculum with courses aligned with the school's regular class schedule.	The development of movement and self-control	58	19.30 %
I-E	Organized as an online learning course conducted outside of regular class hours.	The development of creativity and imagination	122	40.70 %
I-PR	Organized as a onsite club or community course.	The development of emotional and social dimensions	66	22.00 %
	Total		**300**	**100** %

Table 4.34 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 5 (F5) facility/location style expectations from a sample of 300 parents

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Computer lab or workshop training room	The development of analytical and logical thinking	60	20.00 %
I-PU	Regular classroom in school	The development of movement and self-control	52	17.30 %
I-E	Outdoors settings or locations, such as coffee shops, resorts, department stores, etc.	The development of creativity and imagination	128	42.70 %
I-PR	Meeting rooms with small group breakout areas where students can walk around and interact	The development of emotional and social dimensions	60	20.00 %
	Total		**300**	**100** %

Table 4.35 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 6 (F6) teaching approach style expectations from a sample of 300 parents

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	A practical teaching style focused on hands-on learning	The development of analytical and logical thinking	57	19.00 %
I-PU	A teaching format centered on lectures or theoretical instruction	The development of movement and self-control	55	18.30 %

Table 4.35 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 6 (F6) teaching approach style expectations from a sample of 300 parents (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-E	A teaching style that emphasizes experiences from internships or field surveys at real-world work sites	The development of creativity and imagination	119	39.70 %
I-PR	A teaching style that encourages small group participation and discussion for knowledge exchange with others	The development of emotional and social dimensions	69	23.00 %
Total			**300**	**100** %

Table 4.36 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 7 (F7) instructor/teacher style expectations from a sample of 300 parents

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Provide individual feedback to students in every class	The development of analytical and logical thinking	60	20.00 %
I-PU	Measure and evaluate students' progress periodically	The development of movement and self-control	52	17.30 %
I-E	Present strategies and tips relevant to real events or real-life situations in the classroom.	The development of creativity and imagination	125	41.70 %

Table 4.36 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 7 (F7) instructor/teacher style expectations from a sample of 300 parents (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-PR	Organize small groups for students to engage in group discussions or facilitate specific discussion groups to enhance learning communication.	The development of emotional and social dimensions	63	21.00 %
	Total		**300**	**100** %

Table 4.37 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 8 (F8) reasons for self-development style expectations from a sample of 300 parents

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	To clearly develop potential and be able to pursue a career in their own business in the future	The development of analytical and logical thinking	51	17.00 %
I-PU	To obtain certificates or educational qualifications to use in further studies	The development of movement and self-control	61	20.30 %
I-E	To create opportunities and career options for the future	The development of creativity and imagination	122	40.70 %

Table 4.37 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 8 (F8) reasons for self-development style expectations from a sample of 300 parents (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-PR	To meet new people and expand your network for future partnerships or business connections	The development of emotional and social dimensions	66	22.00 %
	Total		**300**	**100** %

Table 4.38 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 9 (F9) preferring for own business in the future expectations from a sample of 300 parents

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Real estate investment, stock market, gold trading, bonds, exchange rates, etc.	The development of analytical and logical thinking	56	18.70 %
I-PU	Industry, food production, processing, agriculture, etc.	The development of movement and self-control	56	18.70 %
I-E	Technology and new innovations, etc.	The development of creativity and imagination	125	41.70 %
I-PR	Hotels, restaurants, entertainment, etc.	The development of emotional and social dimensions	63	21.00 %
	Total		**300**	**100** %

Table 4.39 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 10 (F10) future development skill expectations from a sample of 300 parents

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Analytical skill, financial skill, proactive skill, leadership skill, etc.	The development of analytical and logical thinking	51	16.80 %
I-PU	Organizational skill, consistence, concision, workflow analysis, etc.	The development of movement and self-control	61	20.10 %
I-E	Creative skill, innovative skill, risk taking management, open-minded skill, etc.	The development of creativity and imagination	112	36.80 %
I-PR	Communication skill, conflict management skill, self emotional regulation, negotiate skill, etc.	The development of emotional and social dimensions	76	25.00 %
Total			**300**	**100** %

According to the information in Tables 4.30 - 4.39, the average expectations and needs of digital entrepreneurship (DE) learning management from 300 parents in Scope 1, Group 2.2, based on the principles of Whole Brain Literacy (WBL) are shown in Table 4.40 as follows:

Table 4.40 The average and analysis of need and expectation factors for digital entrepreneurship (DE) learning management from a sample of 300 parents in Scope 1, Group 2.2 based on the principles of Whole Brain Literacy (WBL)

WBL	Expectations and needs	Human brain functions	The average number (people)	The average percent (%)
I-C	Analytical skill, financial skill, proactive skill, leadership skill, etc.	The development of analytical and logical thinking	55	18.41 %
I-PU	Organizational skill, consistence, concision, workflow analysis, etc.	The development of movement and self-control	57	18.92 %
I-E	Creative skill, innovative skill, risk taking management, open-minded skill, etc.	The development of creativity and imagination	123	41.04 %
I-PR	Communication skill, conflict management skill, self emotional regulation, negotiate skill, etc.	The development of emotional and social dimensions	65	21.63 %
	Total		**300**	**100 %**

The questionnaire data from Part 1, Group 2.3, from the sample of 50 teachers and administrators, highlighted expectation factors in digital entrepreneurship (DE) learning management. These 10 factors are detailed in Tables 4.41 to 4.50.

Table 4.41 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 1 (F1) student competency expectation from a sample of 50 teachers and administrators

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Aim to develop the competency to solve systematic problems.	The development of analytical and logical thinking	5	10.00 %
I-PU	Aim to develop the competency to plan work effectively.	The development of movement and self-control	12	24.00 %
I-E	Aim to develop the competency to cultivate creative thinking skills.	The development of creativity and imagination	25	50.00 %
I-PR	Aim to develop the competency to work collaboratively as a team.	The development of emotional and social dimensions	8	16.00 %
Total			**50**	**100** %

Table 4.42 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 2 (F2) student attitude expectations from a sample of 50 teachers and administrators

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Aim to develop a logical thinking attitude, understanding cause and effect.	The development of analytical and logical thinking	7	14.00 %
I-PU	Aim to develop a thoughtful approach towards policies and work procedures for effective order.	The development of movement and self-control	10	20.00 %
I-E	Aim to develop a flexible mindset, adapting seamlessly to varying situations.	The development of creativity and imagination	23	46.00 %
I-PR	Aim to develop a thoughtful approach for resolving conflicts within society or organizations.	The development of emotional and social dimensions	10	20.00 %
Total			**50**	**100** %

Table 4.43 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 3 (F3) student characteristic expectations from a sample of 50 teachers and administrators

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Aim to develop a determined and resolute personality.	The development of analytical and logical thinking	6	12.00 %

Table 4.43 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 3 (F3) student characteristic expectations from a sample of 50 teachers and administrators (continued)

WBL	**Expectations and needs**	**Human brain functions**	**The number (people)**	**Percent (%)**
I-PU	Aim to develop a thorough and diligent work ethic.	The development of movement and self-control	11	22.00 %
I-E	Aim to develop self-confidence.	The development of creativity and imagination	22	44.00 %
I-PR	Aim to develop an interactive personality.	The development of emotional and social dimensions	11	22.00 %
	Total		**50**	**100** %

Table 4.44 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 4 (F4) learning curriculum style expectations from a sample of 50 teachers and administrators

WBL	**Expectations and needs**	**Human brain functions**	**The number (people)**	**Percent (%)**
I-C	Organized as a workshop or short-term training.	The development of analytical and logical thinking	4	8.00 %
I-PU	Organized as a curriculum with courses aligned with the school's regular class schedule.	The development of movement and self-control	13	26.00 %
I-E	Organized as an online learning course conducted outside of regular class hours.	The development of creativity and imagination	26	52.00 %

Table 4.44 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 4 (F4) learning curriculum style expectations from a sample of 50 teachers and administrators (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-PR	Organized as a onsite club or community course.	The development of emotional and social dimensions	7	14.00 %
	Total		**50**	**100** %

Table 4.45 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 5 (F5) facility/location style expectations from a sample of 50 teachers and administrators

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Computer lab or workshop training room	The development of analytical and logical thinking	6	12.00 %
I-PU	Regular classroom in school	The development of movement and self-control	11	22.00 %
I-E	Outdoors settings or locations, such as coffee shops, resorts, department stores, etc.	The development of creativity and imagination	27	54.00 %
I-PR	Meeting rooms with small group breakout areas where students can walk around and interact	The development of emotional and social dimensions	6	12.00 %
	Total		**50**	**100** %

Table 4.46 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 6 (F6) teaching approach style expectations from a sample of 50 teachers and administrators

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	A practical teaching style focused on hands-on learning	The development of analytical and logical thinking	3	6.00 %
I-PU	A teaching format centered on lectures or theoretical instruction	The development of movement and self-control	14	28.00 %
I-E	A teaching style that emphasizes experiences from internships or field surveys at real-world work sites	The development of creativity and imagination	21	42.00 %
I-PR	A teaching style that encourages small group participation and discussion for knowledge exchange with others	The development of emotional and social dimensions	12	24.00 %
	Total		**50**	**100** %

Table 4.47 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 7 (F7) instructor/teacher style expectations from a sample of 50 teachers and administrators

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Provide individual feedback to students in every class	The development of analytical and logical thinking	6	12.00 %

Table 4.47 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 7 (F7) instructor/teacher style expectations from a sample of 50 teachers and administrators (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-PU	Measure and evaluate students' progress periodically	The development of movement and self-control	11	22.00 %
I-E	Present strategies and tips relevant to real events or real-life situations in the classroom.	The development of creativity and imagination	26	52.00 %
I-PR	Organize small groups for students to engage in group discussions or facilitate specific discussion groups to enhance learning communication.	The development of emotional and social dimensions	7	14.00 %
Total			**50**	**100** %

Table 4.48 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 8 (F8) reasons for self-development style expectations from a sample of 50 teachers and administrators

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	To clearly develop potential and be able to pursue a career in their own business in the future	The development of analytical and logical thinking	7	14.00 %
I-PU	To obtain certificates or educational qualifications to use in further studies	The development of movement and self-control	10	20.00 %

Table 4.48 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 8 (F8) reasons for self-development style expectations from a sample of 50 teachers and administrators (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-E	To create opportunities and career options for the future	The development of creativity and imagination	24	48.00 %
I-PR	To meet new people and expand your network for future partnerships or business connections	The development of emotional and social dimensions	9	18.00 %
	Total		**50**	**100** %

Table 4.49 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 9 (F9) preferring for own business in the future expectations from a sample of 50 teachers and administrators

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Real estate investment, stock market, gold trading, bonds, exchange rates, etc.	The development of analytical and logical thinking	3	6.00 %
I-PU	Industry, food production, processing, agriculture, etc.	The development of movement and self-control	14	28.00 %
I-E	Technology and new innovations, etc.	The development of creativity and imagination	24	48.00 %

Table 4.49 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 9 (F9) preferring for own business in the future expectations from a sample of 50 teachers and administrators (continued)

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-PR	Hotels, restaurants, entertainment, etc.	The development of emotional and social dimensions	9	18.00 %
Total			**50**	**100** %

Table 4.50 Expectation factors on the digital entrepreneurship (DE) learning management in Factor 10 (F10) future development skill expectations from a sample of 50 teachers and administrators

WBL	Expectations and needs	Human brain functions	The number (people)	Percent (%)
I-C	Analytical skill, financial skill, proactive skill, leadership skill, etc.	The development of analytical and logical thinking	7	14.00 %
I-PU	Organizational skill, consistence, concision, workflow analysis, etc.	The development of movement and self-control	10	20.00 %
I-E	Creative skill, innovative skill, risk taking management, open-minded skill, etc.	The development of creativity and imagination	23	46.00 %
I-PR	Communication skill, conflict management skill, self emotional regulation, negotiate skill, etc.	The development of emotional and social dimensions	10	20.00 %
Total			**50**	**100** %

According to the information in Tables 4.41 - 4.50, the average expectations and needs of digital entrepreneurship (DE) learning management from 50 teachers and administrators in Scope 1, Group 2.3, based on the principles of Whole Brain Literacy (WBL) are shown in Table 4.51 as follows:

Table 4.51 The average and analysis of need and expectation factors for digital entrepreneurship (DE) learning management from a sample of 50 teachers and administrators in Scope 1, Group 2.3 based on the principles of Whole Brain Literacy (WBL)

WBL	Expectations and needs	Human brain functions	The average number (people)	The average percent (%)
I-C	Analytical skill, financial skill, proactive skill, leadership skill, etc.	The development of analytical and logical thinking	5	10.80 %
I-PU	Organizational skill, consistence, concision, workflow analysis, etc.	The development of movement and self-control	12	23.20 %
I-E	Creative skill, innovative skill, risk taking management, open-minded skill, etc.	The development of creativity and imagination	24	48.20 %

Table 4.51 The average and analysis of need and expectation factors for digital entrepreneurship (DE) learning management from a sample of 50 teachers and administrators in Scope 1, Group 2.3 based on the principles of Whole Brain Literacy (WBL) (continued)

WBL	Expectations and needs	Human brain functions	The average number (people)	The average percent (%)
I-PR	Communication skill, conflict management skill, self emotional regulation, negotiates skill, etc.	The development of emotional and social dimensions	9	17.80 %
Total			**50**	**100 %**

4.3.3 Questionnaire Data Scope 1: Group 3 (10 Successful Entrepreneurs)

The Whole Brain Literacy (WBL) Decoding Manual (Human Brain Function Indicators) which decodes the thinking patterns, were analyzed from the sample of 10 successful entrepreneurs using WBL principles across four areas. These entrepreneurs were divided into two levels: 1) international level, consisting of five individuals, and 2) national level, also consisting of five individuals. The analysis and summary of results can be illustrated in Tables 4.52 - 4.53 as follows:

Table 4.52 Summary and analysis of the thinking patterns of a sample group of five global entrepreneurs, in alignment with the principles of Whole Brain Literacy (WBL)

No.	Name and surname	Source of analysis	Average percent (%) WBL Decoding			
			I-C	I-PU	I-E	I-PR
1	Elon Musk (Tesla and SpaceX)	ChatGPT 3.5	40.00	5.00	52.00	3.00
2	Jeff Bezos (Amazon.com)	ChatGPT 3.5	35.00	7.00	45.00	13.00

Table 4.52 Summary and analysis of the thinking patterns of a sample group of five global entrepreneurs, in alignment with the principles of Whole Brain Literacy (WBL) (continued)

No.	Name and surname	Source of analysis	Average percent (%) WBL Decoding			
			I-C	I-PU	I-E	I-PR
3	Bernard Arnault (Louis Vuitton)	ChatGPT 3.5	39.00	2.00	45.00	14.00
4	Bill Gates (Microsoft Corp.)	ChatGPT 3.5	32.00	4.00	57.00	7.00
5	Larry Page (Google.com)	ChatGPT 3.5	41.00	2.00	47.00	10.00
		Total Average Mean (%)	**37.50**	**4.00**	**49.20**	**9.40**

Table 4.53 Summary and analysis of the thinking patterns of a sample group of 5 Thai entrepreneurs, in alignment with the principles of Whole Brain Literacy (WBL)

No.	Name and surname	Source of analysis	Average percent (%) WBL Decoding			
			I-C	I-PU	I-E	I-PR
1	Dhanin Chearavanont (CP Group)	ChatGPT 3.5	35.00	2.00	41.00	22.00
2	Tos Chirathivat (Central Group)	ChatGPT 3.5	32.00	3.00	40.00	25.00
3	Charoen Sirivadhanabhakdi (Thai Berverage)	ChatGPT 3.5	45.00	3.00	49.00	3.00
4	Sarath Ratanavadi (GULF Power Generation)	ChatGPT 3.5	47.00	2.00	50.00	1.00

Table 4.53 Summary and analysis of the thinking patterns of a sample group of 5 Thai entrepreneurs, in alignment with the principles of Whole Brain Literacy (WBL) (continued)

No.	Name and surname	Source of analysis	Average percent (%) WBL Decoding			
			I-C	I-PU	I-E	I-PR
5	Prasert Prasarttong-Osoth (BDMS)	ChatGPT 3.5	35.00	4.00	45.00	16.00
		Total Average Mean (%)	**38.80**	**2.80**	**45.00**	**13.40**

The analysis of data from Scope 1: Survey Research (DEI Prototype-1) examined relationships with factors and variables of expectations and needs on digital entrepreneurial intelligence (DEI) learning management among secondary students. The sample population consisted of three groups: 1) students, 2) stakeholders in teaching and learning, and 3) successful entrepreneurs at the global level and in Thailand. The results can be summarized as an average percentage that aligns with the principles of Whole Brain Literacy (WBL), as shown in Table 4.54.

Table 4.54 The average percentage of expectations and needs on digital entrepreneurial intelligence (DEI) learning management among secondary students and the relationships with the principles of Whole Brain Literacy (WBL) in Scope 1 – Survey Research (DEI Prototype – 1)

No.	Sample population	The number (people)	Average percentage (%) Whole Brain Literacy (WBL)			
			I-C	I-PU	I-E	I-PR
1	Current students	300	18.51 %	17.11 %	39.09 %	25.31 %
2.1	Alumni	300	21.00 %	21.67 %	37.73 %	19.60 %
2.2	Parents	300	18.41 %	18.92 %	41.04 %	21.63 %

Table 4.54 The average percentage of expectations and needs on digital entrepreneurial intelligence (DEI) learning management among secondary students and the relationships with the principles of Whole Brain Literacy (WBL) in Scope 1 – Survey Research (DEI Prototype – 1) (continued)

No.	Sample population	The number (people)	Average percentage (%) Whole Brain Literacy (WBL)			
			I-C	**I-PU**	**I-E**	**I-PR**
2.3	Teachers and administrators	50	10.80 %	23.20 %	48.20 %	17.80 %
3.1	Entrepreneurs at a global level	5	37.50 %	4.00 %	49.20 %	9.40 %
3.2	Entrepreneurs in Thailand	5	38.80 %	2.80 %	45.00 %	13.40 %
	Total	**960**	**24.17 %**	**14.62 %**	**43.38 %**	**17.86 %**

From Table 4.54 above, the data analysis and explanation based on the principles of Whole Brain Literacy (WBL) can be summarized as follows: Among the six sample population groups, it was observed that a sample group of entrepreneurs in Thailand emphasized the use of the anterior left brain lobe, or I-C (I-Control, responsible for the dimension of analytical and logical thinking - learning through the process of systematic thinking/thinkers and analysts), the most, comprising 38.80 percent.

In addition, it was also discovered that the sample population of teachers and administrators placed the greatest importance on utilizing the posterior left brain lobe, or I-PU (I-Pursue, responsible for the dimensions of movement and self-control - learning through the processes of reading and studying regulations/organizers and inspectors), accounting for 23.20 percent.

The analysis revealed that the sample population of global entrepreneurs prioritized the use of the anterior right brain lobe, or I-E (I-Explore, responsible for the dimension of creativity and imagination - learning through the processes of operating, experimenting and taking risks/experimenters, creators, and innovators) the most, accounting for 49.20 percent.

Furthermore, the sample population of students placed importance on utilizing posterior right brain lobe, or I-PR (I-Preserve, responsible for emotional and social dimension - learning through the processes of listening, sharing experiences, and working with others/helpers and coordinators) the most, comprising 25.31 percent.

A summary of the analysis of expectations and needs for the development of digital entrepreneurship teaching and learning for the six population samples of Scope 1 – Survey Research (DEI Prototype-1), totaling 960 people according to the principles of WBL, can be displayed in Figure 4.1.

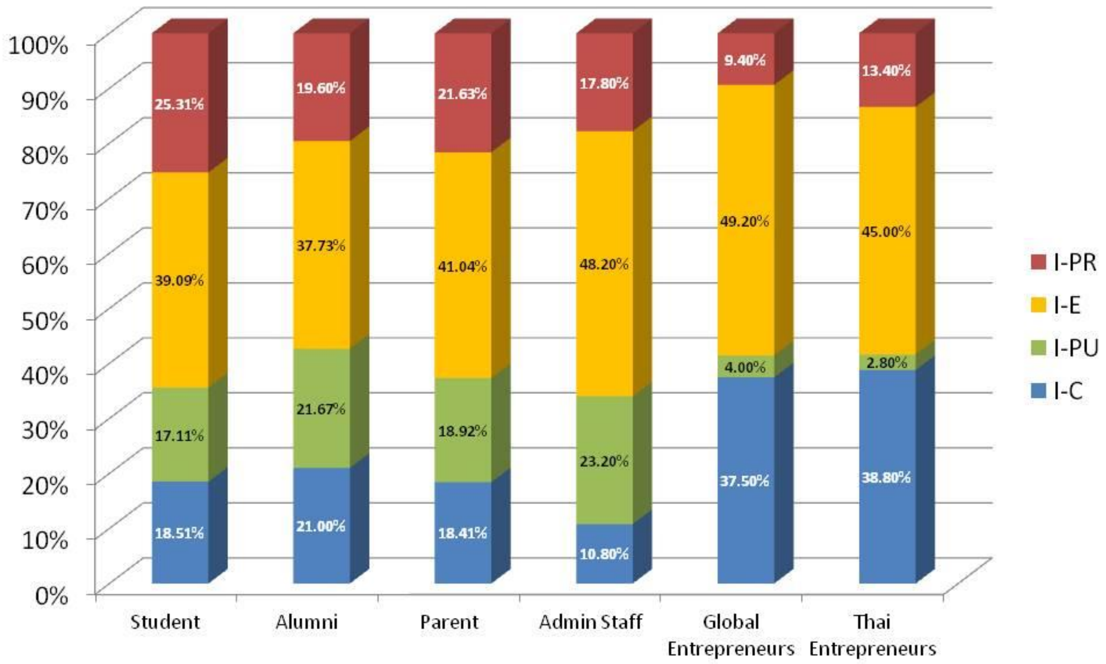


Figure 4.1 A summary of the analysis of expectations and needs for the development of digital entrepreneurship teaching and learning based on WBL from the population samples of Scope 1 – Survey Research (DEI Prototype-1)

From the summary and analysis above, a simulation of the brain's function can be created according to the principles of WBL. This simulation aimed to compare the needs and expectations of digital entrepreneurship teaching and learning styles across all six population groups. The results are illustrated in Figure 4.2, as follows:

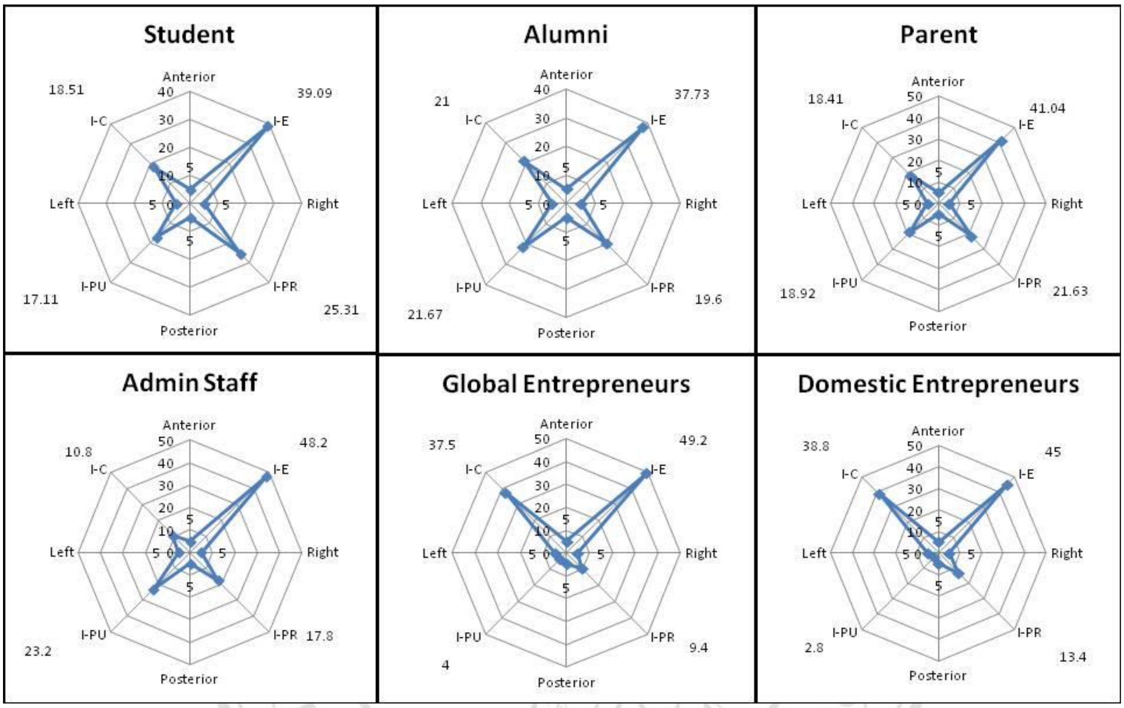


Figure 4.2 A comparison of the brain's function based on WBL across the population samples in Scope 1 about expectations and needs on the development of digital entrepreneurship learning and teaching styles

From Figure 4.3.3.2, the results of the data analysis can be summarized and explained as follows:

1) Student group: For expectations and needs on digital entrepreneurship learning styles, it was found that the average percentage of the anterior right brain lobe or I-E (I-Explore, which is responsible for the dimensions of creativity and imagination - learning through the processes of operating, experimenting, and taking risks/experimenters, creators, and innovators) is the highest, accounting for 39.09 percent. Conversely, the average percentage of the posterior left brain lobe or I-PU (I-Pursue, responsible for the dimensions of movement and self-control - learning through the processes of reading and studying regulations/organizers and inspectors) is the lowest, accounting for 17.11 percent.

2) Alumni group: For expectations and needs on digital entrepreneurship learning styles, it was found that the average percentage of the anterior right brain lobe or I-E (I-Explore, which is responsible for the dimensions of creativity and imagination - learning through the processes of operating, experimenting, and taking risks/experimenters, creators, and innovators) is the highest, accounting for 37.73 percent. In contrast, the average percentage of the posterior right brain lobe or I-PR (I-Perserve, responsible for the emotions and social dimension - learning through the processes of listening, sharing experiences and working with others/helpers and coordinators) is the lowest, accounting for 19.60 percent.

3) Parent group: For expectations and needs on digital entrepreneurship learning styles, it was found that the average percentage of the anterior right brain lobe or I-E (I-Explore, which is responsible for the dimensions of creativity and imagination - learning through the processes of operating, experimenting, and taking risks/experimenters, creators, and innovators) is the highest, accounting for 41.40 percent. On the other hand, the average percentage of the anterior left brain lobe or I-C (I-Control, responsible for the dimensions of analytical and logical thinking - learning through the process of systematic thinking/thinkers and analysts) is the lowest, accounting for 18.41 percent.

4) Teacher and administrator group: For expectations and needs on digital entrepreneurship learning styles, it was found that the average percentage of the anterior right brain lobe or I-E (I-Explore, which is responsible for the dimensions of creativity and imagination - learning through the processes of operating, experimenting, and taking risks/experimenters, creators, and innovators) is the highest, accounting for 48.20 percent. Conversely, the average percentage of the anterior left brain lobe or I-C (I-Control, responsible for the dimensions of analytical and logical thinking - learning through the process of systematic thinking/thinkers and analysts) is the lowest, accounting for 10.80 percent.

5) Global entrepreneurs group: For expectations and needs on digital entrepreneurship learning styles, it was found that the average percentage of the anterior right brain lobe or I-E (I-Explore, which is responsible for the dimensions of creativity and imagination - learning through the processes of operating, experimenting, and taking

risks/experimenters, creators, and innovators) is the highest, accounting for 49.20 percent. In contrast, the average percentage of the posterior left brain lobe or I-PU (I-Pursue, responsible for the dimensions of movement and self-control - learning through the processes of reading and studying regulations/organizers and inspectors) is the lowest, accounting for 4.00 percent.

6) National entrepreneurs group: For expectations and needs on digital entrepreneurship learning styles, it was found that the average percentage of the anterior right brain lobe or I-E (I-Explore, which is responsible for the dimensions of creativity and imagination - learning through the processes of operating, experimenting, and taking risks/experimenters, creators, and innovators) is the highest, accounting for 45.00 percent. Conversely, the average percentage of the posterior left brain lobe or I-PU (I-Pursue, responsible for the dimensions of movement and self-control - learning through the processes of reading and studying regulations/organizers and inspectors) is the lowest, accounting for 2.80 percent.

The researcher summarized the mean percentage (DEI Prototype-1) using the principles of WBL to develop it into a prototype digital entrepreneurship teaching and learning style management. The ratio of the average percentage of management styles from the sample population to develop the DEI Prototype-1 can be concluded as follows:

1) The average percentage of the anterior left brain or I-C (I-Control, responsible for analytical and logical thinking dimensions - learning through the systematic thinking/thinkers and analysts process) is 24.17 percent.

2) The average percentage of the posterior left brain or I-PU (I-Pursue, responsible for the dimensions of movement and self-control - learning through the processes of reading and studying regulations/organizers and inspectors) is 14.62 percent.

3) The average percentage of the anterior right brain or I-E (I-Explore, responsible for the dimensions of creativity and imagination - learning through the processes of operating, experimenting, and taking risks/experimenters, creators, and innovators) is 43.38 percent.

4) The average percentage of the posterior right brain or I-PR (I-Preserve, responsible for emotions and social dimension – learning through the processes of

listening, sharing experiences, and working with others/helpers and coordinators) accounted for 17.86 percent.

Therefore, it can be summarized as the working ratio of WBL of DEI Prototype-1 in organizing the digital entrepreneurship teaching model for secondary students as follows:

I-C: I-PU:I-E: I-PR = 24.17%: 14.62%: 43.38%: 17.86%

Alternatively, it can be specified in the form of a table of relationships between the four factors of WBL and the percentage ratio of brain functions obtained from Scope 1, as shown in Table 4.55.

Table 4.55 The relationships between the four factors of WBL and the percentage ratio of brain functions from Scope 1

WBL	I-C	I-PU	I-E	I-PR
Brain Functions	The development of analytical and logical thinking	The development of movement and self-control	The development of creativity and imagination	The development of emotional and social dimension
Brain Map	Anterior left brain lobe	Posterior left brain lobe	Anterior right brain lobe	Posterior right brain lobe
Percentage	*24.17%*	*14.62%*	*43.38%*	*17.86%*
Simplified percentage	*24%*	*15%*	*43%*	*18%*

From the average percentage ratio of the four brain functions according to the principles of WBL above, it can be utilized in designing DEI Prototype-1 for the digital entrepreneurship learning management for secondary students. This can be explained as follows: The ratio of activity in the anterior left brain lobe, or I-C, has a mean percentage of 24.17. The ratio of activity in the posterior left brain lobe, or I-PU, has a mean percentage of 14.62. The ratio of activity in the anterior right brain lobe, or I-E, has a mean percentage of 43.38. Finally, the ratio of activity in the posterior right brain lobe, or I-PR, has an average percentage of 17.86. These ratios can be modeled as a 4-sided brain function model according to WBL principles, as shown in Figure 4.3 below.

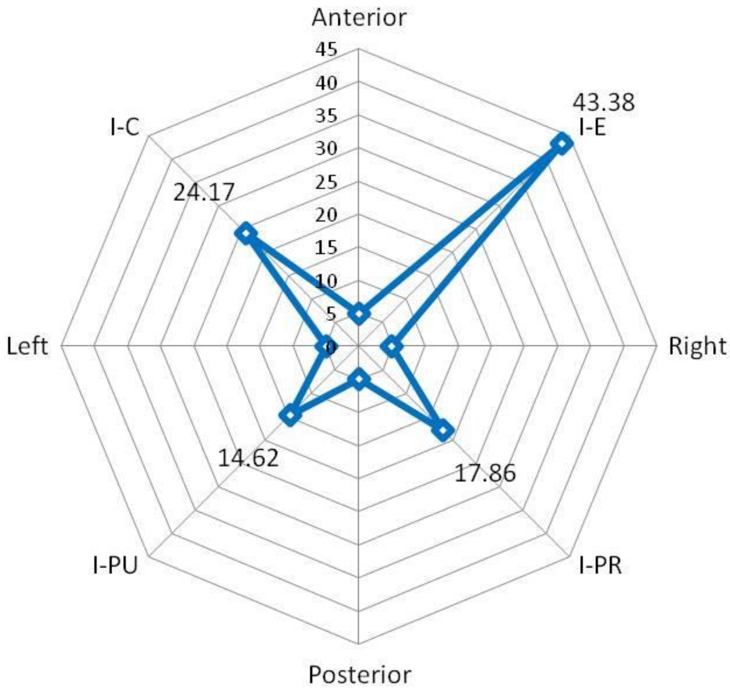


Figure 4.3 The DEI Prototype-1, a 4-sided brain function model according to WBL principles regarding expectations and needs on the digital entrepreneurship learning development among the population sample in Scope 1 – Survey Research

From Figure 4.3, it can be summarized and further explained as follows: The I-E factor, or the anterior right brain lobe, which are related to the development of creativity and imagination, has the greatest influence on the development of digital entrepreneurial intelligence (DEI) in the sample population. It is followed by the I-C factor, or the anterior left brain lobe, which are related to the development of analytical and logical thinking. The third most important factor is the I-PR factor, or the posterior right brain lobe, which is related to the development of emotional and social dimensions. The factor that affects the development of digital entrepreneurial intelligence (DEI) in the sample population the least is the I-PU factor, or the posterior left brain lobe, which is related to the development of movement and self-control.

The researcher then utilized the ratios obtained from these averages to design a prototype learning and activity management model, or DEI Prototype-1, and tested it with the population in Scope 3.

4.3.4 Questionnaire Data Scope 2: Correlational Research (DEI Prototype – 2) (600 secondary students)

The next step involved collecting and analyzing data in Scope 2 – Correlational Research (DEI Prototype-2), which comprised four sets of questionnaires, divided into five parts as follows:

Questionnaire set 1 was about the development of digital entrepreneurship (DE), consisting of eight independent variables: x101 = Cloud computing, x102 = artificial intelligence (AI), x103 = Internet of Things (IoT), x104 = digital business laws, x105 = big data, x106 = blockchain, x107 = FinTech, and x108 = creative social media. Each variable had five items, totaling 40 items.

Questionnaire set 2 was about the development of entrepreneurship, consisting of four independent variables: x201 = business idea and business operation, x202 = marketing plan, x203 = financial plan, and x204 = business project. Each variable had five items, totaling 20 items.

Questionnaire set 3 was about the development of digital intelligence (DI), consisting of eight dependent variables: y101 = digital identity, y102 = digital use, y103 = digital safety, y104 = digital security, y105 = digital emotional intelligence, y106 = digital communication, y107 = digital literacy, and y108 = digital rights. Each variable had five items, totaling 40 items.

Questionnaire set 4 was about the development of entrepreneurial intelligence (EI), consisting of 16 dependent variables: y2001 = leadership, y2002 = planning skill, y2003 = proactive skill, y2004 = analytical thinking, y2005 = self-behavior regulation, y2006 = risk reduction, y2007 = punctuality, y2008 = organizational skill, y2009 = creativity, y2010 = innovativeness, y2011 = visionary, y2012 = risk-taking, y2013 = interpersonal, y2014 = emotional regulation, y2015 = communication skill, and y2016 = team building. Each variable had four items, totaling 64 items.

Each sample completed the 4 sets of questionnaires mentioned above, and the sample population in Scope 2 consisted of: 1) a group of 200 students studying a Science-Mathematics program, 2) a group of 200 students an Art program, 3) a group of 200 students studying an English Program, resulting in a total of 600 people. After that, the researcher analyzed the relationship between the data sets of the independent variables (x) and the dependent variables (y) using the principles of Pearson's product moment correlation coefficient, as shown in Table 56

Table 4.56 The data analysis to determine the relationship between the data sets of the independent variables (x) and the dependent variables (y) using the principles of Pearson's product moment correlation coefficient (N=600)

Variables	X101	X102	X103	X104	X105	X106	X107	X108	X201	X202	X203	X204	Y
X101	1												
X102	*0.184***	1											
X103	0.035	0.040	1										
X104	0.210	0.003	-0.003	1									
X105	-0.014	*-0.070**	0.012	0.007	1								
X106	0.001	-0.029	-0.007	0.000	*-0.201***	1							
X107	0.031	0.045	*0.134***	*-0.130***	-0.028	-0.005	1						
X108	-0.010	0.012	-0.027	*-0.132***	-0.017	-0.038	0.021	1					
X201	-0.005	-0.004	0.034	0.058	0.030	-0.037	-0.001	*0.218***	1				
X202	0.028	-0.004	-0.039	-0.065	0.002	0.000	*0.069**	0.062	0.036	1			
X203	0.010	0.054	-0.038	-0.070*	0.004	0.002	0.040	0.041	0.059	*0.451***	1		
X204	-0.046	0.038	-0.004	-0.007	0.001	-0.005	-0.031	0.005	0.034	*-0.228***	*0.232***	1	
Y	0.029	0.016	-0.027	0.002	0.042	-0.004	0.012	-0.030	0.017	*0.120***	*0.073**	0.018	1

** Correlation is Significant at the 0.01 level (P value < 0.01), * Correlation is Significant at the 0.05 level (P value < 0.05)

According to Table 4.56, the relationship between various variables can be explained as follows.

1) The correlation analysis of independent variables related to digital entrepreneurship (x1) revealed several significant relationships among Group 1 variables. Specifically, big data (x101) and Fin Tech (x102) demonstrated a correlation coefficient (r) of 0.184, significant at the 0.01 level. Similarly, Block chain (x103) and artificial intelligence (AI) (x107) showed a correlation coefficient (r) of 0.134, significant at the 0.01 level. Additionally, artificial intelligence (AI) (x107) and marketing plan (x202) exhibited a correlation coefficient (r) of 0.069, significant at the 0.05 level. Furthermore, Cloud computing (x108) and business idea and operation (x201) demonstrated a correlation coefficient (r) of 0.218, significant at the 0.01 level.

2) The correlation analysis of independent variables related to digital entrepreneurship (x1) also identified relationships in the opposite direction among Group 2 variables. For instance, Fin Tech (x102) and Internet of Things (x105) displayed a correlation coefficient (r) of -0.070, significant at the 0.05 level. Similarly, digital business laws (x104) and artificial intelligence (AI) (x107) showed a correlation coefficient (r) of -0.130, significant at the 0.01 level. Additionally, digital business laws (104) and Cloud computing (x108) exhibited a correlation coefficient (r) of -0.132, significant at the 0.01 level. Moreover, digital business laws (104) and financial plan (x203) demonstrated a correlation coefficient (r) of -0.132, significant at the 0.01 level. Lastly, Internet of Things (x105) and creative social media (x106) displayed a correlation coefficient (r) of -0.201, significant at the 0.01 level.

3) The correlation analysis of independent variables related to entrepreneurship (x2) indicated significant relationships among Group 1 variables. Notably, marketing plan (x202) and financial plan (x203) demonstrated a correlation coefficient (r) of 0.451, significant at the 0.01 level. Furthermore, marketing plan (x202) and digital entrepreneurial intelligence (Y) exhibited a correlation coefficient (r) of 0.120, significant at the 0.01 level. Similarly, financial plan (x203) and business project (x204) showed a correlation coefficient (r) of 0.232, significant at the 0.01 level. Moreover, financial plan (x203) and digital entrepreneurial intelligence (Y) demonstrated a correlation coefficient (r) of 0.073, significant at the 0.05 level.

4) The correlation analysis of independent variables related to Entrepreneurship (x2) also revealed a significant relationship among Group 2 variables. Specifically, marketing plan (x202) and business project (x204) exhibited a correlation coefficient (r) of -0.228, significant at the 0.01 level.

Subsequently, the data from the Scope 2 questionnaire was statistically analyzed, as presented in Table 4.57.

Table 4.57 Basic statistical results and the averages between the independent variables, digital entrepreneurship and entrepreneurship as well as the dependent variables, digital intelligence and entrepreneurial intelligence (DEI)

Variables	Factor / Coding	WBL	Average Means	S.D.	N
Independent	Big data (x101)	I-C	2.844	0.136	600
	FinTech (x102)	I-C	2.847	0.162	600
	Block chain (x103)	I-PU	1.833	0.179	600
	Digital business laws (x104)	I-PU	1.800	0.141	600
	Internet of Things (x105)	I-E	3.835	0.140	600
	Creative social media (x106)	I-E	3.817	0.203	600
	Artificial intelligence (AI) (x107)	I-PR	1.837	0.178	600
	Cloud computing (x108)	I-PR	1.798	0.142	600
	Business idea and operation (x201)	I-E	3.758	0.234	600
	Marketing plan (x202)	I-PR	1.793	0.188	600
	Financial plan (x203)	I-C	2.722	0.208	600
	Business project (x204)	I-PU	1.723	0.193	600
Dependent	Digital entrepreneurial intelligence (DEI) Y	-	2.844	0.136	600

According to the table above, it can be explained that the independent variable group with the highest average from the questionnaire responses is the I-E group, representing the anterior right brain function or the development of creativity and imagination. The average of the factors Internet of Things (IoT) (x105), creative social media (x106), and business idea and operation (x201) is 3.835, 3.817, and 3.758, respectively, with a total average value of 3.803.

The independent variable group with the second-highest average is the group of I-C, representing the anterior left brain function or the development of analytical and logical thinking. The average of the factors FinTech (x102), big data (x101), and financial plan (x203) is 2.847, 2.844, and 2.722, respectively, with a total average value of 2.804.

The independent variable group with the third-highest average is the group of the I-PR, representing the posterior right brain function or the development of emotional and social dimension. The average of the factors Artificial Intelligence (AI) (x107), Cloud Computing (x108), and Marketing Plan (x202)is 1.837, 1.798, and 1.793, respectively, with a total average of 1.809.

The independent variable group with the lowest average is I-PU, representing the posterior left brain function or the development of movement and self-control. The average of factors Block Chain (x103), Digital Business Laws (x104), and Business Project (x204) is 1.833, 1.800, and 1.723, respectively, with a total average of 1.785.

As this study focused on the principles and processes of Whole Brain Literacy (WBL), aiming to understand the various brain functions that affect and relate to the dependent variable, digital entrepreneurial intelligence (DEI), the average values from various variables and sub-factors were grouped and summarized based on the four brain function principles of WBL, as shown in Figure 4.4.

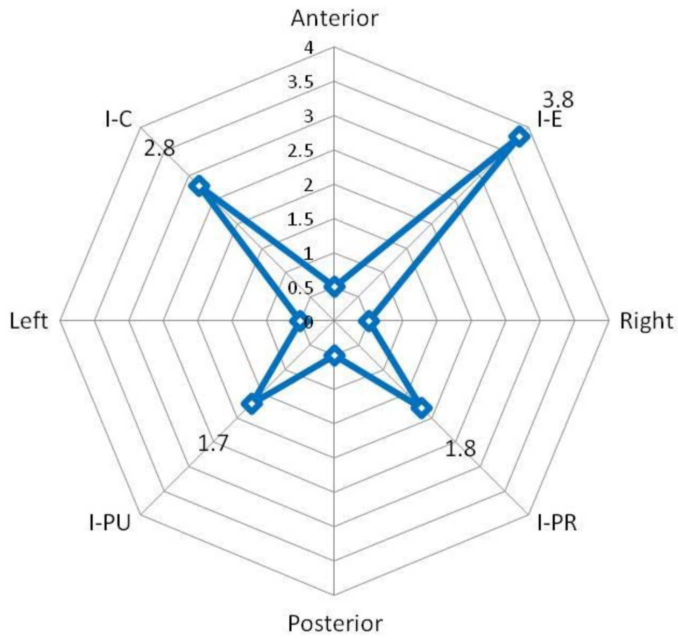


Figure 4.4 The average of the independent variables classified in the four brain functions of WBL that affect the dependent variable from the population sample in Scope 2 – Correlational Research

The researcher then analyzed the average of the independent and dependent variables to conduct multiple regression analysis. This aimed to determine the predictive power of the independent variable (x), digital entrepreneurship and entrepreneurship, across all four areas according to the principles of WBL (I-C/I-PU/I-E/I-PR), on the dependent variables (y), digital intelligence and entrepreneurial intelligence or digital entrepreneurial intelligence (DEI). Multiple regression analysis (MRA) was employed, utilizing the Stepwise Regression technique (with stepwise criteria: Probability of F to Enter <= .050, Probability of F to Remove >= 0.100), with statistical significance set at 0.05 (P value < 0.05). The results were presented in Table 4.58.

Table 4.58 The results of stepwise multiple regression analysis between the independent variables, digital entrepreneurship and entrepreneurship, which affect the dependent variables, digital intelligence and entrepreneurial intelligence

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1 I-PR	0.978[a] **	0.956	0.955	0.222
2 I-PR + I-E	0.995[b] **	0.991	0.991	0.101
3 I-PR + I-E + I-C	0.996[c] **	0.993	0.993	0.088
4 I-PR + I-E + I-C + I-PU	0.997[d] **	0.993	0.993	0.088

** Statistical significance at 0.05 (P value < 0.05)

a. Predictors: (Constant), IPR

b. Predictors: (Constant), IPR, IE

c. Predictors: (Constant), IPR, IE, IC

d. Predictors: (Constant), IPR, IE, IC, IPU

e. Dependent Variable: Y

*** *Note:*	**Correlation levels**	**Interpretation**
	0.85 – 1.00	Strong relationship
	0.71 – 0.84	High relationship
	0.51 – 0.70	Moderate relationship
	0.00 – 0.50	Weak relationship

From Table 4.58, the results can be explained as follows: Model 1 (1 variable): When Brain Function type I-PR (the development of emotional and social dimension) is the independent predictor variable, the predictive power (R^2) is 0.956 or 95.6 percent, with an error of 0.22. The multiple coefficient (R) is 0.978, indicating the strong relationship.

Model 2 (2 variables): When Brain Function types I-PR (the development of emotional and social dimensions) and I-E (the development of creativity and imagination) are the independent predictor variables, the predictive power (R^2) is 0.991 or 99.1 percent, with an error of 0.10. The multiple coefficient (R) is 0.995, and the predictive power is increased by 3.5 percent, indicating the strong relationship.

Model 3 (3 variables): When Brain Function types I-PR (the development of emotional and social dimensions), I-E, (the development of creativity and imagination), and I-C (the development of analytical and logical thinking) are the independent predictor variables, the predictive power (R^2) is 0.993 or 99.3 percent, with an error of 0.08. The multiple coefficient (R) is 0.996, and the predictive power is increased by 0.2 percent, suggesting the strong relationship.

Model 4 (4 variables): When Brain Function types I-PR (the development of emotional and social dimensions), I-E (the development of creativity and imagination), I-C (the development of analytical and logical thinking), and I-PU (the development of movement and self-control) are the independent predictor variables, the predictive power (R^2) is 0.993 or 99.3 percent, with an error of 0.08. The multiple coefficient (R) is 0.997. The predictive power remains the same, but the multiple coefficient is increased by 0.001, indicating the strong relationship.

From the multiple regression analysis in Table 4.58, it is evident that the multiple correlation coefficient, or R, has a positive value, indicating a consistent positive correlation between the independent variables, digital entrepreneurship and entrepreneurship, and the dependent variables, digital intelligence and entrepreneurial intelligence (DEI). This implies that as the independent variable (x) increases or decreases, the dependent variable (y) will also increase or decrease accordingly. This relationship is depicted in Figure 4.5.

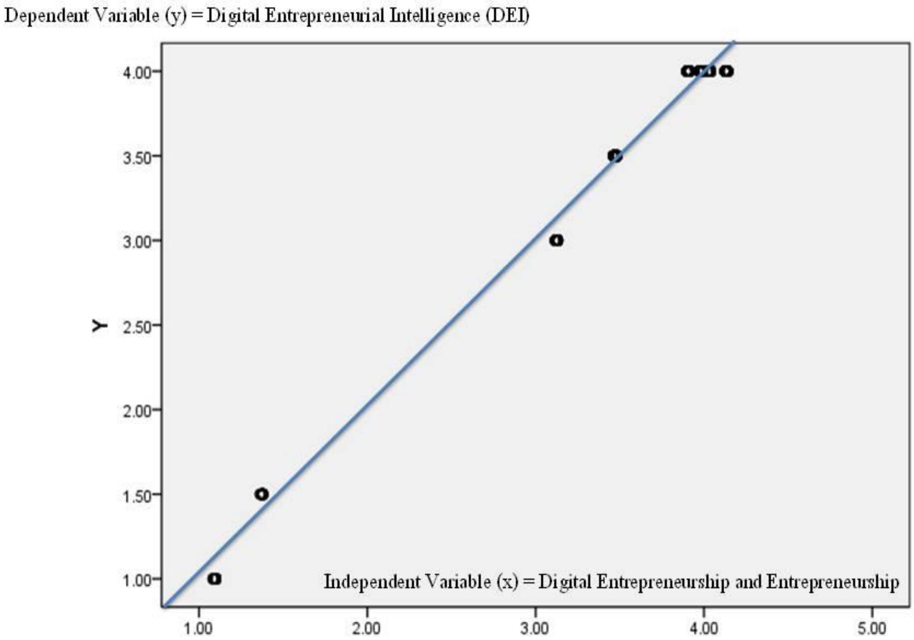


Figure 4.5 The positive linear relationship between the independent variables and the dependent variables through the multiple regression analysis conducted in Scope 2

After that, the researcher conducted an Analysis of Variance (ANOVA) to determine the statistical variance among the four factors associated with the four principles of brain functioning, or WBL, namely I-PR (the development of emotional and social dimension), I-E (the development of creativity and imagination), I-C (the development of analytical and logical thinking), and I-PU (the development of movement and self-control). This analysis aimed to ascertain whether there was statistical significance among these groups. Specifically, the researcher sought to identify which group of variables exhibited statistical significance between the independent variables, digital entrepreneurship and entrepreneurship, and the dependent variables, digital intelligence and entrepreneurial intelligence. The results of this analysis are presented in Table 4.59 below.

Table 4.59 The results of data analysis conducted to determine the statistical variance using One-Way ANOVA on the independent variables, digital entrepreneurship and entrepreneurship, which influence the dependent variables, digital intelligence and entrepreneurial intelligence, or the development of digital entrepreneurial intelligence (DEI)

Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig. (P-Value)**
1	Regression	637.83	1	637.837	12858.69	0.000[a] **
	Residual	29.66	598	.050		
	Total	667.50	599	-		
2	Regression	661.31	2	330.659	31933.02	0.000[b] **
	Residual	6.18	597	.010		
	Total	667.50	599	-		
3	Regression	662.83	3	220.945	28222.93	0.000[c] **
	Residual	4.66	596	.008		
	Total	667.50	599	-		
4	Regression	662.86	4	165.716	21276.30	0.000[d] **
	Residual	4.63	595	.008		
	Total	667.50	599	-		

** Statistical significance at 0.05 (P value < 0.05)

a. Predictors: (Constant), IPR

b. Predictors: (Constant), IPR, IE

c. Predictors: (Constant), IPR, IE, IC

d. Predictors: (Constant), IPR, IE, IC, IPU

e. Dependent Variable: Y

According to Table 4.59, it can be explained that Model 1 consists of one factor, which is I-PR or the function of posterior right brain (the development of emotional and social dimension) with a statistical significance or the p-value of 0.000, which is lower than the predetermined statistical significance of p-value < 0.05.

Model 2 consists of two factors: I-PR or the function of the posterior right brain (the development of emotional and social dimension) and I-E or the function of the anterior right brain (the development of creativity and imagination). Model 2 has a statistical significance or p-value of 0.000, which is less than the specified statistical significance at < 0.05.

Model 3 consists of three factors: I-PR or the function of the posterior right brain (the development of emotional and social dimension), I-E or the function of the anterior right brain (the development of creativity and imagination), and I-C (the Development of analytical and logical thinking). Model 3 has a statistical significance or p-value of 0.000, which is less than the stated statistical significance of p-value < 0.05.

Model 4 consists of four factors: I-PR or the function of the posterior right brain (the development of emotional and social dimension), I-E or the function of the anterior right brain (The development of creativity and imagination), I-C (the development of analytical and logical thinking), and I-PU (the development of movement and self-control). Model 4 has a statistical significance or p-value of 0.000, which is less than the specified statistical significance or p-value <0.05.

Therefore, from the above information, it can be concluded that the four WBL independent variables including I-PR or the function of the posterior right brain (the development of emotional and social dimension), I-E or the function of the anterior right brain (the development of creativity and imagination), I-C (the development of analytical and logical thinking), and I-PU (the development of movement and self-control) have a statistical significance or p-value of 0.000, which is less than the specified statistical significance or p-value < 0.05. Hence, it means that the four independent variables affected and influenced the dependent variable or the development of digital entrepreneurial intelligence (DEI) in Scope 2. It can be utilized to formulate a learning model, Prototype-2, for organizing learning, managing assessments, and developing activities of digital entrepreneurial intelligence (DEI) for the research population of Scope 3.

To identify the independent variables that effectively predict the development of digital entrepreneurial intelligence (DEI), the researcher analyzed the data to ascertain the importance weights or coefficients of the four independent predictive variables (b, ß), namely I-PR or the function of the posterior right brain (the development of emotional and social dimension), I-E or the function of the anterior right brain (the development of creativity and imagination), I-C (the development of analytical and logical thinking), and I-PU (the development of movement and self-control), along with the constant values of the forecasting equations in their raw data form (a), as illustrated in Table 4.60.

Table 4.60 The multiple correlation of four WBL independent variables: digital entrepreneurship and entrepreneurship, with the dependent variable, digital entrepreneurial intelligence (DEI)

Independent variables/ Predictors	**b**	**ß**	**Std. Error**	**t-Test**	**Sig. (p-value)**
Constant	2.698	0.044	-	60.785	0.000 **
I-PR (The development of emotional and social dimension)	0.185	0.180	0.008	14.015	0.000 **
I-E (The development of creativity and imagination)	0.453	0.451	0.008	69.131	0.000 **
I-C (The development of analytical and logical thinking)	0.244	0.242	0.004	54.410	0.000 **
I-PU (The development of movement and self-control)	0.125	0.127	0.003	2.011	0.045 **

** Statistical significance at 0.05 (p-value < 0.05)

a = Dependent Variable y

$R = 0.997$

$R^2 = 0.993$

$F = 21276.305$

From Table 4.60, the multiple correlation of the independent variables or predictors according to the principles of WBL including I-PR or the function of the posterior right brain (the development of emotional and social dimension), I-E or the function of the anterior right brain (the development of creativity and imagination), I-C or the function of the anterior left brain (the development of analytical and logical thinking), and I-PU or the function of the posterior left brain (the development of movement and self-control), with the dependent variable, digital entrepreneurial intelligence (DEI), using the F-test revealed the statistical significance at the 0.000 level in three aspects: I-PR, I-E, and I-C, while at the 0.045 level in the case of I-PU. These findings suggested a good level of predictability concerning the dependent variable, digital entrepreneurial intelligence (DEI).

All four predictors exhibit a predictive power (R^2) of 99.3 percent, a multiple coefficient (R) of 0.997, a standard error in forecasting of 0.088, and a constant value of the forecast equation at 2.698 in raw scores. This information can be synthesized to present a forecasting equation in both raw scores and standard score forms as follows:

1) Predictive equations in raw scores:

$$\hat{y} = 2.698 + 0.185\,(\text{I-PR}) + 0.453\,(\text{I-E}) + 0.274\,(\text{I-C}) + 0.129\,(\text{I-PU})$$

2) Standard score equation:

$$Z\,(_{DEI}) = +\,0.180\,(Z_{\,I\text{-}PR}) + 0.451\,(Z_{\,I\text{-}E}) + 0.244\,(Z_{\,I\text{-}C}) + 0.125\,(Z_{\,I\text{-}PU})$$

Where;

Ŷ = Digital entrepreneurial intelligence (DEI)

I-PR = The function of posterior right brain (the development of emotional and social dimension)

I-E = The function of the anterior right brain (the development of creativity and imagination)

I-C = The function of the anterior left brain (the development of analytical and logical thinking)

I-PU = The function of the posterior left brain (the development of movement and self-control)

Based on the Standard score equation provided above or DEI Prototype-2 from the research conducted in Scope 2, this correlation aligns with the findings derived from DEI Prototype-1, which entailed an analysis and exploration of the expectations and needs on the development of digital entrepreneurial intelligence among the sample population in Scope 1. These findings can be concluded and ranked based on the impact of four brain factors or WBL on the development of digital entrepreneurial intelligence (DEI) as follows: The primary factor, I-E or the function of the anterior right brain (the development of creativity and imagination) has a positive influence on DEI with a coefficient of 0.451. Subsequently, ranked second is I-C or the function of the anterior left brain (the development of analytical and logical thinking), with a positive influence on DEI with a coefficient of 0.244. Positioned third is I-PR or the function of the posterior right brain (the development of emotional and social dimension), exhibiting a positive influence on DEI with a coefficient of 0.180. Finally, in the fourth position, I-PU or the function of the posterior left brain (the development of movement and self-control) positively affects DEI with a coefficient of 0.125.

The data from this Scope 2 study reveals a congruent relationship with the patterns observed in the analysis of WBL brain functions within Scope 1, encompassing among students, alumni, parents, teacher – Administrator. This correlation is depicted in Figure 4.6.

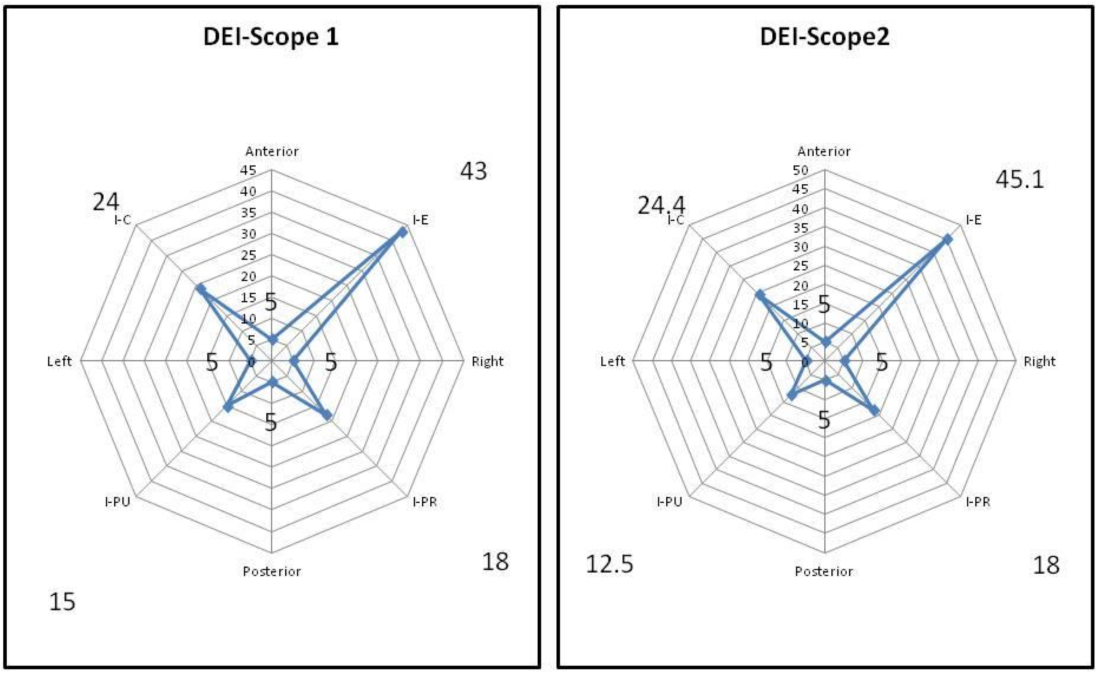


Figure 4.6 The analysis of WBL brain functions in Scope 1 and Scope 2.

According to the Figure above, it is apparent that the WBL brain functions in this study, both scope 1 and scope 2, primarily emphasized the I-E, the function of the anterior right brain (the development of creativity and imagination) averaging 43 percent. Additionally, the I-C, the function of the anterior left brain (the development of analytical and logical thinking) averages 24 percent. Moreover, the I-PR the function of the posterior right brain (the development of emotional and social dimension) averages 18 percent. Also the I-PU, the function of the posterior left brain (the development of movement and self-control) averages 15 percent. This data indicates that the WBL factors influencing the development of digital entrepreneurial intelligence (DEI) in this study primarily focused on the I-E, the function of the anterior right brain (the Development of creativity and imagination) and the I-C, the function of the anterior left brain (the development of analytical and logical thinking). This insight guided the researcher in designing the DEI-WBL Prototype in Scope 3.

Before proceeding with the steps and processes of collecting and analyzing data in Scope 3: Experimental Research (DEI-WBL Prototype), the researcher summarized and analyzed the prototype learning model for the development of digital entrepreneurial intelligence (DEI). This analysis incorporated both WBL DEI Prototype - 1 and DEI Prototype - 2 obtained from Scopes 1 and 2, respectively, to design experimental research involving a population of secondary students, totaling 800 individuals. The relationship between DEI Prototype -1 and DEI Prototype – 2 is depicted in Table 4.61 below.

Table 4.61 The relationship between DEI Prototype – 1 and DEI Prototype – 2 in terms of WBL and the four brain functions derived from the findings of the studies conducted in Scope 1 and Scope 2

Scope	**Prototype**	**WBL / brain map / brain functions**			
		I-C	I-PU	I-E	I-PR
		The anterior left brain	The posterior left brain	The anterior right brain	The posterior right brain
		The development of analytical and logical thinking	The development of movement and self-control	The development of creativity and imagination	The development of emotional and social dimension
1	DEI Prototype-1 Learning expectations	*24 %*	*15 %*	*43 %*	*18 %*
		DEL development expectation ratios based on WBL principles			
	Application	Utilized to formulate four learning ratios concerning classroom time allocation and the number of lesson topics (course outlines) in accordance with WBL principles.			

Table 4.61 The relationship between DEI Prototype – 1 and DEI Prototype – 2 in terms of WBL and the four brain functions derived from the findings of the studies conducted in Scope 1 and Scope 2 (continued)

Scope	**Prototype**	**WBL / brain map / brain functions**			
		I-C	I-PU	I-E	I-PR
		The anterior left brain	The posterior left brain	The anterior right brain	The posterior right brain
		The development of analytical and logical thinking	The development of movement and self-control	The development of creativity and imagination	The development of emotional and social dimension
2	DEI Prototype-2 Relationship between independent and dependent variables	Standard score equation: $Z\ (_{DEI}) = +\ 0.180\ (Z\ _{I\text{-}PR}) + 0.451\ (Z\ _{I\text{-}E}) + 0.244\ (Z\ _{I\text{-}C}) + 0.125\ (Z\ _{I\text{-}PU})$			
	Application	Utilized to establish priorities and design student development activities in line with WBL principles.			

From Table 4.61 above, the relationship can be explained as follows: the group of variables I-E, the function of the anterior right brain (the development of creativity and imagination), occupies the first place in its influence on DEI, while the group of variables I-C, corresponding to the function of the anterior left brain (the development of analytical and logical thinking), ranks the second. And the group of variables I-PR, corresponding to the function of the posterior right brain (the development of emotional and social dimension), ranks the third. Also the group of variables I-PU, corresponding to the function of the posterior left brain (the development of movement and self-control), ranks the fourth. Consequently, in this study, the researcher emphasized the importance of developing the DEI - WBL Prototype by prioritizing the first set of variables, namely I-E and I-C. Subsequently, the significance of the four areas of brain functions based on WBL that influence the development of digital entrepreneurial intelligence (DEI) among secondary students is ranked, as shown in Table 4.62.

Table 4.62 The summary of the importance rankings of DEI-WBL prototype variables associated with DEI development based on the WBL principles

Ranking	DEI Prototype – 1 / WBL	DEI Prototype – 2 / WBL
1	I-E	I-E
2	I-C	I-C
3	I-PR	I-PR
4	I-PU	I-PU
Application	Utilized to formulate four learning ratios concerning classroom time allocation and the number of lesson topics (course outlines) in accordance with WBL principles.	Utilized to establish priorities and design student development activities in line with WBL principles.

From Table 4.62, it can be used to design Experimental Research (DEI - WBL Prototype) in two areas as outlined below:

1) Teaching and learning in digital entrepreneurial intelligence (DEI):

Drawing from the summarized relationship ratios of the four brain function factor groups based on the principles of WBL or DEI Prototype – 1, it can be employed to devise the teaching process or course outline in DEI for secondary students or the sample population in Scope 3. The proposed structure entailed one semester duration (20 weeks), with five hours of instruction per week (conducted in a specialized program on Saturdays, known as M-JET), totaling 100 hours, as detailed in Table 4.63.

Table 4.63 The design of the teaching and learning process or course outline utilizing the DEI - WBL Prototype

WBL	**Percentage Ratio**	**Hour / Week**	**Topic**	**Assessment**
I-E	43%	43 hours Week 1 - 9	The function of the anterior right brain **(t**he development of creativity and imagination**)** # Business idea & operation - Creative social media - 3D Design / IoT / AI / VR, 3D Printing	Questionnaire
I-PR	18%	18 hours Week 10 - 12	The function of the posterior right brain **(t**he development of emotional and social dimension**)** # Marketing plan - Online survey - Digital content design - Cloud computing	Questionnaire
I-C	24%	24 hours Week 13-17	The function of the anterior left brain **(t**he development of analytical and logical thinking**)** # Financial plan - Big Data - Fintech	Questionnaire

Table 4.63 The design of the teaching and learning process or course outline utilizing the DEI - WBL Prototype (continued)

WBL	Percentage Ratio	Hour / Week	Topic	Assessment
I-PU	15%	15 hours Week 18 – 20	The function of the posterior left brain **(t**he development of movement and self-control**)** # Business project - Block chain - Digital business laws	Questionnaire
	100%	100 hours		

2) Organizing student development activities in the area of digital entrepreneurial intelligence (DEI):

Drawing from the summarized relationship ratios of the four brain function factor groups according to the principles of WBL or DEI Prototype -2, This ratio can be utilized to design student development activities or extra-curricular activities for secondary students, the sample population in Scope 3, for one semester (20 weeks), with one hour per week, totaling 20 hours, as presented in Table 4.64.

Table 4.64 The design of student development activities or extra-curricular activities after school utilizing the DEI – WBL Prototype

WBL	Percentage ratio	Hour / Week	Topic	Assessment
I-E	43%	8 Week 1 – 8	- Business inspiration - Business trip - Creative skill - Innovativeness - Visionary - Risk-taking	Questionnaire

Table 4.64 The design of student development activities or extra-curricular activities after school utilizing the DEI – WBL Prototype (continued)

WBL	Percentage ratio	Hour / Week	Topic	Assessment
I-PR	18%	4 Week 9 – 12	- Interpersonal - Emotional Regulation - Communicational skill - Team Building skill	Questionnaire
I-C	24%	5 Week 13 – 17	- Leadership skill - Planning skill - Proactive skill - Analytical skill	Questionnaire
I-PU	15%	3 Week 18 – 20	- Business internship - Punctuality - Organizational skill - Risk – Reduction - Self-behavioral regulation	Questionnaire
	100%	20 hours		

4.3.5 Questionnaire Data Scope 3: Experimental Research (DEI – WBL Prototype) (800 Secondary Students)

The collection and analysis of DEI questionnaire data encompassed 36 factors, employing a Likert Scale with four options (1 = the least level, 2 = a small level, 3 = a high level, 4 = the greatest level), with scores interpreted into three levels. Statistical methods were used to calculate class differences by finding the range of scores. The interpretation of the scores' meaning is as follows:

An average between 1.00 – 1.99 indicates disagreement.

An average between 2.00 – 2.99 indicates moderate.

An average between 3.00 – 3.99 indicates agreement.

In Scope 3, the sample for the experiment was divided into two groups.

1) Control Group – Group A: Utilized a teaching model grounded in Bloom's Taxonomy principles, encompassing learning elements in three areas: cognitive domain (K), psychomotor domain (P), and affective domain (A). The learning ratio was K: P: A, with an average of 70: 20: 10 on DEI topics over a period of 20 weeks, totaling 100 hours. DEI development was then assessed before and after the experiment, with the sample population segmented into four groups: Group CG1 comprised 100 secondary students in the Science-Mathematics program; Group CG2 consisted of 100 secondary students in the Arts-Business program; Group CG3 comprised 100 secondary students utilizing the international student learning model; and Group CG4 included 100 secondary students in the Science-Mathematics program in a government school.The total sample population for the control group was 400 individuals.

2) Experimental Group – Group B: Implemented a teaching model based on the principles of WBL – 4 Brain Functions, integrating learning elements across four areas: I-C, the anterior left brain (the development of analytical and logical thinking), I-PU, the posterior left brain (the development of movement and self-control), I-E, the anterior right brain (the development of creativity and imagination), and I-PR, the posterior right brain (the development of emotional and social dimensions). The learning ratio, derived from the results of the DEI WBL-Prototype analysis in this research, was I-C: I-PU: I-E: I-PR at an average ratio of 24: 15: 43: 18 percent on DEI-related topics over a period of 20 weeks, totaling 100 hours. DEI development was assessed before and after the experiment. The sample population was divided into four groups: Group EG1 consisted of 100 secondary students in the Science-Mathematics program; Group EG2 comprised 100 secondary students in the Arts-Business program; Group EG3 included 100 secondary students utilizing the international student learning model; and Group EG4 encompassed 100 secondary students in the Science-Mathematics program in a government school. The total sample population for the experimental group was 400 individuals.

*** The threshold level set for DEI development for the experimental population samples was 65 percent which followed Thai core curriculum criteria for Home Economic Literacy. (MOE,2023)

4.3.5.1 Questionnaire data of the sample population before the DEI development experiment

Group 1) A control group (Group A)

Group 1.1 CG1: 100 secondary students in the Science-Mathematics program

Table 4.65 The average of the dependent variable (DEI) from the CG1 population before the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variables**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
1	Y101	Big data	I-C	1.60	0.492	Disagree
2	Y102	Fin Tech	I-C	1.32	0.469	Disagree
3	Y103	Block chain	I-PU	1.08	0.273	Disagree
4	Y104	Digital business laws	I-PU	1.12	0.327	Disagree
5	Y105	Internet of thing	I-E	1.24	0.429	Disagree
6	Y106	Creative social media	I-E	1.08	0.273	Disagree
7	Y107	Artificial intelligence	I-PR	1.12	0.327	Disagree
8	Y108	Cloud computing	I-PR	1.20	0.402	Disagree
Factor 2: Entrepreneurship (4 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
9	Y201	Business idea and operation	I-E	1.24	0.429	Disagree
10	Y202	Marketing plan	I-PR	1.20	0.402	Disagree
11	Y203	Financial plan	I-C	1.52	0.502	Disagree
12	Y204	Business project	I-PU	1.20	0.402	Disagree

Table 4.65 The average of the dependent variable (DEI) from the CG1 population before the experiment (continued)

Item	Variable	Description	WBL	Mean ($\bar{x}$)	S.D.	Rating
Factor 3: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	1.20	0.402	Disagree
14	Y302	Digital use	I-E	1.12	0.327	Disagree
15	Y303	Digital safe	I-PU	1.12	0.327	Disagree
16	Y304	Digital security	I-PU	1.08	0.273	Disagree
17	Y305	Digital emotional intelligence	I-PR	1.32	0.469	Disagree
18	Y306	Digital communication	I-PR	1.12	0.327	Disagree
19	Y307	Digital literacy	I-C	1.00	0.000	Disagree
20	Y308	Digital rights	I-C	1.68	0.469	Disagree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	1.12	0.327	Disagree
22	Y402	Planning skill	I-C	1.32	0.469	Disagree
23	Y403	Perseverance	I-C	1.12	0.327	Disagree
24	Y404	Analytical thinking	I-C	2.00	0.000	Disagree
25	Y405	Self-behavioral regulation	I-PU	1.08	0.273	Disagree
26	Y406	Risk-reduction	I-PU	1.24	0.429	Disagree
27	Y407	Work under pressure	I-PU	1.00	0.000	Disagree
28	Y408	Time management	I-PU	1.12	0.327	Disagree
29	Y409	Creativity	I-E	1.20	0.402	Disagree
30	Y410	Innovativeness	I-E	1.00	0.000	Disagree
31	Y411	Visionary	I-E	1.12	0.327	Disagree
32	Y412	Passionate	I-E	1.00	0.000	Disagree
33	Y413	Interpersonal	I-PR	1.20	0.402	Disagree
34	Y414	Emotional regulation	I-PR	1.32	0.469	Disagree

Table 4.65 The average of the dependent variable (DEI) from the CG1 population before the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean $(\bar{x})$**	**S.D.**	**Rating**
35	Y415	Communicational skill	I-PR	1.00	0.000	Disagree
36	Y416	Team building	I-PR	1.16	0.368	Disagree
		Total	**WBL**	**1.21**	**0.317**	**Disagree**

Group 1.2 CG2: 100 secondary students in Art-Business program

Table 4.66 The average of the dependent variable (DEI) from the population CG2 before the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean $(\bar{x})$**	**S.D.**	**Rating**
1	Y101	Big data	I-C	1.10	0.302	Disagree
2	Y102	Fin Tech	I-C	1.10	0.302	Disagree
3	Y103	Block chain	I-PU	1.20	0.402	Disagree
4	Y104	Digital business laws	I-PU	1.10	0.302	Disagree
5	Y105	Internet of thing	I-E	1.17	0.378	Disagree
6	Y106	Creative social media	I-E	1.10	0.302	Disagree
7	Y107	Artificial intelligence	I-PR	1.20	0.402	Disagree
8	Y108	Cloud computing	I-PR	1.40	0.492	Disagree
Factor 2: Entrepreneurship (4 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean $(\bar{x})$**	**S.D.**	**Rating**
9	Y201	Business idea and operation	I-E	1.17	0.378	Disagree
10	Y202	Marketing plan	I-PR	1.33	0.473	Disagree
11	Y203	Financial plan	I-C	1.10	0.302	Disagree

Table 4.66 The average of the dependent variable (DEI) from the population CG2 before the experiment (continued)

Item	Variable	Description	WBL	Mean ($\bar{x}$)	S.D.	Rating
Factor 2: Entrepreneurship (4 aspects)						
12	Y204	Business project	I-PU	1.32	0.469	Disagree
Factor 3: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	1.22	0.416	Disagree
14	Y302	Digital use	I-E	1.10	0.302	Disagree
15	Y303	Digital safe	I-PU	1.32	0.469	Disagree
16	Y304	Digital security	I-PU	1.11	0.314	Disagree
17	Y305	Digital emotional intelligence	I-PR	1.35	0.479	Disagree
18	Y306	Digital communication	I-PR	1.54	0.501	Disagree
19	Y307	Digital literacy	I-C	1.00	0.000	Disagree
20	Y308	Digital rights	I-C	1.29	0.456	Disagree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	1.00	0.000	Disagree
22	Y402	Planning skill	I-C	1.07	0.256	Disagree
23	Y403	Perseverance	I-C	1.10	0.302	Disagree
24	Y404	Analytical thinking	I-C	1.00	0.000	Disagree
25	Y405	Self-behavioral regulation	I-PU	1.00	0.000	Disagree
26	Y406	Risk-reduction	I-PU	1.17	0.378	Disagree
27	Y407	Work under pressure	I-PU	1.11	0.314	Disagree
28	Y408	Time management	I-PU	1.11	0.314	Disagree
29	Y409	Creativity	I-E	1.22	0.416	Disagree
30	Y410	Innovativeness	I-E	1.00	0.000	Disagree
31	Y411	Visionary	I-E	1.17	0.378	Disagree
32	Y412	Passionate	I-E	1.00	0.000	Disagree

Table 4.66 The average of the dependent variable (DEI) from the population CG2 before the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
33	Y413	Interpersonal	I-PR	1.57	0.498	Disagree
34	Y414	Emotional regulation	I-PR	1.59	0.494	Disagree
35	Y415	Communicational skill	I-PR	1.00	0.000	Disagree
36	Y416	Team building	I-PR	1.10	0.302	Disagree
		Total	**WBL**	**1.18**	**0.308**	**Disagree**

Group 1.3 CG3: 100 secondary students utilizing the international student learning model

Table 4.67 The average of the dependent variable (DEI) from the population CG3 before the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
1	Y101	Big data	I-C	1.00	0.000	Disagree
2	Y102	Fin Tech	I-C	1.10	0.302	Disagree
3	Y103	Block chain	I-PU	1.22	0.416	Disagree
4	Y104	Digital business laws	I-PU	1.31	0.465	Disagree
5	Y105	Internet of thing	I-E	1.22	0.416	Disagree
6	Y106	Creative social media	I-E	1.62	0.488	Disagree
7	Y107	Artificial intelligence	I-PR	1.00	0.000	Disagree
8	Y108	Cloud computing	I-PR	1.42	0.496	Disagree

Table 4.67 The average of the dependent variable (DEI) from the population CG3 before the experiment (continued)

Factor 2: Entrepreneurship (4 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
9	Y201	Business idea and operation	I-E	1.41	0.494	Disagree
10	Y202	Marketing plan	I-PR	1.28	0.451	Disagree
11	Y203	Financial plan	I-C	1.11	0.314	Disagree
12	Y204	Business project	I-PU	1.40	0.492	Disagree
Factor 3: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	1.32	0.469	Disagree
14	Y302	Digital use	I-E	1.34	0.476	Disagree
15	Y303	Digital safe	I-PU	1.32	0.469	Disagree
16	Y304	Digital security	I-PU	1.22	0.416	Disagree
17	Y305	Digital emotional intelligence	I-PR	1.42	0.496	Disagree
18	Y306	Digital communication	I-PR	1.28	0.451	Disagree
19	Y307	Digital literacy	I-C	1.00	0.000	Disagree
20	Y308	Digital rights	I-C	1.07	0.256	Disagree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	1.10	0.302	Disagree
22	Y402	Planning skill	I-C	1.00	0.000	Disagree
23	Y403	Perseverance	I-C	1.19	0.394	Disagree
24	Y404	Analytical thinking	I-C	1.00	0.000	Disagree
25	Y405	Self-behavioral regulation	I-PU	1.07	0.256	Disagree
26	Y406	Risk-reduction	I-PU	1.34	0.476	Disagree
27	Y407	Work under pressure	I-PU	1.21	0.409	Disagree
28	Y408	Time management	I-PU	1.32	0.469	Disagree

Table 4.67 The average of the dependent variable (DEI) from the population CG3 before the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
29	Y409	Creativity	I-E	1.31	0.465	Disagree
30	Y410	Innovativeness	I-E	1.33	0.473	Disagree
31	Y411	Visionary	I-E	1.29	0.456	Disagree
32	Y412	Passionate	I-E	1.28	0.451	Disagree
33	Y413	Interpersonal	I-PR	1.48	0.502	Disagree
34	Y414	Emotional regulation	I-PR	1.40	0.492	Disagree
35	Y415	Communicational skill	I-PR	1.00	0.000	Disagree
36	Y416	Team building	I-PR	1.11	0.314	Disagree
		Total	**WBL**	**1.24**	**0.356**	**Disagree**

Group 1.4 CG4: 100 secondary students in Science-Mathematics in a government school

Table 4.68 The average of the dependent variable (DEI) from the population CG4 before the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
1	Y101	Big data	I-C	1.26	0.441	Disagree
2	Y102	Fin Tech	I-C	1.31	0.465	Disagree
3	Y103	Block chain	I-PU	1.19	0.394	Disagree
4	Y104	Digital business laws	I-PU	1.28	0.451	Disagree
5	Y105	Internet of thing	I-E	1.13	0.338	Disagree
6	Y106	Creative social media	I-E	1.00	0.000	Disagree
7	Y107	Artificial intelligence	I-PR	1.00	0.000	Disagree
8	Y108	Cloud computing	I-PR	1.12	0.327	Disagree

Table 4.68 The average of the dependent variable (DEI) from the population CG4 before the experiment (continued)

Factor 2: Entrepreneurship (4 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
9	Y201	Business idea and operation	I-E	1.23	0.423	Disagree
10	Y202	Marketing plan	I-PR	1.08	0.273	Disagree
11	Y203	Financial plan	I-C	1.52	0.502	Disagree
12	Y204	Business project	I-PU	1.54	0.501	Disagree
Factor 3: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	1.19	0.394	Disagree
14	Y302	Digital use	I-E	1.00	0.000	Disagree
15	Y303	Digital safe	I-PU	1.27	0.446	Disagree
16	Y304	Digital security	I-PU	1.29	0.456	Disagree
17	Y305	Digital emotional intelligence	I-PR	1.45	0.500	Disagree
18	Y306	Digital communication	I-PR	1.11	0.314	Disagree
19	Y307	Digital literacy	I-C	1.00	0.000	Disagree
20	Y308	Digital rights	I-C	1.38	0.488	Disagree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	1.12	0.327	Disagree
22	Y402	Planning skill	I-C	1.38	0.488	Disagree
23	Y403	Perseverance	I-C	1.13	0.338	Disagree
24	Y404	Analytical thinking	I-C	1.59	0.494	Disagree
25	Y405	Self-behavioral regulation	I-PU	1.07	0.256	Disagree
26	Y406	Risk-reduction	I-PU	1.30	0.461	Disagree
27	Y407	Work under pressure	I-PU	1.19	0.394	Disagree
28	Y408	Time management	I-PU	1.19	0.394	Disagree
29	Y409	Creativity	I-E	1.19	0.394	Disagree

Table 4.68 The average of the dependent variable (DEI) from the population CG4 before the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
30	Y410	Innovativeness	I-E	1.00	0.000	Disagree
31	Y411	Visionary	I-E	1.13	0.338	Disagree
32	Y412	Passionate	I-E	1.00	0.000	Disagree
33	Y413	Interpersonal	I-PR	1.08	0.273	Disagree
34	Y414	Emotional regulation	I-PR	1.30	0.461	Disagree
35	Y415	Communicational skill	I-PR	1.00	0.000	Disagree
36	Y416	Team building	I-PR	1.07	0.256	Disagree
		Total	**WBL**	**1.20**	**0.321**	**Disagree**

Group 2) The experimental group (Group B)

Group 2.1 EG1: 100 secondary students in Science-Mathematics program

Table 4.69 The average of the dependent variable (DEI) from the population EG1 before the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
1	Y101	Big data	I-C	1.53	0.502	Disagree
2	Y102	Fin Tech	I-C	1.33	0.473	Disagree
3	Y103	Block chain	I-PU	1.12	0.327	Disagree
4	Y104	Digital business laws	I-PU	1.33	0.473	Disagree
5	Y105	Internet of thing	I-E	1.26	0.441	Disagree
6	Y106	Creative social media	I-E	1.00	0.000	Disagree
7	Y107	Artificial intelligence	I-PR	1.07	0.256	Disagree
8	Y108	Cloud computing	I-PR	1.13	0.338	Disagree

Table 4.69 The average of the dependent variable (DEI) from the population EG1 before the experiment (continued)

Item	Variable	Description	WBL	Mean ($\bar{x}$)	S.D.	Rating
Factor 2: Entrepreneurship (4 aspects)						
9	Y201	Business idea and operation	I-E	1.25	0.435	Disagree
10	Y202	Marketing plan	I-PR	1.07	0.256	Disagree
11	Y203	Financial plan	I-C	1.53	0.502	Disagree
12	Y204	Business project	I-PU	1.33	0.473	Disagree
Factor 3: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	1.13	0.338	Disagree
14	Y302	Digital use	I-E	1.19	0.394	Disagree
15	Y303	Digital safe	I-PU	1.20	0.402	Disagree
16	Y304	Digital security	I-PU	1.19	0.394	Disagree
17	Y305	Digital emotional intelligence	I-PR	1.26	0.441	Disagree
18	Y306	Digital communication	I-PR	1.00	0.000	Disagree
19	Y307	Digital literacy	I-C	1.00	0.000	Disagree
20	Y308	Digital rights	I-C	1.60	0.492	Disagree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	1.20	0.402	Disagree
22	Y402	Planning skill	I-C	1.40	0.492	Disagree
23	Y403	Perseverance	I-C	1.13	0.338	Disagree
24	Y404	Analytical thinking	I-C	2.00	0.000	Disagree
25	Y405	Self-behavioral regulation	I-PU	1.20	0.402	Disagree
26	Y406	Risk-reduction	I-PU	1.32	0.469	Disagree
27	Y407	Work under pressure	I-PU	1.20	0.402	Disagree
28	Y408	Time management	I-PU	1.13	0.338	Disagree

Table 4.69 The average of the dependent variable (DEI) from the population EG1 before the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
29	Y409	Creativity	I-E	1.13	0.338	Disagree
30	Y410	Innovativeness	I-E	1.07	0.256	Disagree
31	Y411	Visionary	I-E	1.20	0.402	Disagree
32	Y412	Passionate	I-E	1.00	0.000	Disagree
33	Y413	Interpersonal	I-PR	1.00	0.000	Disagree
34	Y414	Emotional regulation	I-PR	1.27	0.446	Disagree
35	Y415	Communicational skill	I-PR	1.00	0.000	Disagree
36	Y416	Team building	I-PR	1.07	0.256	Disagree
		Total	**WBL**	**1.19**	**0.318**	**Disagree**

Group 2.2 EG2: 100 secondary students in Art-Business program

Table 4.70 The average of the dependent variable (DEI) from the population EG2 before the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
1	Y101	Big data	I-C	1.00	0.000	Disagree
2	Y102	Fin Tech	I-C	1.11	0.314	Disagree
3	Y103	Block chain	I-PU	1.00	0.000	Disagree
4	Y104	Digital business laws	I-PU	1.11	0.314	Disagree
5	Y105	Internet of thing	I-E	1.34	0.476	Disagree
6	Y106	Creative social media	I-E	1.33	0.473	Disagree
7	Y107	Artificial intelligence	I-PR	1.33	0.473	Disagree
8	Y108	Cloud computing	I-PR	1.44	0.499	Disagree

Table 4.70 The average of the dependent variable (DEI) from the population EG2 before the experiment (continued)

Factor 2: Entrepreneurship (4 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
9	Y201	Business idea and operation	I-E	1.22	0.416	Disagree
10	Y202	Marketing plan	I-PR	1.45	0.500	Disagree
11	Y203	Financial plan	I-C	1.23	0.423	Disagree
12	Y204	Business project	I-PU	1.22	0.416	Disagree
Factor 3: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	1.45	0.500	Disagree
14	Y302	Digital use	I-E	1.22	0.416	Disagree
15	Y303	Digital safe	I-PU	1.22	0.416	Disagree
16	Y304	Digital security	I-PU	1.11	0.314	Disagree
17	Y305	Digital emotional intelligence	I-PR	1.45	0.500	Disagree
18	Y306	Digital communication	I-PR	1.66	0.476	Disagree
19	Y307	Digital literacy	I-C	1.00	0.000	Disagree
20	Y308	Digital rights	I-C	1.22	0.416	Disagree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	1.11	0.314	Disagree
22	Y402	Planning skill	I-C	1.22	0.416	Disagree
23	Y403	Perseverance	I-C	1.12	0.327	Disagree
24	Y404	Analytical thinking	I-C	1.11	0.314	Disagree
25	Y405	Self-behavioral regulation	I-PU	1.00	0.000	Disagree
26	Y406	Risk-reduction	I-PU	1.11	0.314	Disagree
27	Y407	Work under pressure	I-PU	1.11	0.314	Disagree
28	Y408	Time management	I-PU	1.11	0.314	Disagree

Table 4.70 The average of the dependent variable (DEI) from the population EG2 before the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
29	Y409	Creativity	I-E	1.33	0.473	Disagree
30	Y410	Innovativeness	I-E	1.11	0.314	Disagree
31	Y411	Visionary	I-E	1.23	0.423	Disagree
32	Y412	Passionate	I-E	1.11	0.314	Disagree
33	Y413	Interpersonal	I-PR	1.56	0.499	Disagree
34	Y414	Emotional regulation	I-PR	1.56	0.499	Disagree
35	Y415	Communicational skill	I-PR	1.33	0.473	Disagree
36	Y416	Team building	I-PR	1.11	0.314	Disagree
		Total	**WBL**	**1.23**	**0.360**	**Disagree**

Group 2.3 EG3: 100 secondary students utilizing the international student learning model

Table 4.71 The average of the dependent variable (DEI) from the population EG3 before the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
1	Y101	Big data	I-C	1.10	0.302	Disagree
2	Y102	Fin Tech	I-C	1.20	0.402	Disagree
3	Y103	Block chain	I-PU	1.00	0.000	Disagree
4	Y104	Digital business laws	I-PU	1.30	0.461	Disagree
5	Y105	Internet of thing	I-E	1.30	0.461	Disagree
6	Y106	Creative social media	I-E	1.60	0.492	Disagree
7	Y107	Artificial intelligence	I-PR	1.10	0.302	Disagree
8	Y108	Cloud computing	I-PR	1.40	0.492	Disagree

Table 4.71 The average of the dependent variable (DEI) from the population EG3 before the experiment (continued)

Item	Variable	Description	WBL	Mean ($\bar{x}$)	S.D.	Rating
Factor 2: Entrepreneurship (4 aspects)						
9	Y201	Business idea and operation	I-E	1.40	0.492	Disagree
10	Y202	Marketing plan	I-PR	1.40	0.492	Disagree
11	Y203	Financial plan	I-C	1.30	0.461	Disagree
12	Y204	Business project	I-PU	1.30	0.461	Disagree
Factor 3: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	1.40	0.492	Disagree
14	Y302	Digital use	I-E	1.30	0.461	Disagree
15	Y303	Digital safe	I-PU	1.20	0.402	Disagree
16	Y304	Digital security	I-PU	1.20	0.402	Disagree
17	Y305	Digital emotional intelligence	I-PR	1.40	0.492	Disagree
18	Y306	Digital communication	I-PR	1.40	0.492	Disagree
19	Y307	Digital literacy	I-C	1.00	0.000	Disagree
20	Y308	Digital rights	I-C	1.30	0.461	Disagree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	1.10	0.302	Disagree
22	Y402	Planning skill	I-C	1.00	0.000	Disagree
23	Y403	Perseverance	I-C	1.30	0.461	Disagree
24	Y404	Analytical thinking	I-C	1.00	0.000	Disagree
25	Y405	Self-behavioral regulation	I-PU	1.10	0.302	Disagree
26	Y406	Risk-reduction	I-PU	1.10	0.302	Disagree
27	Y407	Work under pressure	I-PU	1.20	0.402	Disagree
28	Y408	Time management	I-PU	1.20	0.402	Disagree

Table 4.71 The average of the dependent variable (DEI) from the population EG3 before the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
29	Y409	Creativity	I-E	1.40	0.492	Disagree
30	Y410	Innovativeness	I-E	1.30	0.461	Disagree
31	Y411	Visionary	I-E	1.30	0.461	Disagree
32	Y412	Passionate	I-E	1.30	0.461	Disagree
33	Y413	Interpersonal	I-PR	1.50	0.503	Disagree
34	Y414	Emotional regulation	I-PR	1.50	0.503	Disagree
35	Y415	Communicational skill	I-PR	1.10	0.302	Disagree
36	Y416	Team building	I-PR	1.20	0.402	Disagree
		Total	**WBL**	**1.26**	**0.382**	**Disagree**

Group 2.4 EG4: 100 secondary students in Science-Mathematics in a government school

Table 4.72 The average of the dependent variable (DEI) from the population EG4 before the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
1	Y101	Big data	I-C	1.20	0.402	Disagree
2	Y102	Fin Tech	I-C	1.20	0.402	Disagree
3	Y103	Block chain	I-PU	1.30	0.461	Disagree
4	Y104	Digital business laws	I-PU	1.40	0.492	Disagree
5	Y105	Internet of thing	I-E	1.10	0.302	Disagree
6	Y106	Creative social media	I-E	1.00	0.000	Disagree
7	Y107	Artificial intelligence	I-PR	1.10	0.302	Disagree
8	Y108	Cloud computing	I-PR	1.20	0.402	Disagree

Table 4.72 The average of the dependent variable (DEI) from the population EG4 before the experiment (continued)

Factor 2: Entrepreneurship (4 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
9	Y201	Business idea and operation	I-E	1.10	0.302	Disagree
10	Y202	Marketing plan	I-PR	1.10	0.302	Disagree
11	Y203	Financial plan	I-C	1.40	0.492	Disagree
12	Y204	Business project	I-PU	1.60	0.492	Disagree
Factor 3: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	1.10	0.302	Disagree
14	Y302	Digital use	I-E	1.00	0.000	Disagree
15	Y303	Digital safe	I-PU	1.40	0.492	Disagree
16	Y304	Digital security	I-PU	1.40	0.492	Disagree
17	Y305	Digital emotional intelligence	I-PR	1.40	0.492	Disagree
18	Y306	Digital communication	I-PR	1.10	0.302	Disagree
19	Y307	Digital literacy	I-C	1.00	0.000	Disagree
20	Y308	Digital rights	I-C	1.20	0.402	Disagree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	1.10	0.302	Disagree
22	Y402	Planning skill	I-C	1.20	0.402	Disagree
23	Y403	Perseverance	I-C	1.10	0.302	Disagree
24	Y404	Analytical thinking	I-C	1.60	0.492	Disagree
25	Y405	Self-behavioral regulation	I-PU	1.30	0.461	Disagree
26	Y406	Risk-reduction	I-PU	1.30	0.461	Disagree
27	Y407	Work under pressure	I-PU	1.20	0.402	Disagree
28	Y408	Time management	I-PU	1.20	0.402	Disagree

Table 4.72 The average of the dependent variable (DEI) from the population EG4 before the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
29	Y409	Creativity	I-E	1.10	0.302	Disagree
30	Y410	Innovativeness	I-E	1.00	0.000	Disagree
31	Y411	Visionary	I-E	1.10	0.302	Disagree
32	Y412	Passionate	I-E	1.00	0.000	Disagree
33	Y413	Interpersonal	I-PR	1.10	0.302	Disagree
34	Y414	Emotional regulation	I-PR	1.40	0.492	Disagree
35	Y415	Communicational skill	I-PR	1.10	0.302	Disagree
36	Y416	Team building	I-PR	1.10	0.302	Disagree
		Total	**WBL**	**1.20**	**0.334**	**Disagree**

4.3.5.2 Questionnaire data of the sample population after the DEI development experiment

Group 1) The control group (Group A)

Group 1.1 CG1: 100 secondary students in Science-Mathematics program

Table 4.73 The average of the dependent variable (DEI) from the population CG1 after the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
1	Y101	Big data	I-C	1.33	0.473	Disagree
2	Y102	Fin Tech	I-C	1.29	0.456	Disagree
3	Y103	Block chain	I-PU	1.21	0.409	Disagree
4	Y104	Digital business laws	I-PU	1.19	0.394	Disagree
5	Y105	Internet of thing	I-E	1.11	0.314	Disagree
6	Y106	Creative social media	I-E	1.11	0.314	Disagree

Table 4.73 The average of the dependent variable (DEI) from the population CG1 after the experiment (continued)

Item	Variable	Description	WBL	Mean ($\bar{x}$)	S.D.	Rating
Factor 1: Digital entrepreneurship (8 aspects)						
7	Y107	Artificial intelligence	I-PR	1.11	0.314	Disagree
8	Y108	Cloud computing	I-PR	1.21	0.409	Disagree
Factor 2: Entrepreneurship (4 aspects)						
9	Y201	Business idea and operation	I-E	1.18	0.386	Disagree
10	Y202	Marketing plan	I-PR	1.12	0.327	Disagree
11	Y203	Financial plan	I-C	1.60	0.492	Disagree
12	Y204	Business project	I-PU	1.37	0.485	Disagree
Factor 3: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	1.10	0.302	Disagree
14	Y302	Digital use	I-E	1.07	0.256	Disagree
15	Y303	Digital safe	I-PU	1.10	0.302	Disagree
16	Y304	Digital security	I-PU	1.25	0.435	Disagree
17	Y305	Digital emotional intelligence	I-PR	1.29	0.456	Disagree
18	Y306	Digital communication	I-PR	1.07	0.256	Disagree
19	Y307	Digital literacy	I-C	1.12	0.327	Disagree
20	Y308	Digital rights	I-C	1.48	0.502	Disagree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	1.17	0.378	Disagree
22	Y402	Planning skill	I-C	1.37	0.485	Disagree
23	Y403	Perseverance	I-C	1.21	0.409	Disagree
24	Y404	Analytical thinking	I-C	1.74	0.441	Disagree
25	Y405	Self-behavioral regulation	I-PU	1.12	0.327	Disagree
26	Y406	Risk-reduction	I-PU	1.25	0.435	Disagree

Table 4.73 The average of the dependent variable (DEI) from the population CG1 after the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
27	Y407	Work under pressure	I-PU	1.12	0.327	Disagree
28	Y408	Time management	I-PU	1.10	0.302	Disagree
29	Y409	Creativity	I-E	1.22	0.416	Disagree
30	Y410	Innovativeness	I-E	1.00	0.000	Disagree
31	Y411	Visionary	I-E	1.11	0.314	Disagree
32	Y412	Passionate	I-E	1.00	0.000	Disagree
33	Y413	Interpersonal	I-PR	1.18	0.386	Disagree
34	Y414	Emotional regulation	I-PR	1.30	0.461	Disagree
35	Y415	Communicational skill	I-PR	1.00	0.000	Disagree
36	Y416	Team building	I-PR	1.11	0.314	Disagree
		Total	**WBL**	**1.20**	**0.350**	**Disagree**

Group 1.2 CG2: 100 secondary students in Art-Business program

Table 4.74 The average of the dependent variable (DEI) from the population CG2 after the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
1	Y101	Big data	I-C	1.10	0.302	Disagree
2	Y102	Fin Tech	I-C	1.20	0.402	Disagree
3	Y103	Block chain	I-PU	1.10	0.302	Disagree
4	Y104	Digital business laws	I-PU	1.10	0.302	Disagree
5	Y105	Internet of thing	I-E	1.30	0.461	Disagree
6	Y106	Creative social media	I-E	1.30	0.461	Disagree
7	Y107	Artificial intelligence	I-PR	1.40	0.492	Disagree
8	Y108	Cloud computing	I-PR	1.40	0.492	Disagree

Table 4.74 The average of the dependent variable (DEI) from the population CG2 after the experiment (continued)

Factor 2: Entrepreneurship (4 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
9	Y201	Business idea and operation	I-E	1.30	0.461	Disagree
10	Y202	Marketing plan	I-PR	1.30	0.461	Disagree
11	Y203	Financial plan	I-C	1.10	0.302	Disagree
12	Y204	Business project	I-PU	1.20	0.402	Disagree
Factor 3: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	1.10	0.302	Disagree
14	Y302	Digital use	I-E	1.30	0.461	Disagree
15	Y303	Digital safe	I-PU	1.20	0.402	Disagree
16	Y304	Digital security	I-PU	1.20	0.402	Disagree
17	Y305	Digital emotional intelligence	I-PR	1.50	0.503	Disagree
18	Y306	Digital communication	I-PR	1.40	0.492	Disagree
19	Y307	Digital literacy	I-C	1.00	0.000	Disagree
20	Y308	Digital rights	I-C	1.20	0.402	Disagree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	1.20	0.402	Disagree
22	Y402	Planning skill	I-C	1.00	0.000	Disagree
23	Y403	Perseverance	I-C	1.10	0.302	Disagree
24	Y404	Analytical thinking	I-C	1.10	0.302	Disagree
25	Y405	Self-behavioral regulation	I-PU	1.10	0.302	Disagree
26	Y406	Risk-reduction	I-PU	1.10	0.302	Disagree
27	Y407	Work under pressure	I-PU	1.10	0.302	Disagree
28	Y408	Time management	I-PU	1.10	0.302	Disagree
29	Y409	Creativity	I-E	1.00	0.000	Disagree

Table 4.74 The average of the dependent variable (DEI) from the population CG2 after the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
30	Y410	Innovativeness	I-E	1.30	0.461	Disagree
31	Y411	Visionary	I-E	1.30	0.461	Disagree
32	Y412	Passionate	I-E	1.00	0.000	Disagree
33	Y413	Interpersonal	I-PR	1.50	0.503	Disagree
34	Y414	Emotional regulation	I-PR	1.40	0.492	Disagree
35	Y415	Communicational skill	I-PR	1.40	0.492	Disagree
36	Y416	Team building	I-PR	1.20	0.402	Disagree
		Total	**WBL**	**1.68**	**0.356**	**Disagree**

Group 1.3 CG3: 100 secondary students utilizing the international student learning model

Table 4.75 The average of the dependent variable (DEI) from the population CG3 after the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
1	Y101	Big data	I-C	1.20	0.402	Disagree
2	Y102	Fin Tech	I-C	1.30	0.461	Disagree
3	Y103	Block chain	I-PU	1.00	0.000	Disagree
4	Y104	Digital business laws	I-PU	1.10	0.302	Disagree
5	Y105	Internet of thing	I-E	1.40	0.492	Disagree
6	Y106	Creative social media	I-E	1.40	0.492	Disagree
7	Y107	Artificial intelligence	I-PR	1.00	0.000	Disagree
8	Y108	Cloud computing	I-PR	1.20	0.402	Disagree

Table 4.75 The average of the dependent variable (DEI) from the population CG3 after the experiment (continued)

Factor 2: Entrepreneurship (4 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean $(\bar{x})$**	**S.D.**	**Rating**
9	Y201	Business idea and operation	I-E	1.40	0.492	Disagree
10	Y202	Marketing plan	I-PR	1.10	0.302	Disagree
11	Y203	Financial plan	I-C	1.20	0.402	Disagree
12	Y204	Business project	I-PU	1.20	0.402	Disagree
Factor 3: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	1.40	0.492	Disagree
14	Y302	Digital use	I-E	1.50	0.503	Disagree
15	Y303	Digital safe	I-PU	1.20	0.402	Disagree
16	Y304	Digital security	I-PU	1.20	0.402	Disagree
17	Y305	Digital emotional intelligence	I-PR	1.20	0.402	Disagree
18	Y306	Digital communication	I-PR	1.20	0.402	Disagree
19	Y307	Digital literacy	I-C	1.00	0.000	Disagree
20	Y308	Digital rights	I-C	1.20	0.402	Disagree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	1.10	0.302	Disagree
22	Y402	Planning skill	I-C	1.10	0.302	Disagree
23	Y403	Perseverance	I-C	1.30	0.461	Disagree
24	Y404	Analytical thinking	I-C	1.10	0.302	Disagree
25	Y405	Self-behavioral regulation	I-PU	1.20	0.402	Disagree
26	Y406	Risk-reduction	I-PU	1.10	0.302	Disagree
27	Y407	Work under pressure	I-PU	1.20	0.402	Disagree
28	Y408	Time management	I-PU	1.10	0.302	Disagree

Table 4.75 The average of the dependent variable (DEI) from the population CG3 after the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
29	Y409	Creativity	I-E	1.30	0.461	Disagree
30	Y410	Innovativeness	I-E	1.20	0.402	Disagree
31	Y411	Visionary	I-E	1.30	0.461	Disagree
32	Y412	Passionate	I-E	1.40	0.492	Disagree
33	Y413	Interpersonal	I-PR	1.30	0.461	Disagree
34	Y414	Emotional regulation	I-PR	1.30	0.461	Disagree
35	Y415	Communicational skill	I-PR	1.20	0.402	Disagree
36	Y416	Team building	I-PR	1.10	0.302	Disagree
		Total	**WBL**	**1.21**	**0.371**	**Disagree**

Group 1.4 CG4: 100 secondary students in Science-Mathematics in a government school

Table 4.76 The average of the dependent variable (DEI) from the population CG4 after the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
1	Y101	Big data	I-C	1.40	0.492	Disagree
2	Y102	Fin Tech	I-C	1.40	0.492	Disagree
3	Y103	Block chain	I-PU	1.30	0.461	Disagree
4	Y104	Digital business laws	I-PU	1.40	0.492	Disagree
5	Y105	Internet of thing	I-E	1.10	0.302	Disagree
6	Y106	Creative social media	I-E	1.10	0.302	Disagree
7	Y107	Artificial intelligence	I-PR	1.10	0.302	Disagree
8	Y108	Cloud computing	I-PR	1.10	0.302	Disagree

Table 4.76 The average of the dependent variable (DEI) from the population CG4 after the experiment (continued)

Factor 2: Entrepreneurship (4 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean $(\bar{x})$**	**S.D.**	**Rating**
9	Y201	Business idea and operation	I-E	1.20	0.402	Disagree
10	Y202	Marketing plan	I-PR	1.20	0.402	Disagree
11	Y203	Financial plan	I-C	1.60	0.492	Disagree
12	Y204	Business project	I-PU	1.60	0.492	Disagree
Factor 3: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	1.10	0.302	Disagree
14	Y302	Digital use	I-E	1.20	0.402	Disagree
15	Y303	Digital safe	I-PU	1.40	0.492	Disagree
16	Y304	Digital security	I-PU	1.40	0.492	Disagree
17	Y305	Digital emotional intelligence	I-PR	1.20	0.402	Disagree
18	Y306	Digital communication	I-PR	1.20	0.402	Disagree
19	Y307	Digital literacy	I-C	1.10	0.302	Disagree
20	Y308	Digital rights	I-C	1.40	0.492	Disagree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	1.20	0.402	Disagree
22	Y402	Planning skill	I-C	1.60	0.492	Disagree
23	Y403	Perseverance	I-C	1.10	0.302	Disagree
24	Y404	Analytical thinking	I-C	1.70	0.461	Disagree
25	Y405	Self-behavioral regulation	I-PU	1.20	0.402	Disagree
26	Y406	Risk-reduction	I-PU	1.40	0.492	Disagree
27	Y407	Work under pressure	I-PU	1.30	0.461	Disagree
28	Y408	Time management	I-PU	1.30	0.461	Disagree

Table 4.76 The average of the dependent variable (DEI) from the population CG4 after the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
29	Y409	Creativity	I-E	1.20	0.402	Disagree
30	Y410	Innovativeness	I-E	1.10	0.302	Disagree
31	Y411	Visionary	I-E	1.20	0.402	Disagree
32	Y412	Passionate	I-E	1.10	0.302	Disagree
33	Y413	Interpersonal	I-PR	1.00	0.000	Disagree
34	Y414	Emotional regulation	I-PR	1.30	0.461	Disagree
35	Y415	Communicational skill	I-PR	1.10	0.302	Disagree
36	Y416	Team building	I-PR	1.10	0.302	Disagree
		Total	**WBL**	**1.26**	**0.393**	**Disagree**

Group 2) The experimental group (Group B)

Group 2.1 EG1: 100 secondary students in Science-Mathematics program

Table 4.77 The average of the dependent variable (DEI) from the population EG1 after the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
1	Y101	Big data	I-C	3.20	0.402	Agree
2	Y102	Fin Tech	I-C	3.57	0.498	Agree
3	Y103	Block chain	I-PU	3.00	0.636	Agree
4	Y104	Digital business laws	I-PU	3.40	0.492	Agree
5	Y105	Internet of thing	I-E	4.00	0.000	Agree
6	Y106	Creative social media	I-E	3.36	0.482	Agree
7	Y107	Artificial intelligence	I-PR	3.11	0.764	Agree
8	Y108	Cloud computing	I-PR	3.06	0.802	Agree

Table 4.77 The average of the dependent variable (DEI) from the population EG1 after the experiment (continued)

Factor 2: Entrepreneurship (4 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
9	Y201	Business idea and operation	I-E	3.80	0.402	Agree
10	Y202	Marketing plan	I-PR	3.06	0.802	Agree
11	Y203	Financial plan	I-C	3.35	0.479	Agree
12	Y204	Business project	I-PU	3.05	0.609	Agree
Factor 4: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	3.80	0.402	Agree
14	Y302	Digital use	I-E	3.80	0.402	Agree
15	Y303	Digital safe	I-PU	3.20	0.402	Agree
16	Y304	Digital security	I-PU	3.06	0.600	Agree
17	Y305	Digital emotional intelligence	I-PR	3.09	0.830	Agree
18	Y306	Digital communication	I-PR	3.29	0.729	Agree
19	Y307	Digital literacy	I-C	3.77	0.423	Agree
20	Y308	Digital rights	I-C	3.40	0.492	Agree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	3.68	0.469	Agree
22	Y402	Planning skill	I-C	3.67	0.473	Agree
23	Y403	Perseverance	I-C	3.38	0.488	Agree
24	Y404	Analytical thinking	I-C	3.75	0.435	Agree
25	Y405	Self-behavioral regulation	I-PU	3.10	0.302	Agree
26	Y406	Risk-reduction	I-PU	3.05	0.642	Agree
27	Y407	Work under pressure	I-PU	3.05	0.219	Agree
28	Y408	Time management	I-PU	3.01	0.643	Agree
29	Y409	Creativity	I-E	3.98	0.141	Agree

Table 4.77 The average of the dependent variable (DEI) from the population EG1 after the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
30	Y410	Innovativeness	I-E	3.41	0.494	Agree
31	Y411	Visionary	I-E	3.81	0.394	Agree
32	Y412	Passionate	I-E	3.80	0.402	Agree
33	Y413	Interpersonal	I-PR	3.08	0.849	Agree
34	Y414	Emotional regulation	I-PR	3.45	0.592	Agree
35	Y415	Communicational skill	I-PR	3.16	0.762	Agree
36	Y416	Team building	I-PR	3.25	0.435	Agree
		Total	**WBL**	**3.38**	**0.510**	**Agree**

Group 2.2 EG2: 100 secondary students in Art-Business program

Table 4.78 The average of the dependent variable (DEI) from the population EG2 after the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
1	Y101	Big data	I-C	3.09	0.494	Agree
2	Y102	Fin Tech	I-C	3.06	0.802	Agree
3	Y103	Block chain	I-PU	3.02	0.651	Agree
4	Y104	Digital business laws	I-PU	3.02	0.710	Agree
5	Y105	Internet of thing	I-E	4.00	0.000	Agree
6	Y106	Creative social media	I-E	3.43	0.498	Agree
7	Y107	Artificial intelligence	I-PR	3.22	0.799	Agree
8	Y108	Cloud computing	I-PR	3.21	0.808	Agree

Table 4.78 The average of the dependent variable (DEI) from the population EG2 after the experiment (continued)

Factor 2: Entrepreneurship (4 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
9	Y201	Business idea and operation	I-E	3.80	0.402	Agree
10	Y202	Marketing plan	I-PR	3.23	0.815	Agree
11	Y203	Financial plan	I-C	3.06	0.679	Agree
12	Y204	Business project	I-PU	3.06	0.633	Agree
Factor 3: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	3.82	0.386	Agree
14	Y302	Digital use	I-E	3.81	0.394	Agree
15	Y303	Digital safe	I-PU	3.07	0.537	Agree
16	Y304	Digital security	I-PU	3.06	0.600	Agree
17	Y305	Digital emotional intelligence	I-PR	3.17	0.829	Agree
18	Y306	Digital communication	I-PR	3.41	0.726	Agree
19	Y307	Digital literacy	I-C	3.47	0.658	Agree
20	Y308	Digital rights	I-C	3.07	0.685	Agree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	3.13	0.761	Agree
22	Y402	Planning skill	I-C	3.02	0.841	Agree
23	Y403	Perseverance	I-C	3.05	0.687	Agree
24	Y404	Analytical thinking	I-C	3.28	0.780	Agree
25	Y405	Self-behavioral regulation	I-PU	3.05	0.411	Agree
26	Y406	Risk-reduction	I-PU	3.05	0.642	Agree
27	Y407	Work under pressure	I-PU	3.05	0.219	Agree
28	Y408	Time management	I-PU	3.01	0.643	Agree

Table 4.78 The average of the dependent variable (DEI) from the population EG2 after the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
29	Y409	Creativity	I-E	3.98	0.141	Agree
30	Y410	Innovativeness	I-E	3.49	0.502	Agree
31	Y411	Visionary	I-E	3.85	0.359	Agree
32	Y412	Passionate	I-E	3.82	0.386	Agree
33	Y413	Interpersonal	I-PR	3.13	0.849	Agree
34	Y414	Emotional regulation	I-PR	3.47	0.594	Agree
35	Y415	Communicational skill	I-PR	3.29	0.743	Agree
36	Y416	Team building	I-PR	3.36	0.482	Agree
		Total	**WBL**	**3.30**	**0.587**	**Agree**

Group 2.3 EG3: 100 secondary students utilizing the international student learning model

Table 4.79 The average of the dependent variable (DEI) from the population EG3 after the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
1	Y101	Big data	I-C	3.17	0.551	Agree
2	Y102	Fin Tech	I-C	3.13	0.812	Agree
3	Y103	Block chain	I-PU	3.01	0.718	Agree
4	Y104	Digital business laws	I-PU	3.01	0.732	Agree
5	Y105	Internet of thing	I-E	3.97	0.171	Agree
6	Y106	Creative social media	I-E	3.61	0.490	Agree
7	Y107	Artificial intelligence	I-PR	3.02	0.953	Agree
8	Y108	Cloud computing	I-PR	3.18	0.833	Agree

Table 4.79 The average of the dependent variable (DEI) from the population EG3 after the experiment (continued)

Factor 2: Entrepreneurship (4 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
9	Y201	Business idea and operation	I-E	3.80	0.402	Agree
10	Y202	Marketing plan	I-PR	3.09	0.933	Agree
11	Y203	Financial plan	I-C	3.21	0.701	Agree
12	Y204	Business project	I-PU	3.06	0.633	Agree
Factor 3: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	3.84	0.368	Agree
14	Y302	Digital use	I-E	3.85	0.359	Agree
15	Y303	Digital safe	I-PU	3.01	0.689	Agree
16	Y304	Digital security	I-PU	3.01	0.659	Agree
17	Y305	Digital emotional intelligence	I-PR	3.06	0.919	Agree
18	Y306	Digital communication	I-PR	3.20	0.974	Agree
19	Y307	Digital literacy	I-C	3.68	0.566	Agree
20	Y308	Digital rights	I-C	3.43	0.671	Agree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	3.47	0.703	Agree
22	Y402	Planning skill	I-C	3.97	4.106	Agree
23	Y403	Perseverance	I-C	3.35	0.702	Agree
24	Y404	Analytical thinking	I-C	3.41	0.740	Agree
25	Y405	Self-behavioral regulation	I-PU	3.01	0.502	Agree
26	Y406	Risk-reduction	I-PU	3.01	0.703	Agree
27	Y407	Work under pressure	I-PU	3.03	0.300	Agree
28	Y408	Time management	I-PU	3.01	0.643	Agree

Table 4.79 The average of the dependent variable (DEI) from the population EG3 after the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
29	Y409	Creativity	I-E	3.99	0.100	Agree
30	Y410	Innovativeness	I-E	3.73	0.446	Agree
31	Y411	Visionary	I-E	3.93	0.256	Agree
32	Y412	Passionate	I-E	3.89	0.314	Agree
33	Y413	Interpersonal	I-PR	3.03	0.926	Agree
34	Y414	Emotional regulation	I-PR	3.05	1.029	Agree
35	Y415	Communicational skill	I-PR	3.02	1.172	Agree
36	Y416	Team building	I-PR	3.04	1.024	Agree
		Total	**WBL**	**3.34**	**0.744**	**Agree**

Group 2.4 EG4: 100 secondary students in Science-Mathematics program in a government school

Table 4.80 The average of the dependent variable (DEI) from the population EG4 after the experiment

Factor 1: Digital entrepreneurship (8 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
1	Y101	Big data	I-C	3.20	0.402	Agree
2	Y102	Fin Tech	I-C	3.57	0.498	Agree
3	Y103	Block chain	I-PU	3.14	0.682	Agree
4	Y104	Digital business laws	I-PU	3.50	0.503	Agree
5	Y105	Internet of thing	I-E	4.00	0.000	Agree
6	Y106	Creative social media	I-E	3.36	0.482	Agree
7	Y107	Artificial intelligence	I-PR	3.05	0.809	Agree
8	Y108	Cloud computing	I-PR	3.06	0.802	Agree

Table 4.80 The average of the dependent variable (DEI) from the population EG4 after the experiment (continued)

Item	Variable	Description	WBL	Mean ($\bar{x}$)	S.D.	Rating
Factor 2: Entrepreneurship (4 aspects)						
9	Y201	Business idea and operation	I-E	3.80	0.402	Agree
10	Y202	Marketing plan	I-PR	3.06	0.839	Agree
11	Y203	Financial plan	I-C	3.35	0.479	Agree
12	Y204	Business project	I-PU	3.18	0.672	Agree
Factor 3: Digital intelligence (8 aspects)						
13	Y301	Digital identity	I-E	3.80	0.402	Agree
14	Y302	Digital use	I-E	3.50	0.893	Agree
15	Y303	Digital safe	I-PU	3.26	0.441	Agree
16	Y304	Digital security	I-PU	3.66	4.125	Agree
17	Y305	Digital emotional intelligence	I-PR	3.02	0.899	Agree
18	Y306	Digital communication	I-PR	3.06	0.952	Agree
19	Y307	Digital literacy	I-C	3.76	0.452	Agree
20	Y308	Digital rights	I-C	3.37	0.525	Agree
Factor 4: Entrepreneurial intelligence (16 aspects)						
21	Y401	Leadership	I-C	3.57	0.624	Agree
22	Y402	Planning skill	I-C	3.50	0.689	Agree
23	Y403	Perseverance	I-C	3.25	0.609	Agree
24	Y404	Analytical thinking	I-C	3.70	0.522	Agree
25	Y405	Self-behavioral regulation	I-PU	3.13	0.338	Agree
26	Y406	Risk-reduction	I-PU	3.21	0.701	Agree
27	Y407	Work under pressure	I-PU	3.26	0.441	Agree
28	Y408	Time management	I-PU	3.08	0.692	Agree
29	Y409	Creativity	I-E	3.89	0.314	Agree

Table 4.80 The average of the dependent variable (DEI) from the population EG4 after the experiment (continued)

Factor 4: Entrepreneurial intelligence (16 aspects)						
Item	**Variable**	**Description**	**WBL**	**Mean ($\bar{x}$)**	**S.D.**	**Rating**
30	Y410	Innovativeness	I-E	3.37	0.506	Agree
31	Y411	Visionary	I-E	3.60	0.569	Agree
32	Y412	Passionate	I-E	3.66	0.497	Agree
33	Y413	Interpersonal	I-PR	3.06	0.862	Agree
34	Y414	Emotional regulation	I-PR	3.03	1.049	Agree
35	Y415	Communicational skill	I-PR	3.09	0.854	Agree
36	Y416	Team building	I-PR	3.08	0.748	Agree
		Total	**WBL**	**3.36**	**0.701**	**Agree**

4.4 Summary of Data Analysis Results from the DEI – WBL Prototype Experiment between the Control Group (A) and the Experimental Group (B)

4.4.1 Summary of analytical results before the DEI- WBL Prototype Experiment

1.1) Results of average analysis of DEI between the control group A (400 people) and the experimental group B (400 people)

According to the analysis of DEI development questionnaire data before the DEI – WBL Prototype experiment from both sample population groups, namely the control group and the experimental group above, totaling 800 people, DEI development results can be summarized and compared based on the average values in Table 4.81.

Table 4.81 A comparison of the mean of the dependent variable (DEI) from the DEI development questionnaire before the DEI - WBL Prototype experiment between the controlled group and the experimental group

Group N = 800	Population	Study program	Mean ($\bar{x}$)	Total Mean	Rating
Control Group (A) N = 400	CG1	Science-Mathematics (Montfort)	1.21	1.20	Disagree
	CG2	Art-Business	1.18		Disagree
	CG3	International Program	1.24		Disagree
	CG4	Science-Mathematics (Government school)	1.20		Disagree
Experimental Group (B) N = 400	EG1	Science-Mathematics (Montfort)	1.19	1.22	Disagree
	EG2	Art-Business	1.23		Disagree
	EG3	International Program	1.26		Disagree
	EG4	Science-Mathematics (Government school)	1.20		Disagree

From Table 4.81, the results of the analysis of the DEI development questionnaire in the population sample at the pre-experiment stage of the DEI – WBL Prototype can be summarized as follows:

Control Group (A): Secondary students in the international program exhibited the highest DEI average of 1.24, interpreted at the Disagree level. This was followed by the Science-Mathematics program (Montfort College) with an average DEI of 1.21, also interpreted at the Disagree level. The third highest DEI average was observed in the Science-Mathematics program (government school) with an average DEI of 1.20, also interpreted at the Disagree level. The study program with the lowest average DEI was the Art-Business with an average DEI of 1.18, interpreted at the Disagree level.

Experimental Group (B): Secondary students in the international program exhibited the highest DEI average of 1.26, interpreted at the Disagree level. This was followed by the Art-Business program with an average DEI of 1.23, also interpreted at the Disagree level. The third highest average DEI was observed in the Science-Mathematics program (government school) with an average DEI of 1.20, interpreted at the Disagree level. The study program with the lowest average DEI was the Science-Mathematics (Montfort College), with a mean DEI of 1.19, interpreted at the Disagree level.

From the above information, it can be concluded that the total mean of DEI for the control group was equal to 1.20, interpreted at the Disagree level. Similarly, the total mean of DEI for the experimental group was equal to 1.22, also interpreted at the Disagree level. This indicates that in the pre-experiment phase of the DEI - WBL Prototype, both mean values were interpreted at the Disagree level. The relationship can be illustrated in the form of a bar chart in Figure 4.7.

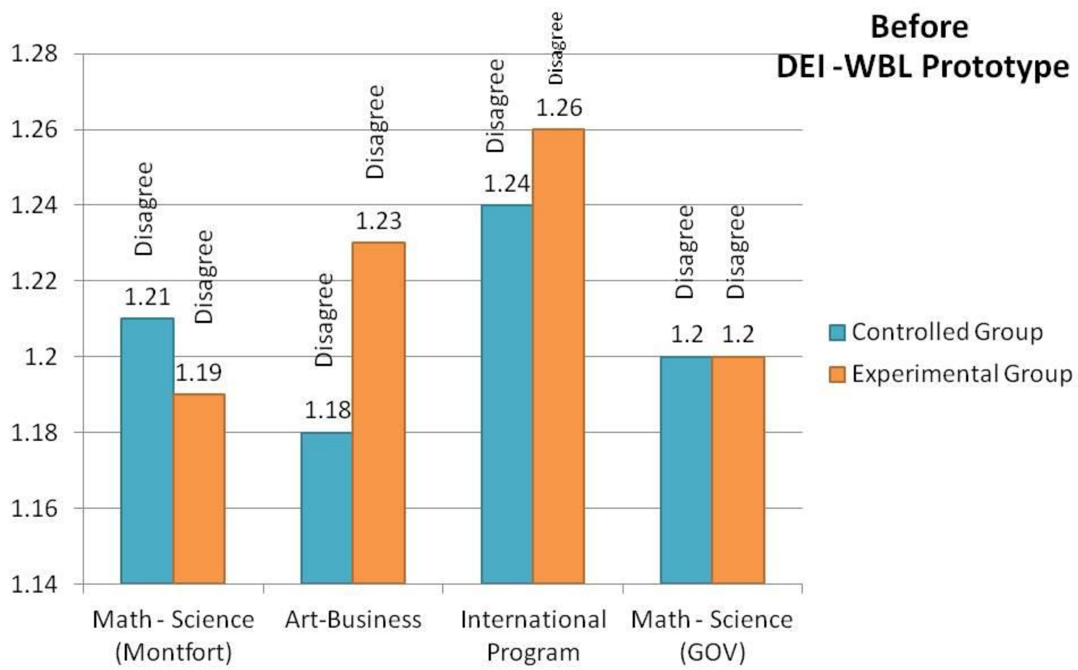


Figure 4.7 A comparison of mean DEI between the control group and the experimental group before the DEI - WBL Prototype experiment in Scope 3

Next, the assumptions in the research were analyzed using the Paired Sample t-Test and enumerated statistics to test the relationship and statistical significance of the control group and the experimental group at the pre-experiment stage of the DEI - WBL Prototype. This analysis is displayed in Table 4.82 as follows.

Table 4.82 The relationship analysis and statistical significance distributed in the Paired Sample t-Test between the control group and the experimental group before the DEI - WBL Prototype experiment

Group	**Study program**	**Mean** ($\bar{x}$)	**Total Mean**	**S.D.**	**t**	**Sig** (2-tailed) (p-value)
Control Group (A)	Sci-Math (Montfort)	1.21	-0.01	-0.029	-0.837	0.464
	Art-Business	1.18				
	International Program	1.24				
	Sci-Math (Government)	1.20				
Experimental Group (B)	Sci-Math (Montfort)	1.19				
	Art-Business	1.23				
	International Program	1.26				
	Sci-Math (Government)	1.20				
Significant at the 0.05 level (P value < 0.05)						

From Table 4.82, the total mean DEI of the control group and the experimental group is -0.01 in the pre-experiment stage of DEI - WBL Prototype. The analysis also revealed that the t-Test value is -0.837, the S.D. value is -0.125, and the p-value (sig 2-tailed) is 0.464, which is greater than the specified statistical significance value of 0.05 (p-value > 0.05). <u>**Therefore, it can be concluded that there is no significant difference**</u>

<u>between the two groups in DEI values and that this difference is not statistically significant in the pre-experiment stage of the DEI - WBL Prototype among secondary students in the Scope 3 experiment.</u>

4.4.2 Summary of analytical results after the DEI - WBL Prototype Experiment

2.1) Results of Analysis between the control group before and after the DEI - WBL Prototype Experiment

Table 4.83 A comparison of the mean of the DEI dependent variables from the control group before and after the DEI - WBL Prototype experiment

Experiment	Control group	Study program	**Mean ($\bar{x}$)**	**Total Mean**	**S.D.**	**Rating**
Before	CG1	Sci-Math (Montfort)	1.21	1.20	0.350	Disagree
	CG2	Art-Business	1.18			Disagree
	CG3	International Program	1.24			Disagree
	CG4	Sci-Math (Government)	1.20			Disagree
After	CG1	Sci-Math (Montfort)	1.20	1.33	0.367	Disagree
	CG2	Art-Business	1.68			Disagree
	CG3	International Program	1.21			Disagree
	CG4	Sci-Math (Government)	1.26			Disagree

From Table 4.83 above, the total mean DEI of the four control population samples, namely, the group of students studying the Science-Math program (Montfort College), the Art-Business program, the International Program, and the Science-Math program (government school), has a total DEI average in the pre-experiment DEI - WBL Prototype stage at 1.20. The standard deviation (S.D.) value is 0.350, indicating the Disagree level. In the post-experiment stage of DEI - WBL Prototype, the total mean DEI is 1.33, with an S.D. value of 0.367, also indicating the Disagree level.

Therefore, the comparison of means and relationships of the control population samples during the pre- and post-DEI - WBL Prototype experiments can be summarized, as illustrated in Figure 4.8.

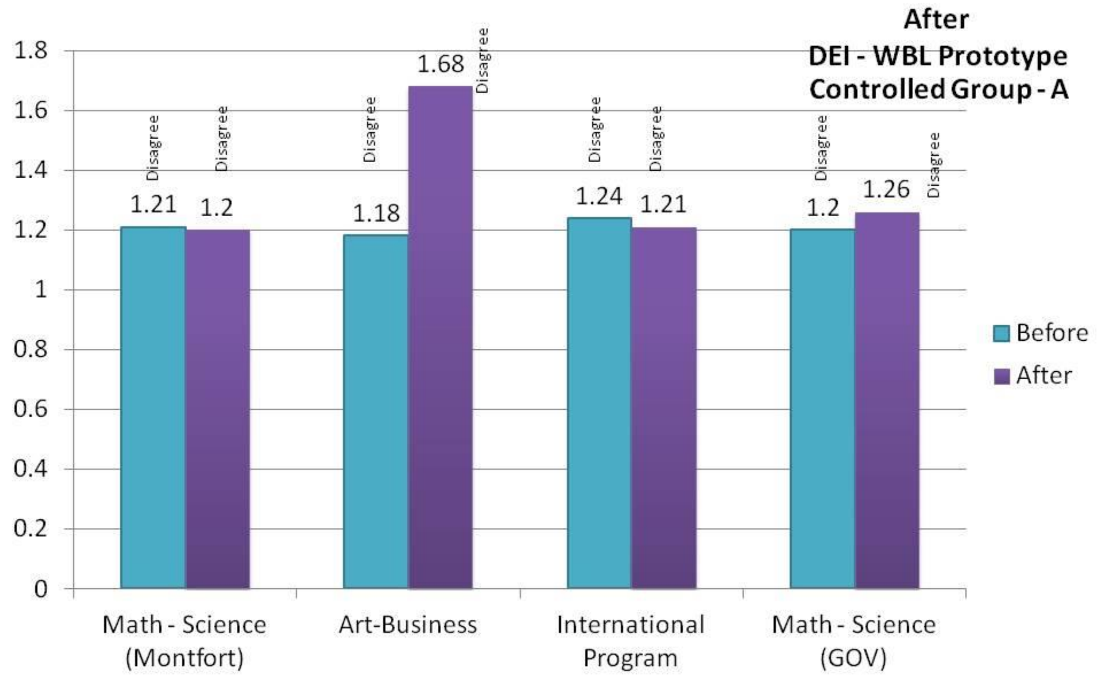


Figure 4.8 A comparison of the mean DEI of the control population samples before and after the DEI - WBL Prototype experiment in Scope 3

Subsequently, the hypotheses in the research were analyzed using the Paired Sample t-Test to test the relationship and statistical significance of the four control population samples before and after the DEI WBL - Prototype experiment. This analysis is presented in Table 4.84 below.

Table 4.84 The relationship analysis and statistical significance in the Paired Sample t-Test distribution from the control population samples before and after the DEI WBL - Prototype experiment

Experiment	Study program	Mean ($\bar{x}$)	Total Mean	S.D.	t	Sig (2-tailed) (p-value)
Before	Sci-Math (Montfort)	1.21	-0.13	0.249	-0.041	0.374
	Art-Business	1.18				
	International Program	1.24				
	Sci-Math (Government)	1.20				
After	Sci-Math (Montfort)	1.20				
	Art-Business	1.68				
	International Program	1.21				
	Sci-Math (Government)	1.26				
Significant at the 0.05 level (P value < 0.05)						

Based on Table 4.84, the analysis revealed that the total mean DEI of the control population samples before and after the DEI - WBL Prototype experiment is -0.13. The t-Test value is -0.041, the standard deviation (S.D.) value is 0.249, and the p-value (sig 2-tailed) is 0.374, which exceeds the specified statistical significance threshold of 0.05 (p-value > 0.05). The conclusion can be drawn as follows:

<u>1) There is no significant difference in the DEI values of the control group using the Thai basic curriculum teaching model based on Bloom's Taxonomy learning criteria before and after the DEI- WBL Prototype experiment in Scope 3.</u>

<u>This suggested that teaching according to Bloom's Taxonomy principles or learning in the three KPA areas did not impact the development of DEI in secondary students both before and after the experiment. Therefore, the research hypothesis H3 is rejected.</u>

H3: *Thailand's Basic Education Core Curriculum using Bloom's Taxonomy has a significant impact on the Digital Entrepreneurial Intelligence (DEI) of secondary students in Montfort College Secondary School.*

<u>2) There is no significant difference in the DEI values of the control group using the International School Program model based on Bloom's Taxonomy criteria before and after the DEI - WBL Prototype experiment. This implied that teaching according to the principles of Bloom's Taxonomy or KPA learning in three areas did not influence the development of DEI in secondary students both before and experiment. Hence, the research hypothesis H4 is also rejected.</u>

H4: International School Program Curriculum using Bloom's Taxonomy has a significant impact on the digital entrepreneurial intelligence (DEI) of secondary students in Montfort College Secondary Section.

2.2) Results of the analysis between the experimental group before and after the DEI - WBL Prototype experiment

Table 4.85 A comparison of the mean of the dependent variable DEI from the experimental group before and after the DEI WBL - Prototype experiment

Experiment period	Experimental group	Study program	**Mean ($\bar{x}$)**	**Total Mean**	**S.D.**	**Rating**
Before	EG1	Sci-Math (Montfort)	1.19	1.22	0.348	Disagree
	EG2	Art-Business	1.23			Disagree
	EG3	International Program	1.26			Disagree
	EG4	Sci-Math (Government)	1.20			Disagree

Table 4.85 A comparison of the mean of the dependent variable DEI from the experimental group before and after the DEI WBL - Prototype experiment (continued)

Experiment period	Experimental group	Study program	**Mean ($\bar{x}$)**	**Total Mean**	**S.D.**	**Rating**
After	EG1	Sci-Math (Montfort)	3.38	3.34	0.635	Agree
	EG2	Art-Business	3.30			Agree
	EG3	International Program	3.34			Agree
	EG4	Sci-Math (Government)	3.36			Agree

From Table 4.85 above, the total mean DEI of the four experimental population samples, including students from the Science-Math program (Montfort College), the Art-Business program, the International Program, and the Science-Mathematics program (government school), is 1.22 in the pre-experiment stage of DEI- WBL Prototype, with a standard deviation (S.D.) value of 0.348. The interpretation of the mean is at the Disagree level. In the post-experiment stage of DEI - WBL Prototype, the total mean DEI increases to 1.34, with an S.D. value of 0.635, and the interpretation of the mean is at the Agree level.

The means and relationships of the experimental population samples during the pre- and post-DEI - WBL Prototype experiments can be summarized and compared, as shown in Figure 4.9.

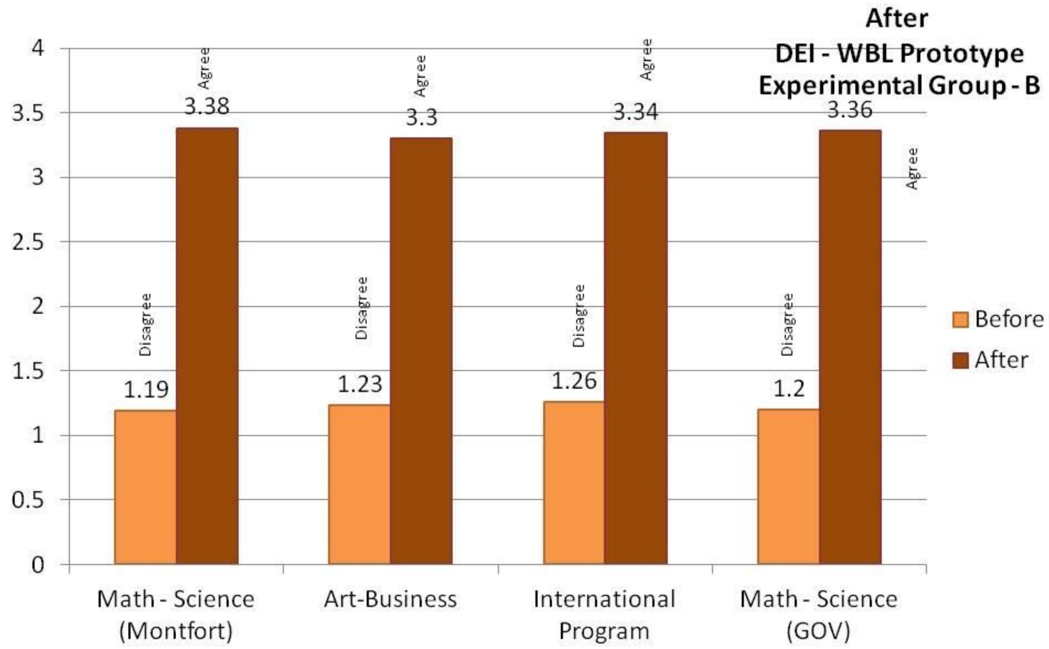


Figure 4.9 A comparison of the mean DEI of the experimental population samples before and after the DEI – WBL Prototype experiment in Scope 3

Subsequently, the hypotheses in the research were analyzed using the Paired Sample t-Test statistics to examine the relationship and statistical significance of the four experimental population samples before and after the DEI - WBL Prototype experiment. This analysis is presented in Table 4.86 as follows:

Table 4.86 The analysis of the relationship and statistical significance of the Paired Sample t-Test distribution from the experimental population samples before and after the DEI – WBL Prototype experiment

Experiment period	**Study program**	**Mean ($\bar{x}$)**	**Total Mean**	**S.D.**	**t**	**Sig** (2-tailed) (p-value)
Before	Sci-Math (Montfort)	1.19	-2.12	0.059	-71.83	0.000
	Art-Business	1.23				
	International Program	1.26				
	Sci-Math (Government)	1.20				
After	Sci-Math (Montfort)	3.38				
	Art-Business	3.30				
	International Program	3.34				
	Sci-Math (Government)	3.36				
Significant at the 0.05 level (P value < 0.05)						

From Table 4.86, the total mean DEI of the experimental group is -2.12 at before and after the DEI - WBL Prototype experiment. The analysis also revealed a t-Test value of -71.83, with a standard deviation (S.D.) value equal to 0.059 and a p-value (sig 2-tailed) of 0.000, which is less than the specified statistical significance value of 0.05 (p-value < 0.05). The conclusion can be drawn as follows:

1) The experimental group, utilizing the teaching model based on the principles of WBL in both pre- and post-DEI- WBL Prototype experiment, showed a difference. Additionally, there was statistical significance in DEI values among secondary students from the Scope 3 experiment. In other words, teaching and learning based on the principles of WBL 4 Brain Functions had an impact on the

<u>development of DEI in secondary students after the experiment. Therefore, the research hypothesis H6 is accepted.</u>

H6: The digital entrepreneurial intelligence (DEI) Prototype using Whole Brain Literacy (WB) has a significant impact on the digital entrepreneurial intelligence (DEI) of secondary students in Montfort College Secondary Section.

2.3) Results of the analysis between the control group and the experimental group after the DEI - WBL Prototype experiment

Table 4.87 A comparison of the mean of the dependent variable DEI from the control group and the experimental group after the DEI - WBL Prototype experiment

Group	Sample type	Study program	**Mean ($\bar{x}$)**	**Total Mean**	**S.D.**	**Rating**
Control A	CG1	Sci-Math (Montfort)	1.20			Disagree
	CG2	Art-Business	1.68			Disagree
	CG3	International Program	1.21	1.33	0.367	Disagree
	CG4	Sci-Math (Government)	1.26			Disagree
Experimental B	EG1	Sci-Math (Montfort)	3.38			Agree
	EG2	Art-Business	3.30			Agree
	EG3	International Program	3.34	3.34	0.635	Agree
	EG4	Sci-Math (Government)	3.36			Agree

From Table 4.87 above, the total mean DEI of the control population samples, comprising four groups (students in the Science-Mathematics program (Montfort College), the Art-Business program, The International Program, and the Science-Mathematics program (government school)), is 1.33 with an S.D. value of 0.367. The interpretation of the mean is at the Disagree level.

For the four experimental groups, including students inthe Science-Mathematics program (Montfort College), the Art-Business program, the International Program, and the Science-Mathematics program (government school), the mean DEI in the post-experiment phase of DEI- WBL Prototype is 3.34, with an S.D. value of 0.635. The interpretation of the mean is at the Agree level.

In summary, the means and relationships of the control population samples and the experimental groups after the DEI - WBL Prototype experiment are compared, as shown in Figure 4.10.

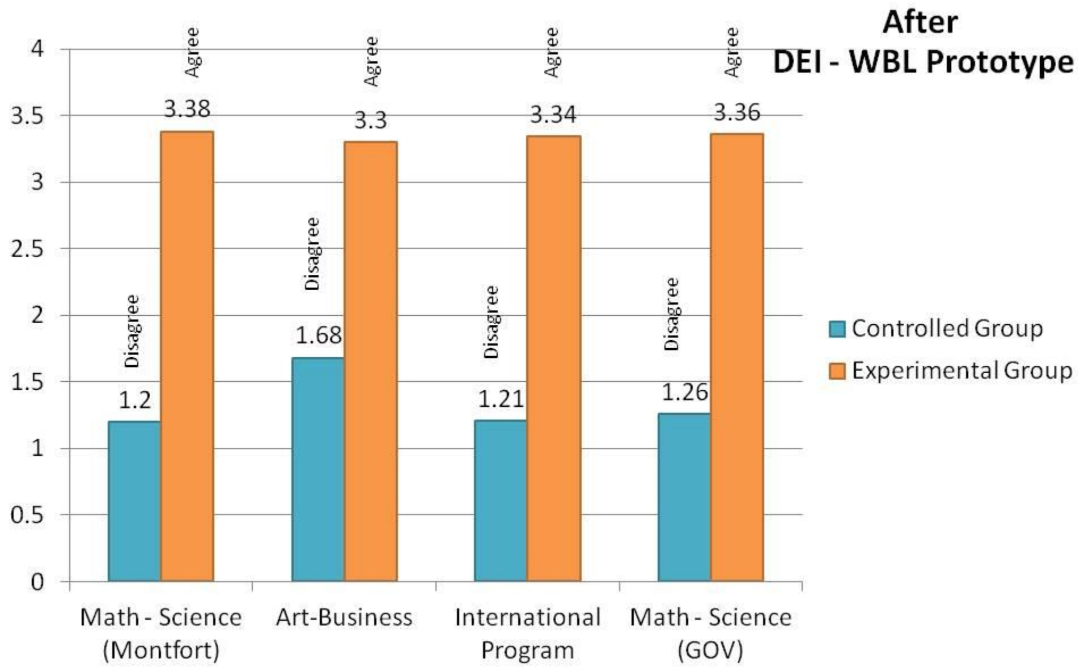


Figure 4.10 A comparison of DEI mean between the control group and the experimental group after the DEI – WBL Prototype experiment in Scope 3

Then, the hypotheses in the research were analyzed using the Paired Sample t-Test statistics to test the relationship and statistical significance of all four groups of the control population sample and experimental sample after the DEI - WBL Prototype experiment. This can be shown in Table 4.88 as follows.

Table 4.88 The analysis of the relationship and statistical significance of the Paired Sample t-Test distribution from the control group and the experimental group after the DEI - WBL Prototype experiment

<table>
<tr><th>Group</th><th>Sample type</th><th>Study program</th><th>Mean ($\bar{x}$)</th><th>Mean ($\bar{x}$)</th><th>Total Mean</th><th>S.D.</th><th>t</th></tr>
<tr><td rowspan="4">Control
A
(KPA)</td><td>CG1</td><td>Sci-Math (Montfort)</td><td>1.20</td><td rowspan="8">-2.00</td><td rowspan="8">0.260</td><td rowspan="8">-15.41</td><td rowspan="8">0.001</td></tr>
<tr><td>CG2</td><td>Art-Business</td><td>1.68</td></tr>
<tr><td>CG3</td><td>International Program</td><td>1.21</td></tr>
<tr><td>CG4</td><td>Sci-Math (Government)</td><td>1.26</td></tr>
<tr><td rowspan="4">Experimental
B
(WBL)</td><td>EG1</td><td>Sci-Math (Montfort)</td><td>3.38</td></tr>
<tr><td>EG2</td><td>Art-Business</td><td>3.30</td></tr>
<tr><td>EG3</td><td>International Program</td><td>3.34</td></tr>
<tr><td>EG4</td><td>Sci-Math (Government)</td><td>3.36</td></tr>
<tr><td colspan="8">Significant at the 0.05 level (P value < 0.05)</td></tr>
</table>

According to Table 4.88, the total mean DEI of the control group and the experimental group is -2.00 in the post-DEI - WBL Prototype experiment. From the analysis, it is also found that there is a t-Test value of -15.41, with an S.D. value of 0.260, and the p-value (sig 2-tailed) is 0.001, which is lower than the specified statistical significance value of 0.05 (p-value < 0.05). The conclusion can be drawn as follows:

1) The control group and the experimental group in the post-DEI - WBL Prototype experiment were different, and there was statistical significance of DEI values in secondary students from the experiment in Scope 3. It can be said that the teaching and learning model that used the principles of WBL 4 Human Brain Functions had an impact on the development of DEI in secondary students after the experiment. Therefore, the research hypothesis H5 is accepted.

H5: Whole Brain Literacy (WBL) has a significant impact on the digital entrepreneurial intelligence (DEI) of secondary students in Montfort College Secondary Section.

2.4) Results of the analysis of variance of the experimental group between the selection of school learning programs and the development of DEI after the DEI-WBL Prototype experiment using one-way analysis of variance or One-way ANOVA.

Table 4.89 A comparison of One-way ANOVA of the experimental group between the selection of school learning programs and the development of DEI after the DEI - WBL Prototype experiment

Learning program	**Source of variance**	**df**	**Sum of Square**	**Mean Square**	**F**	**Sig.** (p-value)
4 learning programs for the DEI development	Between Groups	3	0.356	0.119	5.205	0.002 *
	Within Groups	396	9.024	0.023		
	Total	399	9.380			
* Significant at the 0.05 level (P value < 0.05)						

From Table 4.89 above, it is found that the variance from Between groups has a df value of 3, from Within groups is 396, and the Total is equal to 399, with an F value of 5.205 and a Sig value (p-value) equal to 0.002, which is less than the specified statistical significance value (p value < 0.05). The conclusion can be drawn as follows:

The selection of school learning programs for secondary students across four classrooms, including students in the Science-Mathematics program (Montfort College), the Art-Business program, the International Program, and the Science-Mathematics program (government school) from the experimental group in the post-DEI - WBL Prototype experiment has a statistically significant difference in the mean results of DEI development in Scope 3. Therefore, the research hypothesis H1 is accepted.

H1: The school learning programs have a significant impact on the digital entrepreneurial intelligence (DEI) of secondary students in Montfort College Secondary Section

Then, when the results of the above study found that the differences (at least 1 pair) of the school learning programs in all four classrooms from the experiment had an effect on the development of DEI of secondary students, the researcher analyzed and compared the relationship between each pair of school learning programs to see if they were different in any way using the statistical principle of Multiple Comparisons (Post Hoc Test). This can be shown in Table 4.90 as follows.

Table 4.90 A comparison of the relationship between different school learning programs on the development of DEI using the statistical principle of Multiple Comparisons (Post Hoc Test – LSD)

(I) Program	**(J) Program**	**Mean Dif**	**Std. Error**	**Sig** (p-value)
Science-Math (Montfort)	Art-Business	0.080^{*}	0.021	0.000 *
	International Program	0.047^{*}	0.021	0.026
	Science-Math (GOV)	0.022	0.021	0.287
Art-Business	Science-Math (Montfort)	-0.080^{*}	0.021	0.000 *
	International Program	-0.032	0.021	0.129
	Science-Math (GOV)	-0.057^{*}	0.021	0.007 *
International Program	Science – Math (Montfort)	-0.047^{*}	0.021	0.026
	Art-Business	0.032	0.021	0.129
	Science-Math (GOV)	-0.025	0.021	0.242
Science-Math (GOV)	Science-Math (Montfort)	-0.022	0.021	0.287
	Art-Business	0.057^{*}	0.021	0.007 *
	International Program	0.025	0.021	0.242

* Significant at the 0.05 level (P value < 0.05)

From Table 4.90 above, the results of the comparative analysis of the school learning programs of students in the experimental group that affect DEI development can be summarized as follows:

1) Students in the Science-Mathematics program (Montfort College) showed different results in DEI development from the Art-Business program. Students in the Science-Mathematics program (Montfort College) exhibited significantly greater DEI development results than students in the Art-Business study program, with a p-value of 0.000 and a Mean Difference (Dif) value of 0.080.

2) Students in the Art-Business program demonstrated DEI development results distinct from those of students in the Science-Mathematics program (government school). Students in the Art-Business program displayed significantly lesser DEI development results than students in the Science-Mathematics program (government school), with a p-value of 0.000 and a Mean Difference value of -0.080.

3) Additionally, in the International Program, no statistically significant differences or variances were observed compared to other study programs.

4) From the above relationships, it can be inferred that students in the Art-Business program within the experimental group displayed differing DEI development results, notably less favorable, compared to students in the Science-Mathematics program (Montfort College) and Science-Mathematics program (government schools). A diagram illustrating the relationship between the differences in school learning programs affecting DEI development can be shown in Figure 4.11.

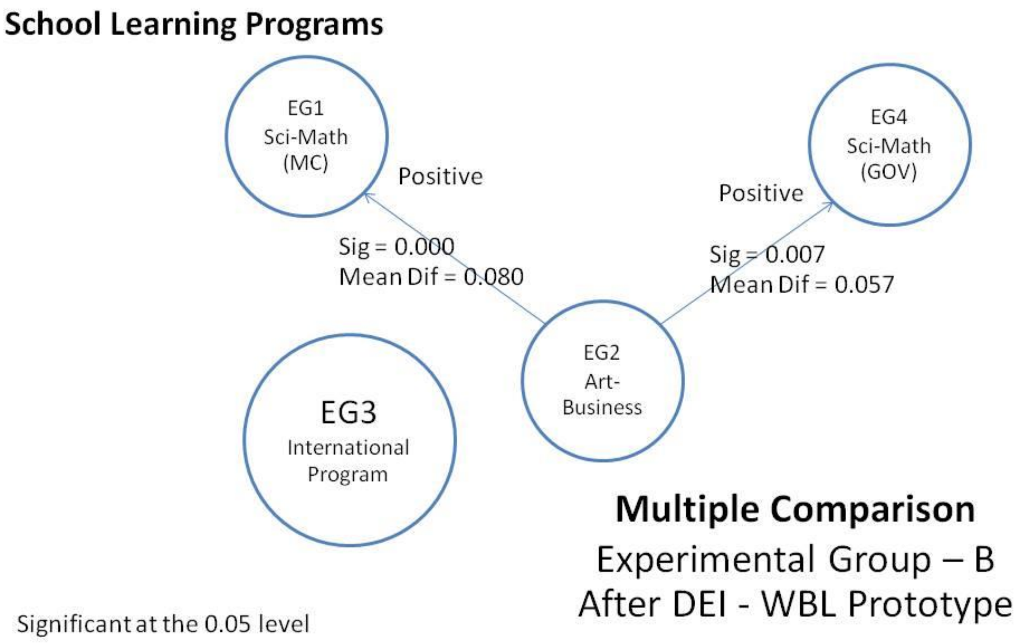


Figure 4.11 A diagram illustrating the relationship between the differences in school learning programs affecting DEI development of the experimental groups in the post-DEI – WBL Prototype experiment in Scope 3

2.5) Results of analysis of variance of the experimental group between the selection of a hobby and the DEI development after the DEI - WBL Prototype experiment using one-way analysis of variance or One-way ANOVA

Table 4.91 A comparison of One-way ANOVA of the experimental group between the selection of a hobby and the DEI development after the DEI - WBL Prototype experiment

Students' hobby	**Source of variance**	**df**	**Sum of Square**	**Mean Square**	**F**	**Sig. (p-value)**
4 types of hobbies	Between Groups	3	0.495	0.165	7.352	0.000 *
	Within Groups	396	8.885	0.022		
	Total	399	9.380			
* Significant at the 0.05 level (P value < 0.05)						

From Table 4.91, it is observed that the variance from Between groups has a df value of 3, from Within groups is 396, and the Total is equal to 399. The F value is 7.352, and the Sig value (p-value) is equal to 0.000, which is less than the specified statistical significance value of p-value < 0.05. The conclusion can be drawn as follows:

1) Students' hobbies in four areas: sports, art, music, and technology, from the experimental group, exhibited a statistically significant difference in the mean results of DEI development in Scope 3 during the post-DEI - WBL Prototype experiment. Therefore, the research hypothesis H2 is accepted.

H2: Students' hobbies have a significant impact on the digital entrepreneurial intelligence (DEI) of secondary students in Montfort College Secondary Section.

Subsequently, when the results of the above study found that the differences (at least 1 pair) of the four types of students' hobbies from the experiment had an effect on the development of DEI of secondary students, the researcher analyzed and compared the relationship between each pair of hobbies see if they were different in any way using the statistical principle of Multiple Comparisons (Post Hoc Test). This analysis is depicted in Table 4.92.

Table 4.92 A comparison of the relationship between different hobbies of students and their development of DEI using the statistical principle of Multiple Comparisons (Post Hoc Test – LSD)

(II) Hobbies	**(J) Hobbies**	**Mean Dif**	**Std. Error**	**Sig** (p-value)
Sports	Art	0.036	0.019	0.059
	Music	0.110*	0.024	0.000 *
	Technology	0.010	0.019	0.579
Art	Sports	-0.036	0.019	0.059
	Music	0.074*	0.025	0.004 *
	Technology	-0.025	0.021	0.223
Music	Sports	-0.110*	0.024	0.000 *
	Art	-0.074*	0.025	0.004 *
	Technology	-0.100*	0.025	0.000 *

Table 4.92 A comparison of the relationship between different hobbies of students and their development of DEI using the statistical principle of Multiple Comparisons (Post Hoc Test – LSD) (continued)

(III) Hobbies	**(J) Hobbies**	**Mean Dif**	**Std. Error**	**Sig** (p-value)
Technology	Sports	-0.010	0.019	0.579
	Art	0.025	0.021	0.223
	Music	0.100*	0.025	0.000 *
* Significant at the 0.05 level (P value < 0.05)				

From Table 4.92, the results of the analysis comparing and contrasting the hobbies of students in the experimental group that affect DEI development can be summarized as follows:

1) Sports hobbies showed significantly different results in the DEI development compared to Music hobbies, with Sports hobbies being more effective in the DEI development than music hobbies. This difference is statistically significant, with a p-value of 0.000 and a Mean Dif of 0.110.

2) Art hobbies exhibited significantly different results in the DEI development compared to Music hobbies, with Art hobbies being more effective in DEI development than music hobbies. This difference is statistically significant, with a p-value of 0.004 and a Mean Dif of 0.074.

3) Music hobbies displayed significantly different results in the DEI development compared to hobbies in Technology, with Music hobbies having a statistically significant lower effect on the DEI development than Technology hobbies. This difference is observed with a p-value of 0.000 and a Mean Dif of -0.100.

4) From the above relationships, it can be concluded that students in the experimental group with music hobbies demonstrated different results in the DEI development, showing less development compared to students who opt for hobbies in sports, art, and technology. A diagram illustrating the relationship between the differences in students' hobbies affecting the DEI development is shown in Figure 4.12.

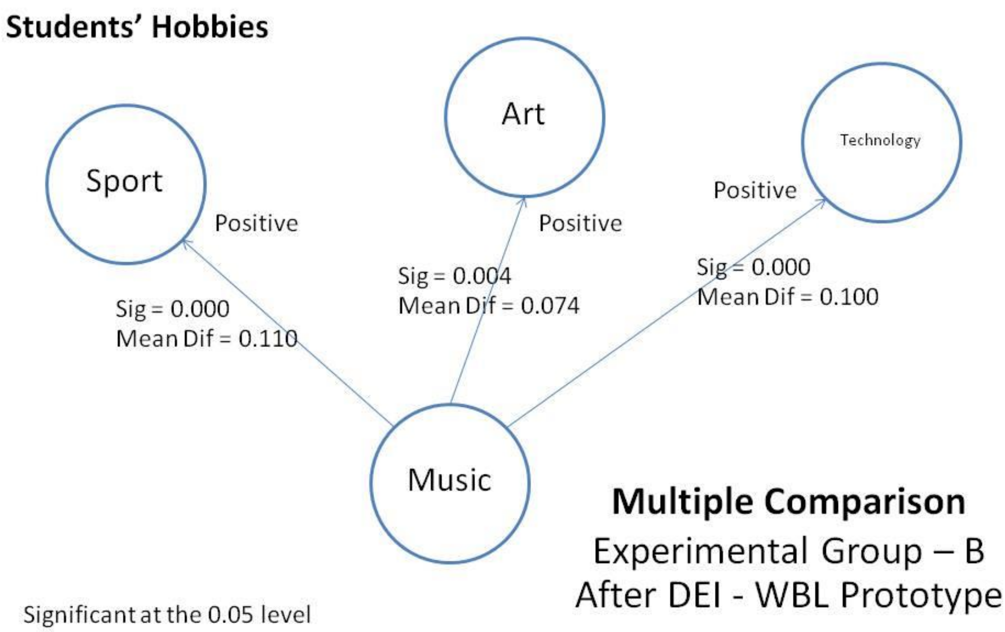


Figure 4.12 A diagram illustrating the relationship between the differences in students' hobbies affecting the DEI development of the experimental group in the post-DEI - WBL Prototype experiment in Scope 3

2.6) Results of analysis and relationship of WBL factors affecting the DEI development in the experimental group after the DEI - WBL Prototype experiment

Table 4.93 A comparison of the relationship of WBL factors influencing the DEI development in the experimental group during the post-DEI - WBL Prototype experiment

Ranking	**WBL**	**Factor**	**Study programs of the experimental group**								Total Mean ($\bar{x}$)	S.D.
			Science – Math (Montfort)		Art-Business		International Program		Science – Math (GOV)			
			($\bar{x}$)	S.D.	($\bar{x}$)	S.D.	($\bar{x}$)	S.D.	($\bar{x}$)	S.D.		
1	I-E	F1	3.96	0.034	3.95	0.035	3.99	0.037	3.98	0.052	3.97	0.040
2	I-E	F2	3.92	0.042	3.94	0.037	3.97	0.041	3.95	0.041	3.94	0.040
3	I-E	F3	3.90	0.037	3.91	0.041	3.91	0.045	3.94	0.045	3.91	0.042
4	I-E	F4	3.87	0.041	3.90	0.045	3.90	0.037	3.91	0.052	3.89	0.044
5	I-C	F5	3.84	0.037	3.87	0.052	3.88	0.041	3.86	0.034	3.86	0.041
6	I-C	F6	3.82	0.041	3.81	0.041	3.85	0.045	3.85	0.055	3.83	0.046
7	I-C	F7	3.80	0.045	3.79	0.045	3.82	0.037	3.84	0.037	3.81	0.041
8	I-C	F8	3.76	0.052	3.77	0.052	3.75	0.041	3.81	0.055	3.77	0.050
9	I-PR	F9	3.72	0.044	3.73	0.034	3.71	0.045	3.80	0.044	3.74	0.042
10	I-PR	F10	3.70	0.038	3.71	0.055	3.69	0.052	3.78	0.038	3.72	0.046
11	I-PR	F11	3.68	0.037	3.70	0.037	3.67	0.035	3.75	0.055	3.70	0.041
12	I-PR	F12	3.65	0.041	3.69	0.055	3.68	0.037	3.69	0.037	3.67	0.043
13	I-PU	F13	3.60	0.045	3.65	0.032	3.64	0.041	3.65	0.055	3.63	0.045
14	I-PU	F14	3.57	0.052	3.60	0.044	3.63	0.045	3.61	0.044	3.60	0.046
15	I-PU	F15	3.55	0.057	3.57	0.038	3.54	0.052	3.60	0.038	3.56	0.046
16	I-PU	F16	3.54	0.055	3.55	0.037	3.53	0.045	3.59	0.037	3.55	0.044

Table 4.93 A comparison of the relationship of WBL factors influencing the DEI development in the experimental group during the post-DEI - WBL Prototype experiment (continued)

Ranking	WBL	Factor	Study programs of the experimental group								Total Mean	S.D.
			Science – Math (Montfort)		Art-Business		International Program		Science – Math (GOV)			
			($\bar{x}$)	S.D.	($\bar{x}$)	S.D.	($\bar{x}$)	S.D.	($\bar{x}$)	S.D.	($\bar{x}$)	

Factor	Definition	Brain Functions
F1	Creativity (I-E)	The development of creativity and imagination (The anterior right brain lobe)
F2	Innovativeness (I-E)	
F3	Visionary (I-E)	
F4	Passionate (I-E)	
F5	Leadership skill (I-C)	The development of analytical and logical thinking (The anterior left brain lobe)
F6	Planning skill (I-C)	
F7	Perseverance (I-C)	
F8	Analytical skill (I-C)	
F9	Interpersonal (I-PR)	The development of emotional and social dimension (The posterior right brain lobe)
F10	Emotional Regulation (I-PR)	
F11	Communicational skill (I-PR)	

Table 4.93 A comparison of the relationship of WBL factors influencing the DEI development in the experimental group during the post-DEI - WBL Prototype experiment (continued)

<table>
<tr><th rowspan="3">Ranking</th><th rowspan="3">WBL</th><th rowspan="3">Factor</th><th colspan="8">Study programs of the experimental group</th><th rowspan="3">Total Mean $(\bar{x})$</th><th rowspan="3">S.D.</th></tr>
<tr><th colspan="2">Science – Math (Montfort)</th><th colspan="2">Art-Business</th><th colspan="2">International Program</th><th colspan="2">Science – Math (GOV)</th></tr>
<tr><th>$(\bar{x})$</th><th>S.D.</th><th>$(\bar{x})$</th><th>S.D.</th><th>$(\bar{x})$</th><th>S.D.</th><th>$(\bar{x})$</th><th>S.D.</th></tr>
<tr><th>Factor</th><th colspan="5">Definition</th><th colspan="7">Brain Functions</th></tr>
<tr><td>F12</td><td colspan="5">Teambuilding skill (I-PR)</td><td colspan="7" rowspan="5">The development of movement and self-control
(The posterior left brain lobe)</td></tr>
<tr><td>F13</td><td colspan="5">Self-Behavioral Regulation (I-PU)</td></tr>
<tr><td>F14</td><td colspan="5">Risk-Reduction (I-PU)</td></tr>
<tr><td>F15</td><td colspan="5">Work under pressure (I-PU)</td></tr>
<tr><td>F16</td><td colspan="5">Time Management (I-PU)</td></tr>
</table>

In summarizing the results, the researcher found that 16 factors related to WBL in the DEI- WBL Prototype experiment out of the factors examined in the experiment, totaling 64 aspects. Table 4.93 above summarized the relationship of various factors influencing the DEI development in the experimental group of secondary students across all four classrooms. This can be explained that Factor F1 in the area of Creativity (I-E) ranks first with an average of 3.97. Factor F2 in the area of Innovativeness (I-E) ranks second with an average of 3.94. Factor F3 in the area of Visionary (I-E) ranks third with an average of 3.3.91. Factor F4 in Passionate (I-E) ranks fourth with an average of 3.89. Factor F5 in Leadership Skill (I-PC) ranks fifth with an average of 3.86. Factor F6 in Planning Skill (I-PC) ranks sixth with an average of 3.83. Factor F7 in Perseverance (I-C) ranks seventh with an average of 3.81. Factor F8 in Analytical Skill (I-C) ranks eighth with an average of 3.77. Factor F9 in Interpersonal (I-PR) ranks ninth with an average of 3.74. Factor F10 in Emotional Regulation (I-PR) ranks tenth with an average of 3.72. Factor F11 in Communicational Skill (I-PR) ranks eleventh with an average of 3.70. Factor F12 in Teambuilding Skill (I-PR) ranks twelfth with an average of 3.67. Factor F13 in Self-Behavioral Regulation (I-PU) ranks thirteenth with an average of 3.63. Factor F14 in Risk-Reducion (I-PU) ranks fourteenth with an average of 3.60. Factor F15 in Work under pressure (I-PU) ranks fifteenth with an average of 3.56. The last ranking is Factor F16 in Time Management (I-PU) with an average value of 3.55.

Based on this information, importance ranking and comparison of factors related to the DEI development among secondary students can be arranged from the highest to lowest value using a bar chart as depicted in Figure 4.13.

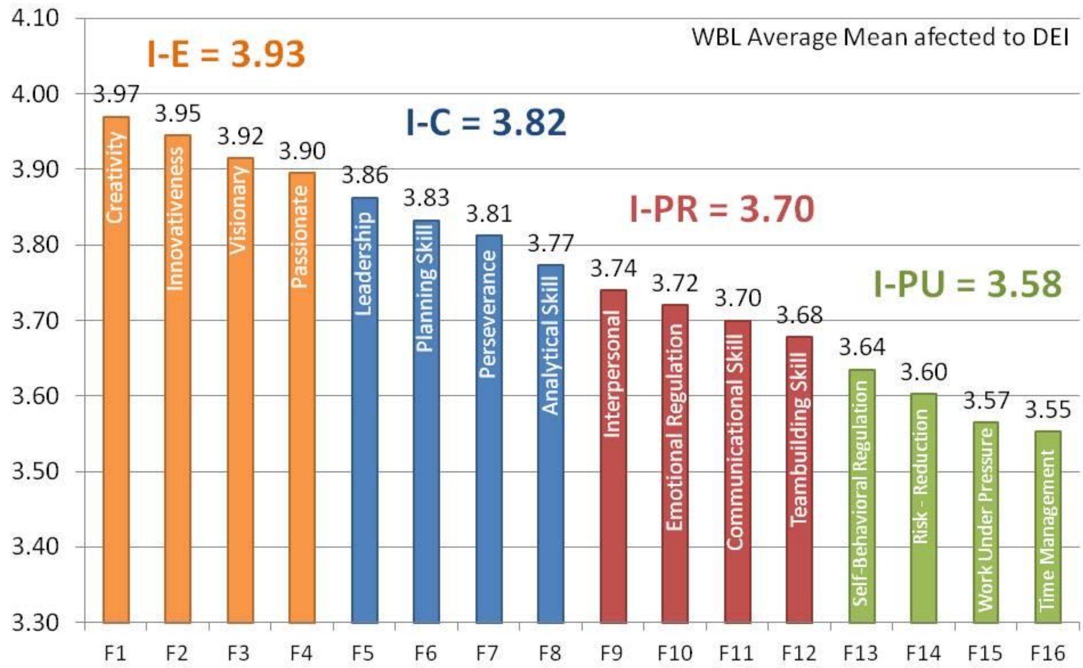


Figure 4.13 A Comparison of factors related to the DEI development among secondary students in the post-DEI - WBL Prototype experiment in Scope 3

From Figure 4.13, the bar chart classified factors according to the WBL principles that positively influenced and affected the development of DEI among secondary students. These factors were classified into four aspects and sixteen factors, detailed as follows: 1) I-E or the anterior right brain lobe: responsible for the development of creativity and imagination with an average of 3.93. 2) I-C or the anterior left brain lobe: responsible for the development of analytical and logical thinking with an average of 3.82. 3) I-PR or the posterior right brain lobe: responsible for the development of emotional and social dimensions with an average of 3.70. And 4) I-PU or the posterior left brain lobe: responsible for the development of movement and self-control with an average of 3.58.

CHAPTER 5

EVALUATION AND DUSCUSSION

5.1 Chapter Overview

Chapter 5 presents a summary of the evaluation of the prototype model for the digital entrepreneurial intelligence (DEI) development, employing the principles of WBL or the Four Human Brain Functions. This model is referred to as the DEI - WBL Prototype. Moreover, other relevant research studies are discussed and compared. This chapter is divided into four parts:

1) A summary and discussion of the evaluation results of the DEI - WBL Prototype in this study

2) A summary of comparing the DEI - WBL Prototype with the Four Human Brain Functions

3) A comparison of the DEI - WBL Prototype experiment's findings with other research studies

4) Chapter summary

5.2 Summary and Discussion of Evaluation Results of the DEI - WBL Prototype in This Study

5.2.1 Summary of Research Hypothesis Testing Results and Answers to Research Questions

According to the DEI - WBL Prototype experiment within the sample population, consisting of both the control and experimental groups as presented in Chapter 4, the findings of the research hypothesis testing can be outlined, as depicted in Table 5.1 below:

Table 5.1 Summary of research hypothesis testing results

Hypothesis	Results	Compared group	Period of experiment	Analysis	Statistic		
					Mean square	**F**	**Sig.**
H1	**Accepted**	Experimental group (B)	Before and after DEI - WBL Prototype	One-way ANOVA multiple comparison	0.119	5.205	0.002
		Experimental group (B)			0.023		
		Summary: Sig < 0.05, Accepted H1: *The school learning programs have a significant impact on the digital entrepreneurial intelligence (DEI) of secondary students in Montfort College Secondary Section.*					
					Mean square	**F**	**Sig.**
H2	**Accepted**	Experimental group (B)	Before and After DEI - WBL Prototype	One-way ANOVA multiple comparison	0.165	7.352	0.000
		Experimental group (B)			0.022		
		Summary: Sig < 0.05, Accepted ***H2:*** *Students' hobbies have a significant impact on the digital entrepreneurial intelligence (DEI) of secondary students in Montfort College Secondary Section..*					
Significant at the 0.05 level (P value < 0.05)							

Table 5.1 Summary of research hypothesis testing results (continued)

Hypothesis	Results	Compared group	Period of experiment	Analysis	Statistic			
					Total Mean	**S.D.**	**t**	**Sig.**
H3	**Rejected**	Controlled group (A)	Before and after DEI - WBL Prototype	Pair sample t-Test	-0.13	0.249	-0.041	0.374
		Controlled group (A)						
		<u>Summary:</u> Sig > 0.05, Rejected ***H3:*** *Thailand's Basic Education Core Curriculum using Bloom's Taxonomy has a significant impact on the digital entrepreneurial intelligence (DEI) of secondary students in Montfort College Secondary Section.*						
					Total Mean	**S.D.**	**t**	**Sig.**
H4	**Rejected**	Controlled group (A)	Before and after DEI - WBL Prototype	Pair sample t-Test	-0.13	0.249	-0.041	0.374
		Controlled group (A)						
		<u>Summary:</u> Sig > 0.05, Rejected ***H4:*** *International School Program Curriculum using Bloom's Taxonomy has a significant impact on the digital entrepreneurial intelligence (DEI) of secondary students in Montfort College Secondary Section.*						
Significant at the 0.05 level (P value < 0.05)								

Table 5.1 Summary of research hypothesis testing results (continued)

Hypothesis	Results	Compared group	Period of experiment	Analysis	Statistic			
					Total Mean	**S.D.**	**t**	**Sig.**
H5	**Accepted**	Controlled group (A)	Before and after DEI - WBL Prototype	Pair sample t-Test	-2.00	0.260	-15.41	0.001
		Experimental group (B)						
		Summary: Sig < 0.05, Accepted ***H5:*** *Whole Brain Literacy (WBL) has a significant impact on the digital entrepreneurial intelligence (DEI) of secondary students in Montfort College Secondary Section.*						
					Total Mean	**S.D.**	**t**	**Sig.**
H6	**Accepted**	Experimental group (B)	Before and after DEI - WBL Prototype	Pair sample t-Test	-2.12	0.059	-7.183	0.000
		Experimental group (B)						
		Summary: Sig < 0.05, Accepted ***H6:*** *The digital entrepreneurial intelligence (DEI) prototype using Whole Brain Literacy (WBL) has a significant impact on the digital entrepreneurial intelligence (DEI) of secondary students in Montfort College Secondary Section.*						
Significant at the 0.05 level (P value < 0.05)								

5.2.2 Summary Discussion and Answers to Research Questions

1) How does the school learning program affect digital entrepreneurial intelligence (DEI) in secondary students?

From the study and analysis using the Multiple Comparison (Post Hoc Test) method, it was observed that among the experimental group, students in the Art-Business program exhibited varied developmental outcomes in DEI, leaning towards statistically significantly less development than students in the Science-Mathematics program (Montfort) and students in the Science-Mathematics program (a government school). This suggested that students in the Science-Mathematics program (Montfort) and Science-Mathematics program (a government school) displayed higher DEI development compared to those in the Art-Business program. Furthermore, it was noted that the International program did not yield any statistically significant differences or variances compared to other learning programs.

<u>In conclusion, it can be inferred that school' learning program at the secondary level yield varying mean values of DEI and exert distinct effects on DEI development.</u> A diagram illustrating the relationship between differences in students' study programs impacting the DEI development is depicted in Figure 5.1 below.

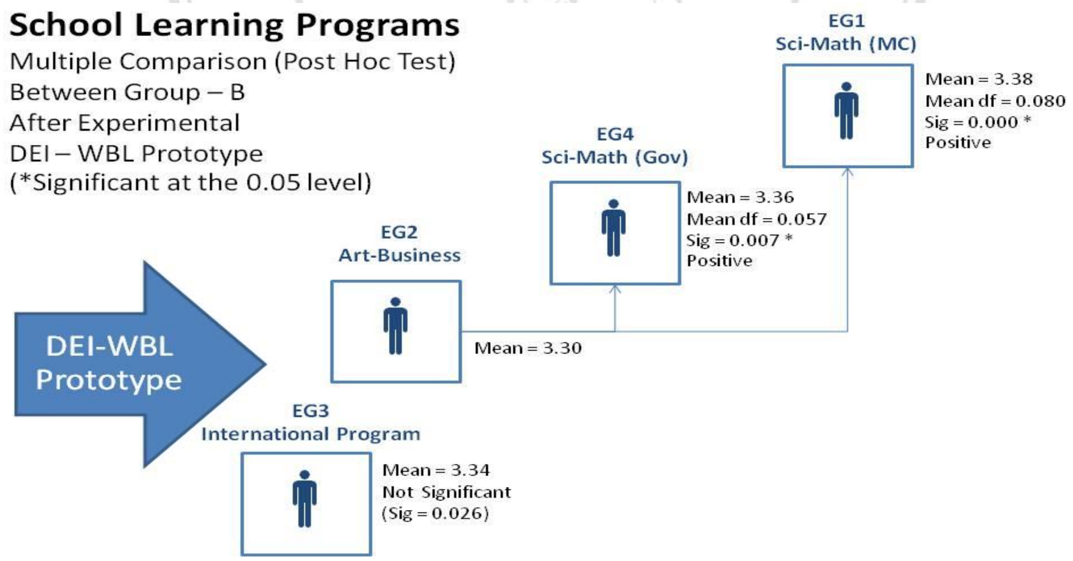


Figure 5.1 The relationship between different study programs influencing the development of DEI among the experimental group during the post-experiment phase of DEI-WBL Prototype within Scope 3

<u>2) How does student's hobby affect digital entrepreneurial intelligence (DEI) in secondary students?</u>

From the study and analysis using the Multiple Comparison (Post Hoc Test) method, it was evident that within the experimental group, students with musical hobbies exhibited differing outcomes in DEI development, showing less progress. Conversely, students engaged in hobbies related to sports, art, and technology demonstrated statistically significant differences, indicating greater DEI development than those with musical hobbies.

<u>It can be concluded that the hobbies of secondary students yield varying mean values of DEI and influence its development differently.</u> A diagram illustrating the relationship between differences in student's hobbies impacting the DEI development is presented in Figure 5.2 below.

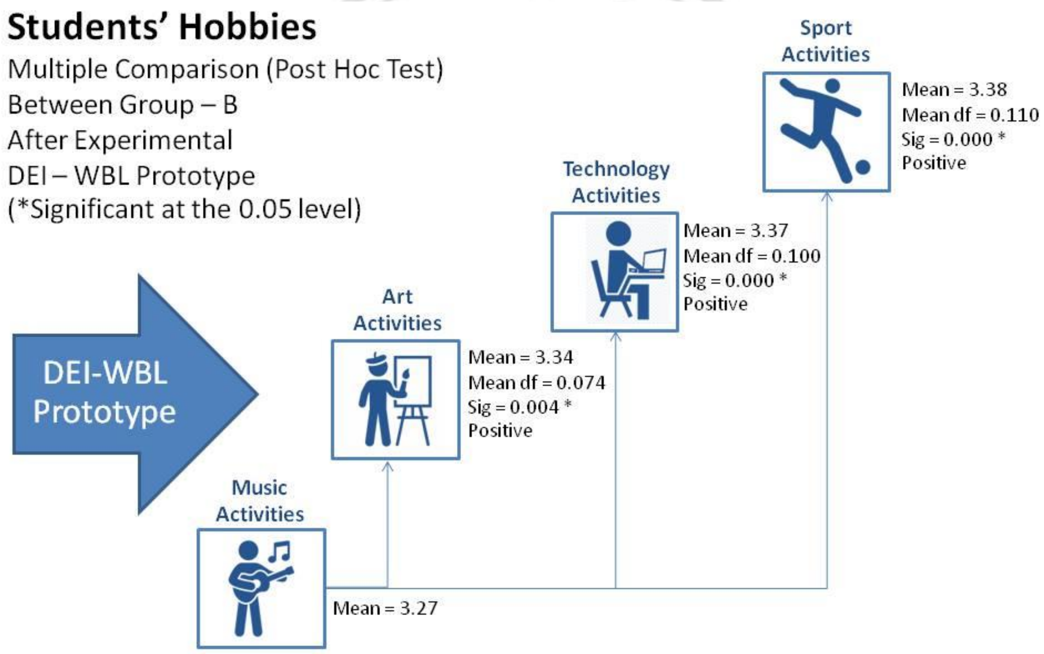


Figure 5.2 The relationship between different student's hobbies affecting the development of DEI within the experimental group during the post-experiment phase of DEI-WBL Prototype within Scope 3

3) How does Whole Brain Literacy (WBL) affect digital entrepreneurial intelligence (DEI) in secondary students?

From the study and analysis using the pair sample t-test method, it was revealed that the control group and the experimental group from all four study programs in the post-experiment phase of DEI-WBL Prototype in Scope 3 had significantly different mean values. This indicated that the teaching model based on the principles of WBL - 4 Brain Functions in the classroom had an impact on the development of DEI in secondary students after the experiment.

It can be concluded that the average of the control population sample exhibited a lower mean DEI than the experimental group in the post-experiment stage of the DEI-WBL Prototype. This suggested that WBL - 4 Human Brain Functions have an impact on the development of DEI in secondary students. A chart comparing the differences in DEI between the control group and the experimental group is presented in Figure 5.3 below.

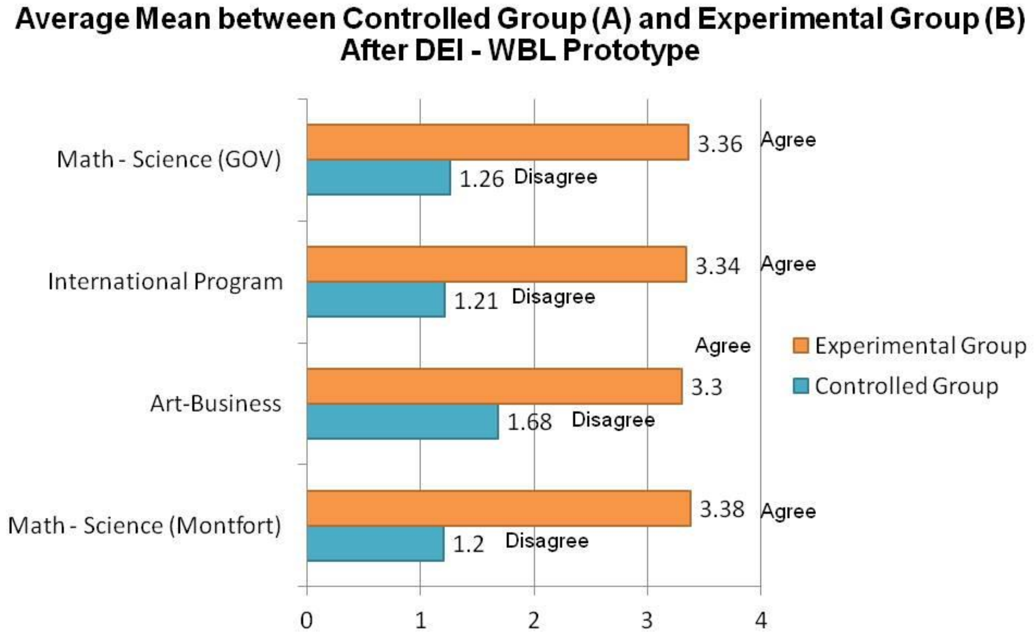


Figure 5.3 The comparison of mean DEI between the controlled and experimental groups during the post-experiment phase of the DEI-WBL Prototype in Scope 3

4) How to design a suitable learning process on digital entrepreneurial intelligence (DEI) using the Whole Brain Literacy (WBL) in secondary students?

In the process of collecting and analyzing data in Scope 3: Experimental Research (DEI - WBL Prototype), the results from the prototype learning models for the digital entrepreneurial intelligence (DEI) development were summarized and analyzed using WBL Prototype-1 and Prototype-2 obtained from Scope 1 and Scope 2 to design an experimental research with a population of secondary students, totaling 800 individuals. The relationship between Prototype-1 and Prototype-2 is depicted in Table 5.2.

Table 5.2 The relationship between Prototype-1 and Prototype-2 in the form of WBL and 4 Brain Functions derived from the results of studies in Scope 1 and Scope 2

Scope	**Prototype**	**WBL / Brain map / Brain functions**			
		I-C	I-PU	I-E	I-PR
		Anterior left brain lobe	**Posterior left brain lobe**	**Anterior right brain lobe**	**Posterior right brain lobe**
		The development of analytical and logical thinking	The development of movement and self-control	The development of creativity and imagination	The development of emotional and social dimension
1	Prototype-1 Learning expectations	***24%***	***15%***	***43%***	***18%***
		DEL development expectation ratios based on WBL principles			
	Application	Utilized to formulate four learning ratios concerning classroom time allocation and the number of lesson topics (course outlines) in accordance with WBL principles.			
2	Prototype-2 Relationship between independent and dependent variables	Standard score equation: $Z\ (_{DEI}) = 0.180\ (Z\ _{I\text{-}PR}) + 0.451\ (Z\ _{I\text{-}E}) + 0.244\ (Z\ _{I\text{-}C}) + 0.125\ (Z\ _{I\text{-}PU})$			
	Application	Utilized to establish priorities and design student development activities in line with WBL principles.			

According to Table 5.2, the variable group I-E, representing the function of the anterior right brain lobe (the development of creativity and imagination), has the greatest impact on DEI, followed by the variable group I-C, representing the function of the anterior left brain lobe (the development of analytical and logical thinking). The third is the I-PR group, indicating the function of the posterior right brain lobe (the development of emotional and social dimension), and lastly, the I-PU group, representing the function of posterior left brain lobe (the development of movement and self-control).

From the data analysis, the data obtained from Scope 1 and Scope 2 exhibited consistency regarding the ratio or percentage of brain activity influencing the development of DEI in secondary students, which was utilized in designing the DEI – WBL Prototype in this study.

5) How to develop the learning process on digital entrepreneurial intelligence (DEI) using the Whole Brain Literacy (WBL) in secondary students?

The design and development of teaching and learning processes utilizing the principles of 4 Brain Functions of WBL influencing the digital entrepreneurial intelligence (DEI) development in secondary students can be presented in Table 5.3.

Table 5.3 The ranking of the importance of DEI Prototypes related to the independent variables based on the WBL principles associated with DEI development

Ranking	Prototype-1 / WBL	Prototype-2 / WBL
1	I-E	I-E
2	I-C	I-C
3	I-PR	I-PR
4	I-PU	I-PU
Application	Utilized to formulate four learning ratios concerning classroom time allocation and the number of lesson topics (course outlines) in accordance with WBL principles.	Utilized to establish priorities and design student development activities in line with WBL principles.

From Table 5.3, it can be utilized to design Experimental Research (DEI - WBL Prototype) in two areas:

- Teaching and learning about digital entrepreneurial intelligence (DEI)

Based on the summary of the relationship ratio of the four brain functions according to the principles of WBL or DEI Prototype-1, it can be employed to design the teaching process or course outline in DEI for secondary students or sample population in Scope 3. The duration would be one semester (20 weeks), with five hours per week, totaling 100 hours. This design is outlined in Table 5.4 below.

Table 5.4 The design of the teaching and learning process or course outline using the WBL - DEI Prototype

WBL	**Percentage ratio**	**Hour / Week**	**Topic**	**Assessment**
I-E	43%	43 hours Week 1 - 9	The function of the anterior right brain (the development of creativity and imagination) # Business idea & operation - Creative social media - 3D Design / IoT / AI / VR	Questionnaire
I-PR	18%	18 hours Week 10 - 12	The function of the posterior right brain (the development of emotional and social dimension) # Marketing plan - Online survey - Digital content design - Cloud computing	Questionnaire
I-C	24%	24 hours Week 13- 17	The function of the anterior left brain (the development of analytical and logical thinking) # Financial plan - Big data / FinTech	Questionnaire
I-PU	15%	15 hours Week 18 – 20	The function of the posterior left brain (the development of movement and self-control) # Business project - Block chain - Digital business laws	Questionnaire
Total	100%	100 hours		

- Organizing student development activities in the area of digital entrepreneurial intelligence (DEI)

Based on the summary of the relationship ratio of the four brain functions according to the principles of WBL or DEI Prototype-2, it can be utilized to design student development activities or extra activities after school for secondary students or sample population in Scope 3. The duration would be one semester (20 weeks), with one hour per week, totaling 20 hours. This design is outlined in Table 5.5 below.

Table 5.5 The design of student development activities or extra activities after school using DEI – WBL Prototype

WBL	Percentage ratio	Hour / Week	Topic	Assessment
I-E	43%	8 Week 1 – 8	- Business inspiration - Business trip - Creative skill - Innovativeness - Visionary - Risk-taking	Questionnaire
I-PR	18%	4 Week 9 –12	- Interpersonal - Emotional regulation - Communicational skill - Team building skill	Questionnaire
I-C	24%	5 Week 13 –17	- Leadership skill - Planning skill - Proactive skill - Analytical skill	Questionnaire

Table 5.5 The design of student development activities or extra activities after school using DEI – WBL Prototype (continued)

WBL	Percentage ratio	Hour / Week	Topic	Assessment
I-PU	15%	3 Week 18 – 20	- Business internship - Punctuality - Organizational skill - Risk-reduction - Self-behavioral regulation	Questionnaire
Total	100%	20 hours		

6) How to propose and apply the learning process on digital entrepreneurial intelligence (DEI) using the Whole Brain Literacy (WBL) in secondary school?

The findings from the experiment as well as the research study were compiled and presented to senior management to seek approval for establishing the Montfort-Junior Entrepreneur Track (M-JEDI), which is the youth entrepreneur development center at the secondary school level, specifically within the English study program. The program involved adjusting the curriculum and various courses using the principles of DEI - WBL Prototype. Currently, it has undergone testing with one batch of students during the 2023 academic year and is anticipated to be integrated into the school curriculum in the 2024 academic year. The Montfort-Junior Entrepreneur Track project implementation plan is outlined in Table 5.6 below.

Table 5.6 The procedures undertaken to apply the DEI - WBL Prototype to the Montfort-Junior Entrepreneur Track (M-JET) project at Montfort College School, Chiang Mai Province

Activities (PDCA - Cycle)	**The 2023 academic year**											
	Month											
	Ma	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
(Plan) 1) Planning meeting to request permission to establish the M-JET center.												
(Do) 2) Proceeding with setting up the M-JET center.												
(Do) 3) Beginning teaching and learning about entrepreneurship using the DEI – WBL Prototype.												
(Check) 4) Evaluating and following up on project results.												
(Action) 5)Summarizing and reporting project implementation results to senior management.												

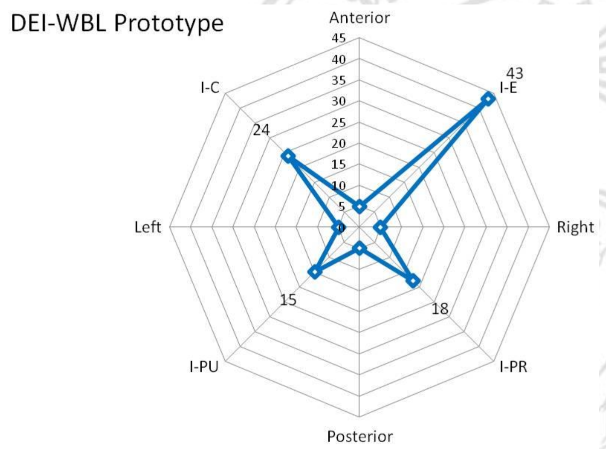
Table 5.6 The procedures undertaken to apply the DEI - WBL Prototype to the Montfort-Junior Entrepreneur Track (M-JET) project at Montfort College School, Chiang Mai Province (continued)

Activities (PDCA - Cycle)	**The 2023 academic year**											
	Month											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
(Action) 6) Requesting approval of a resolution from the Academic Administration Committee to incorporate the M-JET project into the school's student development activities according to the educational curriculum of Montfort College Secondary Section, Chiang Mai Province.												
(Action) 7) Organizing workshop/seminar activities to share and exchange research knowledge related to the DEI development for network schools and partners.												

5.3 Summary of Comparing the DEI - WBL Prototype with the Four Human Brain Functions

The findings from the study and experiment of the DEI - WBL Prototype can be compared with the average development in DEI and the Four Brain Map Functions from a sample population, as illustrated in Table 5.7

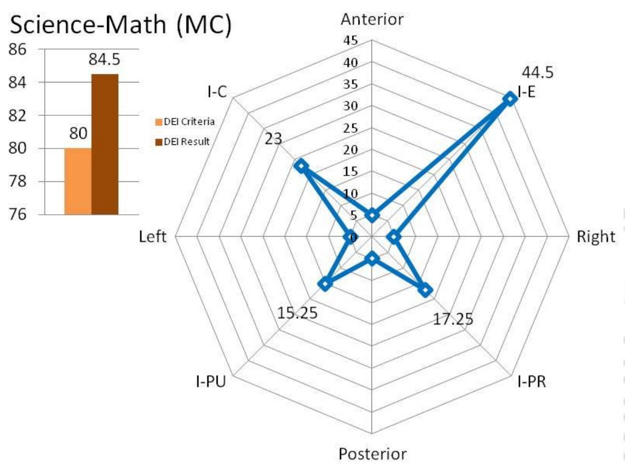
Table 5.7 Brain map functions of the DEI - WBL Prototype

Results of WBL brain map	**WBL**	**Percentage of WBL**	**Df of DEI percentage**
	I-C	24.00 %	-
	I-PU	15.00 %	-
	I-E	43.00 %	-
	I-PR	18.00 %	-
	Total % Mean	100	-
	Criteria (65 %)	-	-

From Table 5.7, the average percentages of the DEI - WBL Prototype in the DEI development experiment are as follows: I-C, the anterior left brain lobe (the development of analytical and logical thinking) averages at 24.00 percent, I-PU, the posterior left brain lobe (the development of movement and self-control) averages at 15.00 percent, I-E, the anterior right brain lobe (the development of creativity and imagination) averages at 43.00 percent, and I-PR, the posterior right brain lobe (the development of emotional and social dimension) averages at 18.00 percent.

The subsequent table summarized the comparison results between the DEI - WBL Prototype and DEI - WBL obtained from experiments among students in all four study programs.

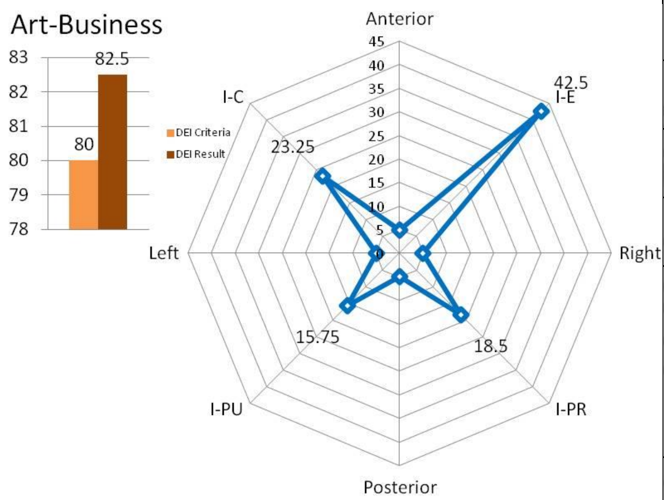
Table 5.8 Brain map functions of students in the Science-Mathematics program

Results of WBL brain map	WBL	Percentage of WBL	Df of DEI prototype
	I-C	23.00 %	- 4.17 %
	I-PU	15.25 %	+ 1.67 %
	I-E	44.50 %	+ 3.49 %
	I-PR	17.25 %	- 4.17 %
	Total % Mean	**<u>84.50 %</u>** (3.38)	-
	Criteria (65 %)	**<u>Passed</u>**	-

From Table 5.8, the mean percentages of DEI-WBL among students in the Science-Mathematics program in the DEI development experiment for each function are as follows: I-C, the anterior left brain lobe (the development of analytical and logical thinking) averages at 23.00 percent, which is lower than the prototype average by 4.17 percent; I-PU, the posterior left brain lobe (the development of movement and self-control) averages at 15.25 percent, which is 1.67 percent higher than the prototype's average; I-E, the anterior right brain lobe (the development of creativity and imagination) averages at 44.50 percent, exceeding the prototype average by 3.49 percent; and I-PR, the posterior right brain lobe (the development of emotional and social dimension) averages at 17.25 percent, lower than the prototype's average by 4.17 percent.

These results indicated that the average percentage of DEI-WBL among students in the Science-Mathematics program in this experiment was 84.50, surpassing the criteria set for this experiment, which was 65 percent. **<u>Thus, it can be inferred that the group of students in the Science-Mathematics program met the criteria for the DEI development using the DEI - WBL Prototype in this experiment.</u>**

Table 5.9 Brain map functions of students in the Art-Business program

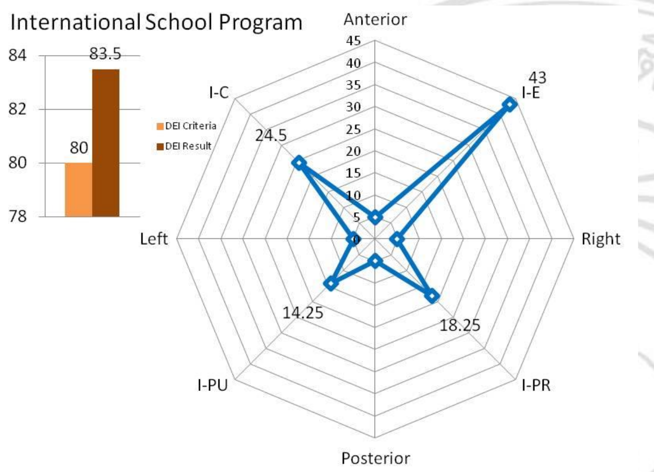
Results of WBL brain map	**WBL**	**Percentage of WBL**	**Df of DEI prototype**
	I-C	23.25 %	- 3.13 %
	I-PU	15.75 %	+ 5.00 %
	I-E	42.50 %	- 1.16 %
	I-PR	18.50 %	+ 2.78 %
	Total % Mean	**82.50 %** (3.30)	-
	Criteria (65 %)	**Passed**	-

From Table 5.9, the average percentage of DEI-WBL among students in the Art-Business program in the DEI development experiment for each function are as follows: I-C, the anterior left brain lobe (the development of analytical and logical thinking), averages at 23.25 percent, which is lower than the prototype's average by 3.13 percent; I-PU, the posterior left brain lobe (the development of movement and self-control), averages at 15.75 percent, which is 5.00 percent higher than the prototype's average; I-E, the anterior right brain lobe (the development of creativity and imagination), averages at 42.50 percent, which is lower than the prototype average by 1.16 percent; and I-PR, the posterior right brain lobe (the development of emotional and social dimension), averages at 18.50 percent, which is 2.78 percent higher than the prototype's average.

These results indicated that the average percentage of DEI-WBL among students in the Art-Business program in this experiment was 82.50, exceeding the criteria set for this experiment, which was 65 percent. **It can be concluded and interpreted that the**

group of students in the Art-Business program met the criteria for the DEI development using the DEI-WBL Prototype in this experiment.

Table 5.10 Brain map functions of students in the International program

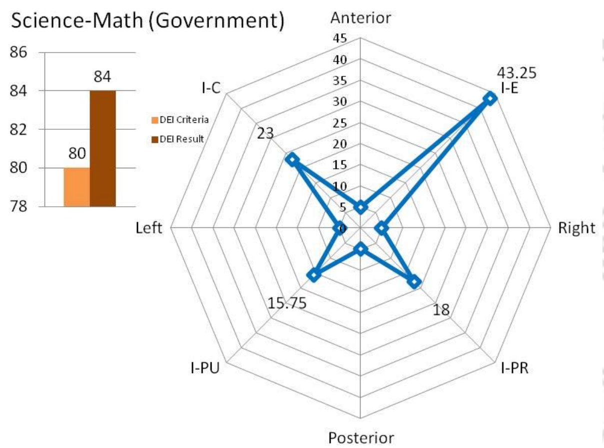
Results of WBL brain map	WBL	Percentage of WBL	Df of DEI prototype
	I-C	24.50 %	+ 2.08 %
	I-PU	14.25 %	- 5.00 %
	I-E	43.00 %	0.00 %
	I-PR	18.25 %	+ 1.39 %
	Total % Mean	**83.50 %** (3.34)	-
	Criteria (65 %)	**Passed**	-

From Table 5.10, the average percentage of DEI-WBL among students in the international program in the DEI development experiment for each area are as follows: I-C, the anterior left brain lobe (the development of analytical and logical thinking), averages at 24.50 percent, which is higher than the prototype's average by 2.08 percent; I-PU, the posterior left brain lobe (the development of movement and self-control), averages at 14.25 percent, which is 5.00 percent lower than the prototype average; I-E, the posterior right brain lobe (the development of creativity and imagination), averages at 43.00 percent, which is equal to the prototype's average; and I-PR, the posterior right brain lobe (the development of emotional and social dimension), averages at 18.25 percent, which is 1.39 percent higher than the prototype's average.

These results indicated that the average percentage of DEI-WBL among students in the international program in this experiment was 83.50, exceeding the criteria set for this experiment, which was 65 percent. **It can be concluded and interpreted that the**

<u>group of students in the international program met the criteria for the DEI development using the DEI-WBL Prototype in this experiment.</u>

Table 5.11 Brain map functions of students in the Science-Mathematics program (a government school)

<table>
<tr><th>Results of WBL brain map</th><th>WBL</th><th>Percentage of WBL</th><th>Df of DEI prototype</th></tr>
<tr><td rowspan="6">
</td><td>I-C</td><td>23.00 %</td><td>- 4.17 %</td></tr>
<tr><td>I-PU</td><td>15.75 %</td><td>+ 5.00 %</td></tr>
<tr><td>I-E</td><td>43.25 %</td><td>+ 0.58 %</td></tr>
<tr><td>I-PR</td><td>18.00 %</td><td>0.00 %</td></tr>
<tr><td>Total %
Mean</td><td><u>84.00 %</u>
(3.36)</td><td>-</td></tr>
<tr><td>Criteria
(65 %)</td><td><u>Passed</u></td><td>-</td></tr>
</table>

From Table 5.11, the mean percentage of DEI-WBL among students in the Science-Mathematics program (a government school) in the DEI development for each function are as follows: I-C, the anterior left brain lobe (the development of analytical and logical thinking), averages at 23.00 percent, which is lower than the prototype's average by 4.17 percent; I-PU, the posterior left brain lobe (the development of movement and self-control), averages at 15.75 percent, which is 5.00 percent higher than the prototype's average; I-E, the anterior right brain lobe (the development of creativity and imagination), averages at 43.25 percent, which is higher than the prototype average by 0.58 percent; and I-PR, the posterior right brain lobe (the development of emotional and social dimension), averages at 18.00 percent, which is equal to the prototype's average.

These results indicated that the average percentage of DEI-WBL among students in the Science-Mathematics program (a government school) in this experiment was 84.00, exceeding the criteria set for this experiment, which was 65 percent. **<u>It can be concluded and interpreted that the group of students in the Science-Mathematics</u>**

programs (a government school) met the criteria for the DEI development using the DEI-WBL Prototype in this experiment.

5.4 Comparison of the DEI - WBL Prototype Experiment's Findings with Other Research Studies

5.4.1 DEI – WBL Prototype (4 Human Brain Functions) and Bloom's Taxonomy (KPA – 3 Learning Domains)

This research study discovered that the development of DEI in secondary students using the DEI - WBL Prototype process, based on the principles of WBL 4 Human Brain Functions in organizing teaching and learning, resulted in a statistically significant difference in the mean DEI of the experimental population samples between before and after the experiment.

However, it was observed that the teaching model employing the principles of Bloom's Taxonomy (KPA - 3 Learning Domains) did not exhibit a significant difference in the mean DEI from the control population sample before and after the experiment. Consequently, it can be inferred that the principles of Bloom's Taxonomy did not hold statistical significance regarding the experimental hypothesis.

An important finding from this experiment is that it highlighted the strength or advantage of using WBL 4 Human Brain Functions in the DEI development, which is more pronounced than the principles of Bloom's Taxonomy, particularly in terms of the number of domains utilized in teaching and learning design. To elaborate, Bloom's Taxonomy emphasizes teaching only three areas: 1) cognitive domain (K), 2) psychomotor domain (P), and 3) affective domain (A).

In contrast, the DEI – WBL Prototype incorporates four domains corresponding to four areas of brain functions: 1) I-C or the anterior left brain lobe, responsible for the development of analytical and logical thinking (K), 2) I-PU or the posterior left brain lobe, associated with the development of movement and self-control (P), 3) I-E or the anterior right brain lobe, involved in the development of creativity and imagination, and 4) I-PR or the posterior right brain, linked to the development of emotional and social dimensions (A). The learning flow between DEI – WBL Prototype and Bloom's Taxonomy can be shown in Figure 5.4 below.

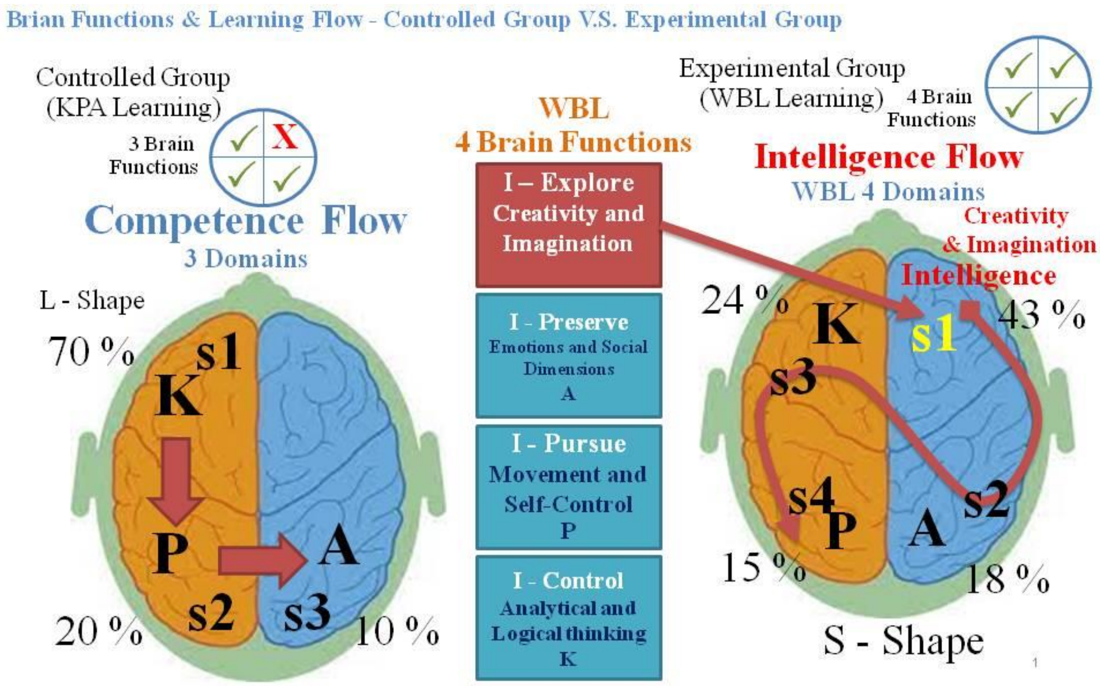


Figure 5.4 The learning flow between DEI – WBL Prototype and Bloom's Taxonomy

Notably, the I-E part or the anterior right brain lobe is responsible for the development of creativity and imagination, a factor distinguishing WBL learning from Bloom's Taxonomy teaching. This distinction arises from Bloom's Taxonomy's deficiency in developing the human brain's creativity. The study found that population samples with higher creativity or imagination averages also exhibited higher DEI, while those with lower average creativity or imagination demonstrated lower DEI. Therefore, the researcher compared other studies related to the results of this study, focusing on creativity or I-E WBL - Function and the DEI development using other models as follows:

5.4.2 DEI – WBL Prototype and Creativity

From the study and comparison, it was discovered that Alshaar (2023) conducted an experiment on the relationship between creativity and its impact on digital entrepreneurship among Palestinian refugee volunteers in Middle Eastern countries. A total of 180 participants were surveyed using a five-choice questionnaire as the data collection instrument. The three independent variables were identified as originality, flexibility, and fluency, while the dependent variables comprised of 3 factors, including digital knowledge management, digital business environment management, and digital leadership skills. The findings indicated that creativity significantly influences the development of digital entrepreneurship, consistent with the results of this research. Specifically, the I-E or the anterior right brain, responsible for the development of creativity and imagination, was found to have a statistically significant influence on the DEI development. Hence, it can be inferred that the WBL learning management model positively impacts the DEI development in the experimental population sample, exhibiting a 12% predictive power with statistical significance. The prediction equation derived from the experiment's raw scores was $\hat{y} = 2.14 + 0.44$ (Creativity), aligning with the prediction equation from the present researcher's study, which is $\hat{y} = 2.698 + 0.185$ (I-PR) + 0.453 (I-E) + 0.274 (I-C) + 0.129 (I-PU). Notably, the positive direction of the Creativity value in both equations suggests its significant contribution. However, this current study unveiled an equation with a predictive power of 99.30%, surpassing the findings of Alshaar (2023).

Additionally, Akhter et al. (2022) investigated the influence of creativity on digital entrepreneurship among 120 students from public universities in Bangladesh. Data were collected using a survey questionnaire. The findings revealed a statistically significant impact of creativity on digital entrepreneurship, consistent with the current research. The I-E or the anterior right brain lobe, associated with the development of creativity and imagination, emerged as a significant factor influencing the DEI development, affirming the positive effect of the WBL learning management model on the experimental population sample's DEI development.

Furthermore, Hisrich & Soltanifar (2021) explored the correlation between creativity and its effect on digital entrepreneurship, albeit without specifying the type and number of the population sample. The experiment employed the digital creative model, incorporating activities such as brainstorming, imaginative play, and problem inventory analysis. The dependent variables encompassed skills in utilizing artificial intelligence (AI), virtual reality (VR), and Internet of Things (IoT) in trials. Results indicated a statistically significant impact of creativity on digital entrepreneurship, consistent with the findings of this research. The I-E or the anterior right brain lobe, responsible for the development of creativity and imagination, exhibited a significant influence on DEI development, suggesting the positive effect of the WBL learning management model on the experimental population sample's DEI development.

5.4.3 WBL Prototype and Research Using Other Models or Methodologies in the DEI Development

From the study and comparison of the DEI development using alternative models and tools from relevant research, it was noted that Oosthuizen (2021) conducted a study on the development of entrepreneurial intelligence by applying Schwab's four-type intelligence principles. While a framework was laid out in principles, it has not been tested yet. The independent variables were defined across four areas: contextual (mind), emotional (heart), inspired (soul), and physical intelligence (body), expected to impact the dependent variable DEI, namely knowledge and skills in AI, biotechnology, nanotechnology, 3D-printing, and robotics, aligning with the researcher's 4-domain research model. This allowed for a comparison between Schwab's 4-type intelligence and WBL as follows: context (mind) = I-C, emotional (heart) = I-PR, inspired (soul) = I-E, and physical intelligence (body) = I-PU. Oosthuizen (2021) concluded that this research framework may suggest a direction for future DEI development characterized by four domains, potentially enhancing DEI better than the traditional 3-Domain model of Bloom's Taxonomy, aligning with the researcher's hypothesis.

Additionally, the researcher found that Chae & Goh (2020) introduced the prototype variable of big five personality traits, consisting of five human behavioral characteristics: openness, conscientiousness, extraversion, agreeableness, and neuroticism, to study their relationships with digital entrepreneurship development. Utilizing big data analytics for statistical analysis, the behavior of entrepreneurs via the Twitter API was examined, focusing on 48,000 entrepreneurs in the United States. Only three factors—openness, conscientiousness, and extraversion—were found to influence digital entrepreneurship development. These factors align with the principles of WBL and can be categorized as functions of the I-E or the anterior right brain lobe, responsible for the development of creativity and imagination, significantly impacting digital entrepreneurship development. This finding supported the present research, indicating that I-E has a statistically significant influence on the DEI development, implying that a learning management model fostering creativity positively affects the DEI development among the sample population in this experiment.

5.4.4 Other Applications of WBL

According to the latest research results related to the application of WBL, Policarpio (2023) applied WBL principles to develop a communication teaching model in secondary schools in the Philippines. The experiment involved control and experimental groups, utilizing before and after questionnaires to analyze differences between the sample populations. The results revealed that while the control population taught using Bloom's Taxonomy - 3 Learning Domains showed no significant difference after the experiment, the experimental population taught WBL 4 Human Brain Functions exhibited statistically significant differencs after the experiment. This suggests that the development of oral communication through WBL principles yielded better efficiency than through Bloom's Taxonomy - 3 Learning Domains in this study.

5.5 Chapter Summary

In this research study, it was observed that the DEI - WBL Prototype, designed and based on the theory of Whole Brain Literacy (WBL) regarding the principles of 4 brain functions, was utilized to experiment with teaching and learning aimed at developing digital entrepreneurial intelligence (DEI) among a sample population of secondary students. The findings indicated a statistically significant impact on students' DEI development, with a higher mean observed after the experiment compared to the teaching model based on the principles of Bloom's Taxonomy - 3 Learning Domains (KPA).

Moreover, it can be inferred that the average DEI of secondary students may either increase or decrease, with the primary factor being the function of the I-E or the anterior right brain lobe, responsible for the development of creativity and imagination, which affected the digital entrepreneurship development significantly. This aligns with the comparative study findings mentioned earlier, suggesting that creativity and imagination serve as crucial factors with statistical significance in the development of DEI among secondary students.

Ultimately, the researcher was able to categorize factors according to WBL principles that positively influence and impact the development of DEI among secondary students, totaling 4 areas and 16 factors. These factors are as follows: Factor F1 in the area of Creativity (I-E) ranks first with an average of 3.97. Factor F2 in the area of

Innovativeness (I-E) ranks second with an average of 3.94. Factor F3 in the area of Visionary (I-E) ranks third with an average of 3.3.91. Factor F4 in Passionate (I-E) ranks fourth with an average of 3.89. Factor F5 in Leadership Skill (I-PC) ranks fifth with an average of 3.86. Factor F6 in Planning Skill (I-PC) ranks sixth with an average of 3.83. Factor F7 in Perseverance (I-C) ranks seventh with an average of 3.81. Factor F8 in Analytical Skill (I-C) ranks eighth with an average of 3.77. Factor F9 in Interpersonal (I-PR) ranks ninth with an average of 3.74. Factor F10 in Emotional Regulation (I-PR) ranks tenth with an average of 3.72. Factor F11 in Communicational Skill (I-PR) ranks eleventh with an average of 3.70. Factor F12 in Teambuilding Skill (I-PR) ranks twelfth with an average of 3.67. Factor F13 in Self-Behavioral Regulation (I-PU) ranks thirteenth with an average of 3.63. Factor F14 in Risk-Reduction (I-PU) ranks fourteenth with an average of 3.60. Factor F15 in Work under pressure (I-PU) ranks fifteenth with an average of 3.56. The last ranking is Factor F16 in Time Management (I-PU) with an average value of 3.55. It can be shown in the Figure 5.5 below.

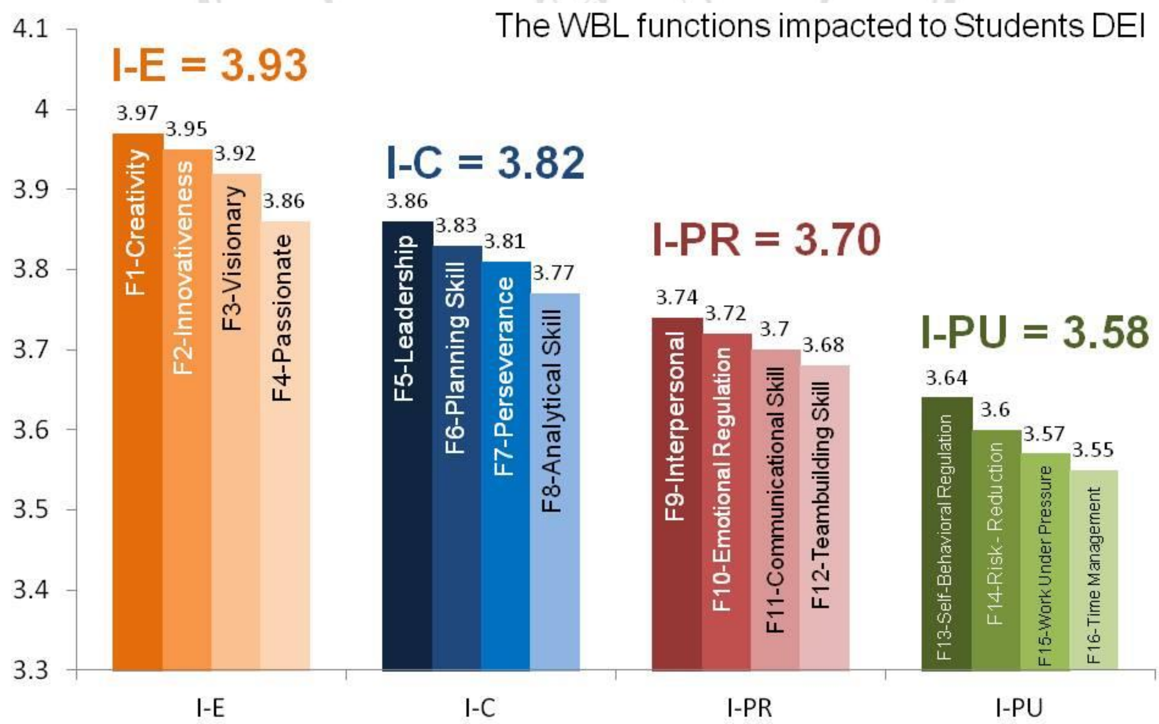


Figure 5.5 The factors according to WBL principles that positively influence and impact the development of DEI among secondary students, totaling 4 areas and 16 factors

From Figure 5.4 above, these 16 WBL factors play a significant role in shaping the DEI development of secondary students. Furthermore, these factors align with the brain patterns of successful entrepreneurs at both national and global levels, as indicated in a comparative study within Scope 1, involving a total of 10 samples. A table depicting the relationships between WBL factors discovered from this research study and the brain functioning patterns of successful entrepreneurs is presented in Table 5.12 below.

Table 5.12 The relationship between WBL factors discovered from this research study and the brain functioning patterns of successful entrepreneurs at the national and global levels

No.	WBL – Factors	DEI – WBL Prototype	National entrepreneurs WBL functions	Global entrepreneurs WBL functions
1	Leadership (I-C) *	✓	✓	✓
2	Planning skill (I-C)	✓	✓	✓
3	Perseverance (I-C)	✓	✓	✓
4	Analytical thinking (I-C)	✓	✓	✓
5	Self-behavioral regulation (I-PU) *	✓	✓	✓
6	Risk-reduction (I-PU)	✓	✓	✓
7	Work under pressure (I-PU)	✓	✓	✓
8	Time management (I-PU)	✓	✓	✓
9	Creativity (I-E) *	✓	✓	✓
10	Innovativeness (I-E)	✓	✓	✓
11	Visionary (I-E)	✓	✓	✓
12	Passionate (I-E)	✓	✓	✓
13	Interpersonal skill (I-PR) *	✓	✓	✓

Table 5.12 The relationship between WBL factors discovered from this research study and the brain functioning patterns of successful entrepreneurs at the national and global levels (continued).

No.	WBL – Factors	DEI – WBL Prototype	National entrepreneurs WBL functions	Global entrepreneurs WBL functions
14	Emotional regulation (I-PR)	✓	✓	✓
15	Communicational skill (I-PR)	✓	✓	✓
16	Team building (I-PR)	✓	✓	✓
	** The maximum average of mean score*			

From Table 5.12 above, it can be concluded that the key WBL factors identified in this study for the development of DEI among secondary students exhibit a consistent relationship with the brain function model or WBL - 4 Human Brain Functions of successful entrepreneurs, both nationally and globally. This insight can be utilized to develop and expand upon the creation of a real DEI Learning Framework worldwide, thereby organizing teaching and learning formats at the secondary level more effectively in the future.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Chapter Overview

This study aims to explore the teaching and learning model based on the principles of Whole Brain Literacy (WBL) or the Four Human Brain Functions and its statistically significant impact on the development of digital entrepreneurial intelligence (DEI) among secondary students at Montfort College, Chiang Mai.

The study's objectives are outlined in five key points as follows:

1) To identify and analyze the factors affecting digital entrepreneurial intelligence (DEI) in secondary students at Montfort College.

2) To design the learning process using Whole Brain Literacy (WBL) for digital entrepreneurial intelligence (DEI) in secondary students at Montfort College.

3) To test and compare the learning process using Whole Brain Literacy (WBL) for digital entrepreneurial intelligence (DEI) in secondary students, at Montfort College.

4) To develop the learning process using the Whole Brain Literacy (WBL) process for digital entrepreneurial intelligence (DEI) in secondary students, at Montfort College.

5) To propose the learning process and Academic policy using Whole Brain Literacy (WBL) for digital entrepreneurial intelligence (DEI) to Montfort College Secondary Section.

In Chapter 6, the summary of the research results was divided into four sections as follows: 1) conclusion, 2) novelty aspects of the study, 3) beneficiaries, and 4) recommendations and future research.

6.2 Conclusion

This study surveyed, analyzed, and designed a teaching and learning prototype for digital entrepreneurial intelligence (DEI) using the principles of Whole Brain Literacy (WBL) or the Four Human Brain Functions. The DEI-WBL Prototype was developed from an experimental design with a total sample population of 2,360 people, including secondary students, parents, alumni, and successful entrepreneurs both domestically and internationally. The study was conducted at Montfort College, Chiang Mai Province, and included a comparative study with a population of 200 students in a government school during the experimental phase, comparing the DEI-WBL Prototype in Scope 3.

The research study was divided into three scopes. Scope 1: Survey Research (DEI-Prototype #1): this scope involved surveying the opinions, expectations, and needs of a sample population totaling 960 people, including 300 secondary students, 300 parents, 300 alumni, 50 teachers and administrators, and 10 domestic and international entrepreneurs. Data collection was conducted through a survey of expectations and needs on teaching and learning about entrepreneurship. The data covered 10 factors as follows: Factor 1 (F1) student competency expectations, Factor 2 (F2) student attitude expectations, Factor 3 (F3) student characteristic expectations, Factor 4 (F4) learning curriculum style expectations, Factor 5 (F5) facility/location style expectations, Factor 6 (F6) teaching approach style expectations, Factor 7 (F7) instructor/teacher style expectations, Factor 8 (F8) reasons for self-development expectations, Factor 9 (F9) preference for owning a business in the future, and Factor 10 (F10) future skill development expectations.

The survey data, when analyzed according to WBL principles, revealed the following ratio of expectations for DEI development from the sample population: I-C: I-PU: I-E: I-PR = 24%: 15%: 43%: 18%. These results informed the design of Prototype-1 for teaching and learning digital entrepreneurship at the secondary school level. Specifically, the brain function ratios were as follows: anterior left brain lobe or I-C (the development of analytical and logical thinking) at 24%; posterior left brain lobe or I-PU (the development of movement and self-control) at 15%; anterior right brain lobe or I-E (the development of creativity and imagination) at 43%; and posterior right brain lobe or I-PR (the development of emotional and social dimensions) at 18%.

The researcher then conducted the study in part 2, Scope 2: Correlational Research (DEI Prototype #2), to find the relationship between the independent and dependent variables used in the experiment: digital entrepreneurship (x1), entrepreneurship (x2), digital intelligence (y1), and entrepreneurial intelligence (y2). The sample population consisted of 600 people, divided into three groups: 1) 200 students in the Science-Mathematics program, 2) 200 students in the Arts program, and 3) 200 students in the English Program. Data were collected using a 4-choice Likert scale questionnaire. The data were analyzed using Pearson's Product Moment Correlation Coefficient and Multiple Regression Analysis (MRA) with the Stepwise Regression technique (stepwise criteria: Probability of F to Enter <= .050, Probability of F to remove >= 0.100) and statistical significance set at 0.05 (P value < 0.05). The results produced prediction equations: 1) the raw score equation: $\hat{y} = 2.698 + 0.185 \text{ (I-PR)} + 0.453 \text{ (I-E)} + 0.274 \text{ (I-C)} + 0.129 \text{ (I-PU)}$, and 2) the standard score equation: $Z \text{ (DEI)} = 0.180 \text{ (Z I-PR)} + 0.451 \text{ (Z I-E)} + 0.244 \text{ (Z I-C)} + 0.125 \text{ (Z I-PU)}$, where $\hat{y}$ is digital entrepreneurial intelligence (DEI), I-PR is the function of the posterior right brain (the development of emotional and social dimension), I-E is the function of the anterior right brain (the development of creativity and imagination), I-C is the function of the anterior left brain (the development of analytical and logical thinking), and I-PU is the function of the posterior left brain (the development of movement and self-control). These results were used to design Prototype-2 for organizing DEI development activities for secondary students in Scope 3.

The final part, Scope 3: Experimental Research (DEI-WBL Prototype), involved testing DEI Prototype-1 and DEI Prototype-2 with two sample groups: 400 control and 400 experimental subjects, totaling 800 people. The sample included 1) 100 secondary students in the Science-Mathematics program, 2) 100 students in the Arts-Business program, 3) 100 students in the international program, and 4) 100 students from a government school in the Science-Mathematics program. The control group used a DEI teaching model based on Bloom's Taxonomy (3 Learning Domains - KPA), while the experimental group used a DEI teaching model based on the 4 WBL Human Brain Functions. The experiment lasted one semester (20 weeks) for a total of 100 hours, including 20 hours of extracurricular activities. Data were collected before and after the experiment using a 4-choice Likert scale questionnaire. The results showed no significant statistical difference in the control group (p-value = 0.374; p-value > 0.05) using Bloom's Taxonomy to develop DEI before and after the experiment. However, there was a statistically significant difference in the experimental group (p-value = 0.000; p-value < 0.05) using WBL principles to develop DEI. This indicated that the DEI-WBL Prototype positively influences secondary students' DEI development (statistical significance level of 0.05; P value < 0.05).

6.3 Novelty Aspects of the Study

6.3.1 Advantages of DEI – WBL Prototype vs. Bloom's Taxonomy

The study revealed the strengths, advantages, and new findings from the experiment on teaching and learning management styles for the development of digital entrepreneurial intelligence (DEI). The control group, utilizing the principles of Bloom's Taxonomy (3 Learning Domains - KPA), and the experimental group, employing the DEI teaching model based on the principles of the 4 WBL Human Brain Functions were compared. The results from the experiment were summarized as follows:

The DEI – DEI-WBL prototype significantly enhanced brain development in all four areas of secondary students. This is in contrast to the teaching model based on Bloom's Taxonomy (3 Learning Domains - KPA), which showed no significant difference in DEI between pre- and post-experiment measurements in the control group. Thus, the DEI – DEI-WBL prototype demonstrated superior efficacy in developing the four brain areas of students compared to Bloom's Taxonomy.

Furthermore, the DEI – WBL Prototype significantly increased brain function in the I-E, or the anterior right brain, which is associated with creativity and imagination. This increase was statistically significant and clearly evident, whereas the teaching model using Bloom's Taxonomy showed no DEI development in this area. Moreover, the development of the I-E of the brain was found to directly influence DEI development. Specifically, increases or decreases in I-E brain function corresponded to similar changes in DEI.

Integrating student development activities with the DEI – WBL Prototype, based on different student hobbies, resulted in varying DEI development. Hobbies related to sports, arts, and technology had a greater impact on students' DEI development compared to music-related hobbies.

The DEI – WBL Prototype was effective in improving DEI across four types of study programs: Science-Mathematics (Montfort College), Arts-Business, International Program, and Science-Mathematics (a government school). All these programs showed statistically significant improvement in DEI, indicating the prototype's effectiveness in enhancing student development across various study programs and educational institutions, both private and public.

6.3.2 DEI – WBL Prototype Learning Cycle and Learning Flow

The distinguishing feature of the DEI - WBL Prototype used in this experiment is fundamentally different from the sequence of learning cycles according to Bloom's Taxonomy (3 Learning Domains - KPA). Bloom's Taxonomy arranges learning cycles starting with the cognitive domain (K), followed by the psychomotor domain (P), and concluding with the affective domain (A). In other words, Bloom's sequence begins with theory, proceeds to actions, and ends with attitudes. In contrast, the DEI - WBL Prototype learning cycle begins with I-E (the development of creativity and imagination), aiming to stimulate students' imagination and creativity first. It then progresses to I-PR (the development of emotional and social dimensions), which involves mobilizing and exchanging ideas with others, comparable to Bloom's affective domain (A). The next step is I-C (the development of analytical and logical thinking), equivalent to Bloom's cognitive domain (K), where knowledge and opinions gained from exchanges are synthesized, compared, and analyzed to find the most appropriate learning theory and logic. The final step is I-PU (the development of movement and self-control), equivalent to Bloom's psychomotor domain (P), which involves executing the planned steps to achieve learning objectives. From the experiment, it can be concluded that the DEI - WBL Prototype is more effective in developing DEI than Bloom's Taxonomy (3 Learning Domains - KPA). The DEI model significantly enhances the I-E brain, which impacts imagination and creativity—the part of the brain directly linked to human intelligence. This enhancement is not found in Bloom's Taxonomy, which primarily develops knowledge within the cognitive domain.

6.3.3 DEI – WBL Learning Model and Framework

Based on this research study and experiment, the DEI - WBL Prototype was tested on a sample population to design a framework or model for the DEI development, known as the DEI - WBL Learning Model, for secondary students. This model is depicted in Figure 6.1.

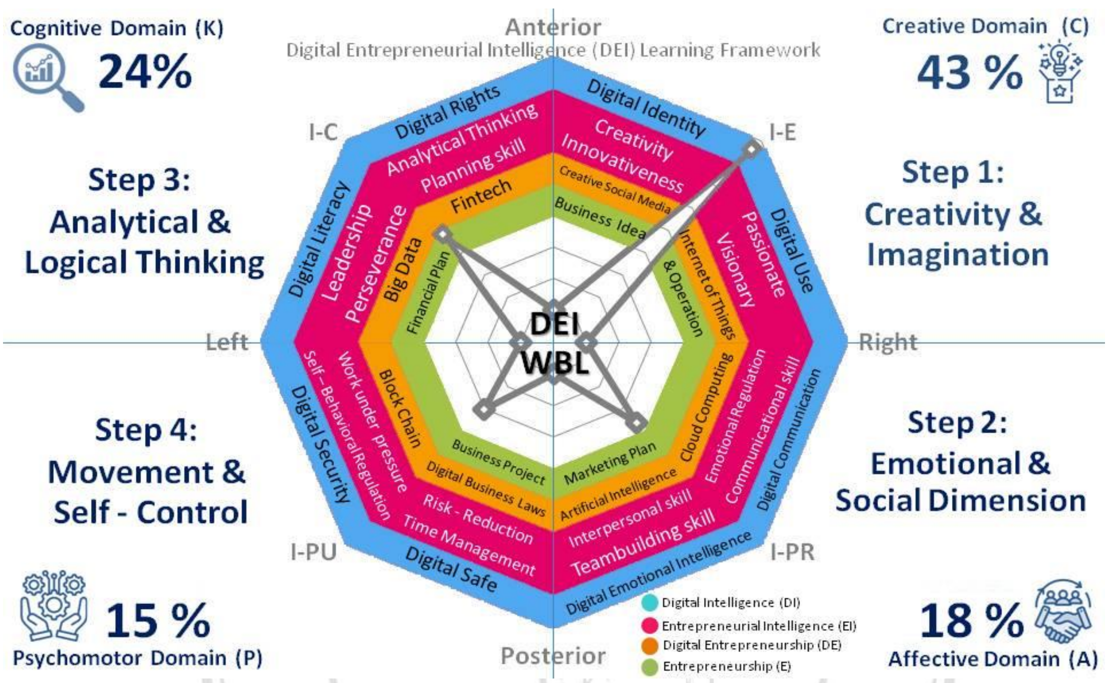


Figure 6.1 DEI – WBL Learning Model obtained from this research study

The DEI – WBL Learning Model's working process can be described as follows:

The learning management model using the DEI – WBL learning model begins with step 1, called I-E or I-Explore (the development of creativity and imagination/anterior right brain). This can be considered a creative domain, which does not appear in Bloom's Taxonomy (3 Learning Domains - KPA). This learning style encourages students to use their imagination and creativity, comprising 43 percent of the total study time. Four main WBL factors stimulate learners to engage in this aspect of their brains: creativity, innovativeness, visionary thinking, and passion. The DEI content includes topics such as business ideas and operations, creative social media, 3D printing, 3D design, Internet of Things (IoT), virtual reality (VR), digital identity, and digital use. Measurement and evaluation focus on innovation projects, creative concepts, Appreciative Inquiry (AI-4D), and Design Thinking Project frameworks. The teaching style emphasizes real-world activities such as field surveys, internships, work visits, and surveys outside the classroom.

The second step, called I-PR or I-Preserve (the development of emotional and social dimensions/posterior right brain) is equivalent to the affective domain (A) of Bloom's Taxonomy. It is a learning model that encourages students to use their brains to control their emotions and social dimensions, accounting for 18 percent of the total study time. Four main WBL factors motivate students to use this aspect of their brains: interpersonal skills, emotional regulation, communication skills, and team-building skills. The DEI-related content includes marketing plans, online surveys, digital content design, artificial intelligence (AI), Cloud computing, digital emotional intelligence, and digital communication. Measurement and evaluation focus on group work, group presentations, and oral presentations. The teaching style in this section emphasizes group seminars, creative criticism, workshops, brainstorming, and group discussions.

The third step, called I-C or I-Control (the development of analytical and logical thinking/anterior left brain) is equivalent to the cognitive domain (K) of Bloom's Taxonomy. It is a learning model that encourages students to think systematically and logically, comprising 24 percent of the total study time. Four main WBL factors stimulate learners to use this aspect of the brain: leadership skills, planning skills, perseverance, and analytical thinking. The DEI-related content includes financial plans, big data and Fintech, digital literacy, and digital rights. Measurement and evaluation focus on science projects, systematic problem solving, flow chart analysis, and using numbers to solve problems and explain phenomena. The teaching style emphasizes theoretical learning, principles in the classroom, logical questioning, and systematic cause-finding.

The fourth step, which is the final step, called I-PU or I-Pursue (the development of movement and self-control/posterior left brain) is equivalent to the psychomotor domain (P) of Bloom's Taxonomy. It is a learning model that encourages students to use their brains for movement and practice, working according to steps or manuals, comprising 15 percent of the total study time. Four main WBL factors stimulate students to use this aspect of their brains: self-behavioral regulation, risk reduction, working under pressure, and time management. The DEI-related content includes business projects, blockchain, digital business laws, digital safety, and digital security. Measurement and evaluation focus on project-based learning, following manuals, patterns, and templates, and performing work step by step. The teaching style emphasizes practical learning in real laboratories, project rooms, and skill training rooms, following systematic steps.

From this research study, the researcher found clear differences between WBL 4 Human Brain Functions and Bloom’s Taxonomy. The results can be used to present a new learning management model that can develop DEI in secondary students with statistical significance. The design of DEI development according to the principles of WBL includes four factors: 1) digital entrepreneurship (DE), 2) entrepreneurship (E), 3) digital intelligence (DI), and 4) entrepreneurial intelligence (EI). This can be summarized as DEI = DE + E + DI + EI, as presented in Table 6.1.

Table 6.1 Summary of the learning styles of digital entrepreneurial intelligence (DEI) in secondary students using the principles of WBL.

<table>
<tr><th rowspan="2">WBL functions</th><th rowspan="2">Percentage of learning ratio</th><th colspan="4">Digital entrepreneurial intelligence (DEI) learning factors</th></tr>
<tr><th>Digital entrepreneurship (DE)</th><th>Entrepreneurship (E)</th><th>Digital intelligence (DI)</th><th>Entrepreneurial intelligence (EI)</th></tr>
<tr><td rowspan="5">I-E
Anterior right brain</td><td rowspan="4">43%</td><td>Internet of Things (IoT)</td><td rowspan="4">Business idea & operation</td><td>Digital identity</td><td>Creativity</td></tr>
<tr><td rowspan="3">Creative social media, VR, 3D printing & design</td><td rowspan="3">Digital use</td><td>Innovativeness</td></tr>
<tr><td>Visionary</td></tr>
<tr><td>Passionate</td></tr>
<tr><td colspan="5">The measurement and evaluation focus on innovation projects, creative concept formats, Appreciative Inquiry (AI-4 D), and Design Thinking Project frameworks. Additionally, this section emphasizes real field surveys, internships, work visits, and surveys outside the classroom.</td></tr>
</table>

Table 6.1 Summary of the learning styles of digital entrepreneurial intelligence (DEI) in secondary students using the principles of WBL. (continued)

WBL functions	**Percentage of learning ratio**	**Digital entrepreneurial intelligence (DEI) learning factors**			
		Digital entrepreneurship (DE)	**Entrepreneurship (E)**	**Digital intelligence (DI)**	**Entrepreneurial intelligence (EI)**
I-PR Posterior right brain	18%	Artificial intelligence (AI)	Marketing Plan	Digital emotional intelligence	Interpersonal skill
		Cloud computing		Digital communication	Emotional Regulation
					Communicational skill
					Team building
	The measurement and evaluation focus on group work, group presentations, and oral presentations. Moreover, the teaching style in this section emphasizes group seminars, creative criticism, workshops, brainstorming, and group discussions.				

Table 6.1 Summary of the learning styles of digital entrepreneurial intelligence (DEI) in secondary students using the principles of WBL. (continued)

<table>
<tr><th rowspan="2">WBL functions</th><th rowspan="2">Percentage of learning ratio</th><th colspan="4">Digital entrepreneurial intelligence (DEI) learning factors</th></tr>
<tr><th>Digital entrepreneurship (DE)</th><th>Entrepreneurship (E)</th><th>Digital intelligence (DI)</th><th>Entrepreneurial intelligence (EI)</th></tr>
<tr><td rowspan="5">I-C
Anterior left brain</td><td rowspan="4">24%</td><td>Big data</td><td rowspan="4">Financial plan</td><td>Digital literacy</td><td>Leadership</td></tr>
<tr><td rowspan="3">Fintech</td><td rowspan="3">Digital rights</td><td>Planning skill</td></tr>
<tr><td>Perseverance</td></tr>
<tr><td>Analytical thinking</td></tr>
<tr><td colspan="5">The measurement and evaluation focus on science projects, systematic problem solving, flow chart analysis, and using numbers to solve problems and explain phenomena. The teaching style emphasizes theoretical learning, principles in the classroom, logical questioning, and systematic cause-finding.</td></tr>
<tr><td rowspan="5">I-PU
Posterior left brain</td><td rowspan="4">15%</td><td>Blockchain</td><td rowspan="4">Business project</td><td>Digital safe</td><td>Self-behavioral regulation</td></tr>
<tr><td rowspan="3">Digital business laws</td><td rowspan="3">Digital security</td><td>Risk-reduction</td></tr>
<tr><td>Work under pressure</td></tr>
<tr><td>Time management</td></tr>
<tr><td colspan="5">The measurement and evaluation focus on project-based learning, following manuals, patterns, and templates, and performing work step by step. The teaching style emphasizes practical learning in real laboratories, project rooms, and skill training rooms, following systematic steps.</td></tr>
</table>

From Table 6.1, the factors affecting the development of the DEI – WBL Learning Framework for secondary students from this study and research can be explained as follows:

Digital entrepreneurship (DE) consists of eight factors: 1) Internet of Things (IoT), 2) creative social media (virtual reality: VR, 3D printing, 3D design, 3) artificial intelligence (AI), 4) Cloud computing, 5) big data, 6) Fintech, 7) block chain, and 8) digital business laws.

Entrepreneurship (E) consists of four factors: 1) business idea and operation, 2) marketing plan, 3) financial plan, and 4) business project.

Digital intelligence (DI) consists of eight factors: 1) digital identity, 2) digital use, 3) digital emotional intelligence, 4) digital communication, 5) digital literacy, 6) digital rights, 7) digital safe and 8) digital security.

Entrepreneurial intelligence (EI) consists of 16 factors: 1) leadership, 2) planning skill, 3) perseverance, 4) analytical thinking, 5) self-behavioral regulation, 6) risk-reduction, 7) work under pressure, 8) time management, 9) creativity, 10) innovativeness, 11) visionary, 12) passionate, 13) interpersonal skill, 14) emotional regulation, 15) communicational skill, and 16) team building skill.

The study identified 36 factors in four main areas: digital entrepreneurship (DE), entrepreneurship (E), digital intelligence (DI), and entrepreneurial intelligence (EI), as shown in Table 6.1 above.

6.4 Beneficiary

In this study on the development of digital entrepreneurial intelligence (DEI) using Whole Brain Literacy (WBL) among secondary students, the researcher expected academic and practical contributions as follows:

6.4.1 Academic Contributions

This recent research is expected to bring the following academic contributions:

1) The knowledge about human brain functions based on the Whole Brain Literacy (WBL) theory, modern educational psychology, was applied to develop a learning model as well as teaching and learning management on digital entrepreneurial intelligence (DEI) among secondary students. Nowadays, it has been found that there have been no domestic and international studies on a causal structural relationship model of these factors. Therefore, this research created new knowledge and theory related to modern educational psychology in the context of entrepreneurship, which is considered a different perspective on current research studies.

2) The knowledge and principles related to Whole Brain Literacy (WBL) were used to design a measurement and assessment of secondary students. The results can be measured in four aspects based on the principles of human brain functions and used to assess digital entrepreneurial intelligence (DEI) in a classroom. The current measurement model based on Bloom's Taxonomy (3 learning domains - KPA) principle can only measure three aspects. This research, hence, created new knowledge in the development of teaching and learning models and learner assessment, which is different from the previous studies.

6.4.2 Practical Contributions

This recent research is expected to bring the following practical contributions:

1) Students and the learning process in classrooms: students are expected to receive an opportunity for education with an effective learning process and model affecting the development of digital entrepreneurial intelligence (DEI) to prepare themselves with skills essential for the digital economy and global citizens.

2) Teachers and effective teaching pedagogies: another important issue for this study was to develop and promote the pedagogy of teachers to be more effective, modern, and consistent with future education directions. Teachers are expected to integrate the body of knowledge of their present subject with those related to digital entrepreneurial intelligence (DEI) from this study to apply in their pedagogy or develop new educational innovations where students can apply skills to solve problems in their daily lives.

3) School academic policies: for the significance of the study, a case study of Montfort College Secondary Section, the researcher would like to improve and develop learning process in business studies, entrepreneurial skills, and digital entrepreneurial intelligence (DEI) in secondary levels so that the standard curriculum of an educational institution can be increased to be consistent with future education directions. Moreover, educational policies and strategies can be driven to focus on preparing students as future global citizens with the necessary skills for a career under the National Economic and Social Development Plan and the National Strategy to enter the digital economy. As well, they can respond to the educational policies of a country.

4) Other schools and educational collaborations: in terms of dissemination of research results to other schools, organizations, or other educational institutions related to teaching and learning management, the researcher expects to foster academic collaboration between educational institutions such as establishing a center for young entrepreneurs that can provide concrete knowledge and skills with standardized learning in digital entrepreneurial intelligence (DEI) for both public and private schools. As well, cooperation in research between schools at the higher levels can be created to develop new educational innovations for the benefit of the country in the future.

6.5 Recommendations and Future Research

From an additional study of the core curriculum structure for basic education in Thailand, 2008, latest revised edition 2023 (Ministry of Education Thailand, 2023), it was found that the vocational learning subject group at the primary and secondary levels has areas that should be developed and improved, particularly in relation to the development and promotion of future occupational skills of learners. This is consistent with the research study on digital entrepreneurial intelligence (DEI) and can be classified into several issues:

At the primary, junior high school, and high school levels, the curriculum lacks intermediate and end indicators related to promoting digital entrepreneurship. This deficiency limits Thailand's ability to develop and provide opportunities for learners within the classroom, potentially negatively impacting the future competitiveness of the working-age population. This highlights the stagnation and lack of evolution in the core curriculum, which fails to adapt to future career trends.

In light of these findings, the Ministry of Education should encourage the inclusion of entrepreneurship skills and understanding in the compulsory curriculum from primary to secondary levels. As outlined by UNESCO (2016) in the SDG4: Quality Education Framework for 2030, future education should align with the demands of the economy, entrepreneurship, and professional labor.

The researcher intends to present and expand the DEI knowledge gained from the research to private schools at the secondary level in Chiang Mai province, making it a pilot area for education and research development of DEI in the northern region.

The researcher also aims to study and experiment with DEI development in elementary school students to create a DEI prototype that can be connected to research at the secondary level. This will help elevate and expand education in Thailand. Notably, in developed countries such as China, the United States, and the European Union countries (OECD, 2022), there are courses related to DEI, such as digital entrepreneurship, investment, the stock market, and digital finance, even at the primary school level. This indicates that promoting DEI in the basic education system can significantly impact a country's GDP, and its economic and social conditions in the future.

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APPENDIX A

Questionnaire Scope-1: Part 1

The Survey of Student's Expectation for DEI

Learning Framework in Secondary School

Research Questionnaire

Expectations and Needs

Digital Entrepreneurship Learning Management among Secondary Students
Montfort College Secondary Section, Chiang Mai

(English Version – Scope 1 / Group 1: Student / Code: RQ#S01G01-Q)

Instruction

1. This questionnaire is developed to gather information for the dissertation on the "Development of Digital Entrepreneurial Intelligence (DEI)" among secondary students at Montfort College Secondary Section, Chiang Mai. The research is conducted on collaboration with the International College, Department of Digital Innovation and Financial Technology at Chiang Mai University, where faculty members serve as consultants.
2. The researcher kindly requests your cooperation in providing truthful responses to all questions, as each piece of information is crucial for this research. All data collected through this questionnaire will be treated as confidential and will solely be used for research purposes related to the dissertation. Respondents are not required to specify their first and last names and/or addresses.
3. The questionnaire is divided into three sections across eight pages:
   3.1 Part 1: General information about the respondents (5 items)
   3.2 Part 2: Expectations on digital entrepreneurship learning management (10 items)
   3.3 Part 3: Additional suggestions

Should you have any queries about this questionnaire, please direct them to the staff member who distributed it to you. Once you have completed answering all questions, kindly return the questionnaire to the designated official.

We sincerely appreciate your cooperation in responding to this questionnaire.

Warinthrone Vasuwat
Doctoral student at International College
Department of Digital Innovation and Financial Technology
Chiang Mai University

Part 1: General information of the respondents (5 items)

Instruction: Please provide truthful information in the following set of questions regarding your personal details.

No.	General information	Remark
1.1	Current grade level	
	☐ Grade 7	
	☐ Grade 8	
	☐ Grade 9	
	☐ Grade 10	
	☐ Grade 11	
	☐ Grade 12	
1.2	Study program	
	☐ Science-Mathematics (Thai program)	
	☐ Science-Mathematics (English program)	
	☐ Arts-language	
	☐ Arts-Mathematics	
	☐ Arts-Music	
	☐ Arts-Business (English program)	
1.3	Gender	
	☐ Male	
	☐ Female	
1.4	Age (please specify) ……………….. Years	

No.	General information	Remark
1.5	Parent's occupation (please specify)	
	☐ Civil servant	
	☐ State enterprise employee	
	☐ Teacher/ lecturer/ academics/ educational personnel	
	☐ Business owner	
	☐ Politician	
	☐ Farmer	
	☐ Employee	
	☐ Others (please specify)	
	☐ Not specified	

Part 2: Expectations and Needs for Digital Entrepreneurship Learning Management (10 items)

Instruction – Please respond to the question by indicating the corresponding mark on options A-D. Choose only one option realistically. This questionnaire consists of four multiple choices (A-D).

No.	Expectations and needs on digital entrepreneurship learning management	Options				
		I-C	I-PU	I-E	I-PR	Remark
		A	B	C	D	
•	**Factor 1: Student competency expectation (F1)**					
1	**Do you have the need to enhance your competencies in the digital entrepreneurship learning management? If so, in what specific area?**					
I-C	Aim to develop the competency to solve systematic problems.	A				
I-PU	Aim to develop the competency to plan work effectively.		B			
I-E	Aim to develop the competency to cultivate creative thinking skills.			C		
I-PR	Aim to develop the competency to work collaboratively as a team.				D	
•	**Factor 2: Student attitude expectation (F2)**					
2	**Do you have the need to cultivate a specific attitude towards digital entrepreneurship learning management? If so, in what specific area?**					
I-C	Aim to develop a logical thinking attitude, understanding cause and effect.	A				
I-PU	Aim to develop a thoughtful approach towards policies and work procedures for effective order.		B			
I-E	Aim to develop a flexible mindset, adapting seamlessly to varying situations.			C		
I-PR	Aim to develop a thoughtful approach for resolving conflicts within society or organizations.				D	

No.	Expectations and needs on digital entrepreneurship learning management	Options				
		I-C	I-PU	I-E	I-PR	Remark
		A	B	C	D	
•	**Factor 3: Student characteristic expectation (F3)**					
3	**Do you have the need to improve your characteristics relating to digital entrepreneurship learning management? If so, in what specific area?**					
I-C	Aim to develop a determined and resolute personality.	A				
I-PU	Aim to develop a thorough and diligent work ethic.		B			
I-E	Aim to develop self-confidence.			C		
I-PR	Aim to develop an interactive personality.				D	
•	**Factor 4: Learning curriculum style expectation (F4)**					
4	**Do you have a specific style for the digital entrepreneurship curriculum? If so, what kind of style are you looking for?**					
I-C	Organized as a workshop or short-term training.	A				
I-PU	Organized as a curriculum with courses aligned with the school's regular class schedule.		B			
I-E	Organized as an online learning course conducted outside of regular class hours.			C		
I-PR	Organized as an onsite club or community course.				D	
•	**Factor 5: Facility / location style expectation (F5)**					
5	**Do you have a preferred location or type of classroom for studying digital entrepreneurship? If so, in what specific area?**					
I-C	Computer lab or workshop training room	A				
I-PU	Regular classroom in school		B			
I-E	Outdoors settings or locations, such as coffee shops, resorts, department stores, etc.			C		
I-PR	Meeting rooms with small group breakout areas where students can walk around and interact				D	

No.	Expectations and needs on digital entrepreneurship learning management	Options				
		I-C	I-PU	I-E	I-PR	Remark
		A	B	C	D	
•	**Factor 6: Teaching approach style expectation (F6)**					
6	**Do you have a preference for the teaching approach or style for knowledge transfer in the digital entrepreneurship classroom? If so, in what specific area?**					
I-C	A practical teaching style focused on hands-on learning	A				
I-PU	A teaching format centered on lectures or theoretical instruction		B			
I-E	A teaching style that emphasizes experiences from internships or field surveys at real-world work sites			C		
I-PR	A teaching style that encourages small group participation and discussion for knowledge exchange with others				D	
•	**Factor 7: Instructor / teacher style expectation (F7)**					
7	**Do you have a preference for the characteristics of an educator or lecturer in the field of Digital Entrepreneurship? If so, in what specific area?**					
I-C	Provide individual feedback to students in every class	A				
I-PU	Measure and evaluate students' progress periodically		B			
I-E	Present strategies and tips relevant to real events or real-life situations in the classroom.			C		
I-PR	Organize small groups for students to engage in group discussions or facilitate specific discussion groups to enhance learning communication.				D	

No.	Expectations and needs on digital entrepreneurship learning management	Options				
		I-C	I-PU	I-E	I-PR	Remark
		A	B	C	D	
•	**Factor 8: Reason for self-development expectation (F8)**					
8	**Why do you want to develop your skills in digital entrepreneurship?**					
I-C	To clearly develop potential and be able to pursue a career in their own business in the future	A				
I-PU	To obtain certificates or educational qualifications to use in further studies		B			
I-E	To create opportunities and career options for the future			C		
I-PR	To meet new people and expand your network for future partnerships or business connections				D	
•	**Factor 9: Preferring for own business in the future expectation (F9)**					
9	**What type of business do you want to operate in the future?**					
I-C	Real estate investment, stock market, gold trading, bonds, exchange rates, etc.	A				
I-PU	Industry, food production, processing, agriculture, etc.		B			
I-E	Technology and new innovations, etc.			C		
I-PR	Hotels, restaurants, entertainment, etc.				D	
•	**Factor 10: Future development skill expectation (F10)**					
10	**How would you like to develop your focus on future skills and knowledge in digital entrepreneurship?**					
I-C	Analytical skill / Financial skill / Proactive skill / Leadership skill etc.	A				
I-PU	Organizational skill / Consistence / Concision / Workflow Analysis etc.		B			
I-E	Creative skill / Innovative skill / Risk Taking Management / Open – Minded skill etc.			C		
I-PR	Communication skill / Conflict Management skill / Self Emotional Regulation / Negotiate skill etc.				D	

Part 3: Additional suggestions

……….

……….

……….

APPENDIX B

Questionnaire Scope-1: Part 2

The Survey of Stakeholder's Expectation for DEI Learning Framework in Secondary School

Research Questionnaire

Expectations and Needs

Digital Entrepreneurship Learning Management among Secondary Students

Montfort College Secondary Section, Chiang Mai

(English Version – Scope 1 / Group 2: Stakeholders / Code: RQ#S01G02-Q)

Instruction

1. This questionnaire is developed to gather information for the dissertation on the "Development of Digital Entrepreneurial Intelligence (DEI)" among secondary students at Montfort College Secondary Section, Chiang Mai. The research is conducted on collaboration with the International College, Department of Digital Innovation and Financial Technology at Chiang Mai University, where faculty members serve as consultants.
2. The researcher kindly requests your cooperation in providing truthful responses to all questions, as each piece of information is crucial for this research. All data collected through this questionnaire will be treated as confidential and will solely be used for research purposes related to the dissertation. Respondents are not required to specify their first and last names and/or addresses.
3. The questionnaire is divided into three sections across nine pages:
   3.1 Part 1: General information about the respondents (6 items)
   3.2 Part 2: Expectations on digital entrepreneurship learning management (10 items)
   3.3 Part 3: Additional suggestions

Should you have any queries about this questionnaire, please direct them to the staff member who distributed it to you. Once you have completed answering all questions, kindly return the questionnaire to the designated official.

We sincerely appreciate your cooperation in responding to this questionnaire.

Warinthrone Vasuwat
Doctoral student at International College
Department of Digital Innovation and Financial Technology
Chiang Mai University

Part 1: General information of the respondents (5 items)

Instruction: Please provide truthful information in the following set of questions regarding your personal details.

No.	General information	Remark
1.1	Current status	
	☐ Alumni	
	☐ Parents	
	☐ Teachers / Staff at Montfort College Subject taught (please specify)	
	☐ School Administrator Responsible department/unit (please specify)	
1.2	Gender	
	☐ Male	
	☐ Female	
1.3	Business experience	
	☐ 0 – 5 years	
	☐ 5 - 10 years	
	☐ 11 - 15 years	
	☐ More than 15 years	
1.4	Education level	
	☐ Associate degree	
	☐ Bachelor degree	
	☐ Master degree	
	☐ Doctor degree	
	☐ Others (please specify) …………………………………….	
1.6	Type of business	
	☐ Manufacturing business	
	☐ Service business	
	☐ Commercial business	
	Questionnaire number .... /	

Part 2: Expectations and Needs for Digital Entrepreneurship Learning Management (10 items)

Instruction – Please respond to the question by indicating the corresponding mark on options A-D. Choose only one option realistically. This questionnaire consists of four multiple choices (A-D).

No.	Expectations and needs on digital entrepreneurship learning management	Options				
		I-C	I-PU	I-E	I-PR	Remark
		A	B	C	D	
•	**Factor 1: Student competency expectation (F1)**					
1	**Do you have the need to enhance your competencies in the digital entrepreneurship learning management? If so, in what specific area?**					
I-C	Aim to develop the competency to solve systematic problems.	A				
I-PU	Aim to develop the competency to plan work effectively.		B			
I-E	Aim to develop the competency to cultivate creative thinking skills.			C		
I-PR	Aim to develop the competency to work collaboratively as a team.				D	
•	**Factor 2: Student attitude expectation (F2)**					
2	**Do you have the need to cultivate a specific attitude towards digital entrepreneurship learning management? If so, in what specific area?**					
I-C	Aim to develop a logical thinking attitude, understanding cause and effect.	A				
I-PU	Aim to develop a thoughtful approach towards policies and work procedures for effective order.		B			
I-E	Aim to develop a flexible mindset, adapting seamlessly to varying situations.			C		
I-PR	Aim to develop a thoughtful approach for resolving conflicts within society or organizations.				D	

No.	Expectations and needs on digital entrepreneurship learning management	Options				
		I-C	I-PU	I-E	I-PR	Remark
		A	B	C	D	
•	**Factor 3: Student characteristic expectation (F3)**					
3	**Do you have the need to improve your characteristics relating to digital entrepreneurship learning management? If so, in what specific area?**					
I-C	Aim to develop a determined and resolute personality.	A				
I-PU	Aim to develop a thorough and diligent work ethic.		B			
I-E	Aim to develop self-confidence.			C		
I-PR	Aim to develop an interactive personality.				D	
•	**Factor 4: Learning curriculum style expectation (F4)**					
4	**Do you have a specific style for the digital entrepreneurship curriculum? If so, what kind of style are you looking for?**					
I-C	Organized as a workshop or short-term training.	A				
I-PU	Organized as a curriculum with courses aligned with the school's regular class schedule.		B			
I-E	Organized as an online learning course conducted outside of regular class hours.			C		
I-PR	Organized as an onsite club or community course.				D	
•	**Factor 5: Facility / location style expectation (F5)**					
5	**Do you have a preferred location or type of classroom for studying digital entrepreneurship? If so, in what specific area?**					
I-C	Computer lab or workshop training room	A				
I-PU	Regular classroom in school		B			
I-E	Outdoors settings or locations, such as coffee shops, resorts, department stores, etc.			C		
I-PR	Meeting rooms with small group breakout areas where students can walk around and interact				D	

No.	Expectations and needs on digital entrepreneurship learning management	Options				
		I-C	I-PU	I-E	I-PR	Remark
		A	B	C	D	
•	**Factor 6: Teaching approach style expectation (F6)**					
6	**Do you have a preference for the teaching approach or style for knowledge transfer in the digital entrepreneurship classroom? If so, in what specific area?**					
I-C	A practical teaching style focused on hands-on learning	A				
I-PU	A teaching format centered on lectures or theoretical instruction		B			
I-E	A teaching style that emphasizes experiences from internships or field surveys at real-world work sites			C		
I-PR	A teaching style that encourages small group participation and discussion for knowledge exchange with others				D	
•	**Factor 7: Instructor / teacher style expectation (F7)**					
7	**Do you have a preference for the characteristics of an educator or lecturer in the field of Digital Entrepreneurship? If so, in what specific area?**					
I-C	Provide individual feedback to students in every class	A				
I-PU	Measure and evaluate students' progress periodically		B			
I-E	Present strategies and tips relevant to real events or real-life situations in the classroom.			C		
I-PR	Organize small groups for students to engage in group discussions or facilitate specific discussion groups to enhance learning communication.				D	

No.	Expectations and needs on digital entrepreneurship learning management	Options				
		I-C	I-PU	I-E	I-PR	Remark
		A	B	C	D	
•	**Factor 8: Reason for self-development expectation (F8)**					
8	**Why do you want to develop your skills in digital entrepreneurship?**					
I-C	To clearly develop potential and be able to pursue a career in their own business in the future	A				
I-PU	To obtain certificates or educational qualifications to use in further studies		B			
I-E	To create opportunities and career options for the future			C		
I-PR	To meet new people and expand your network for future partnerships or business connections				D	
•	**Factor 9: Preferring for own business in the future expectation (F9)**					
9	**What type of business do you want to operate in the future?**					
I-C	Real estate investment, stock market, gold trading, bonds, exchange rates, etc.	A				
I-PU	Industry, food production, processing, agriculture, etc.		B			
I-E	Technology and new innovations, etc.			C		
I-PR	Hotels, restaurants, entertainment, etc.				D	
•	**Factor 10: Future development skill expectation (F10)**					
10	**How would you like to develop your focus on future skills and knowledge in digital entrepreneurship?**					
I-C	Analytical skill / Financial skill / Proactive skill / Leadership skill etc.	A				
I-PU	Organizational skill / Consistence / Concision / Workflow Analysis etc.		B			
I-E	Creative skill / Innovative skill / Risk Taking Management / Open – Minded skill etc.			C		
I-PR	Communication skill / Conflict Management skill / Self Emotional Regulation / Negotiate skill etc.				D	

Part 3: Additional suggestions

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APPENDIX C

Questionnaire Scope-1: Part 3

Whole Brain Literacy (WBL) Decoding Manual

(Four Human Brain Function Indicators)

Research Analysis Form

Whole Brain Literacy (WBL) Decoding Manual

(Four Human Brain Function Indicators)

(English Version – Scope 1 / Group 3: Business People / Code: RQ#S01G03-D)

Instruction

1. This analysis form is developed to gather information for the dissertation on the "Development of Digital Entrepreneurial Intelligence (DEI)" among secondary students at Montfort College Secondary Section, Chiang Mai. The research is conducted on collaboration with the International College, Department of Digital Innovation and Financial Technology at Chiang Mai University, where faculty members serve as consultants.
2. Some of the information in this research analysis has been adapted from WBL Indicators (Takyo, 2015) for educational and research purposes only. The researcher does not have any commercial objectives.
3. This research analysis is designed to examine human brain functions using 95 comparable indicators.
4. Applications of this analysis include deciphering live interviews from target groups, analyzing television interview tapes and audio interviews, and reviewing interview articles such as books and various publications. This is done by comparing data, messages, and conversations with the indicators related to human brain functions.

Should you have any questions about this research analysis tool, please inquire with the staff who provided this analysis. Once you have completed the decoding analysis, kindly return the results to the official who distributed this document.

Warinthrone Vasuwat
Doctoral student at International College
Department of Digital Innovation and Financial Technology
Chiang Mai University

Part 1: Personal General Information

No.	Item	Target group information	Remark
1	Name and surname of the person being analyzed		
2	Type of business		
3	Business name / Trade name		
4	Ranking of the business	☐ Global ☐ Domestic (Thailand)	
5	Business success ranking	No. .... in the world No. .... in Thailand	
6	Estimated annual business income	☐ ………………… USD ☐ ………………… THB	
7	Data source format for decoding WBL and analyzing data	☐ Live interviews ☐ Television program recordings ☐ Conversation recording tapes ☐ Printed sources ☐ Internet resources ☐ Others (please specify)	
8	Reference sources of interviewee analysis data		
9	**Analysis instruction** - Place a mark ✓in the box ☐ Frequency (f) when you find that there is a message / article / verbal communication / vocabulary that is consistent with the indicators of characteristics prominently displayed. When the analysis is complete, summarize the decoding results as percentages.		

Part 2: WBL Decoding Analysis

WBL 1	Brain function and the skills needed to conduct a prototypical model	Define keyword code from the interview Skills – qualifications – characteristics prominently displayed	Frequency (f)	Percentage (%)
I–Control = I-C (Code = 23 indicators)	Anterior left brain lobe Analytical and logical thinking	Efficiency = C01	□□□ ……	
		Finance = C02	□□□ ……	
		Performance = C03	□□□ ……	
		Logic = C04	□□□ ……	
		Analysis = C05	□□□ ……	
		Quantitative = C06	□□□ ……	
		Quantify = C07	□□□ ……	
		Realistic = C08	□□□ ……	
		Direction = C09	□□□ ……	
		Goal = C10	□□□ ……	
		Objective = C11	□□□ ……	
		Number = C12	□□□ ……	
		Systematic = C13	□□□ ……	
		Rational = C14	□□□ ……	
		Theoretical = C15	□□□ ……	
		Methodology = C16	□□□ ……	
		Control = C17	□□□ ……	
		Commitment = C18	□□□ ……	
		Critical = C19	□□□ ……	
		Evaluation = C20	□□□ ……	
		Leading = C21	□□□ ……	
		Proactive = C22	□□□ ……	
		Planning = C23	□□□ ……	
		Total		
Note				

WBL **2**	**Brain function and the skills needed to conduct a prototypical model**	**Define keyword code from the interview** **Skills – qualifications – characteristics prominently displayed**	**Frequency** **(f)**	**Percentage** **(%)**
I-Pursue = I-PU (Code = 22 indicators)	Posterior left Brain lobe Movement and self-control	Regulations = U01	□□□ ……	
		Quality = U02	□□□ ……	
		Risk reduction = U03	□□□ ……	
		Timing = U04	□□□ ……	
		Policy = U05	□□□ ……	
		Forming = U06	□□□ ……	
		Sequential = U07	□□□ ……	
		Organizing = U08	□□□ ……	
		Detailed = U09	□□□ ……	
		Prioritized = U10	□□□ ……	
		Focused = U11	□□□ ……	
		Ordered = U12	□□□ ……	
		Tasking = U13	□□□ ……	
		Tradition = U14	□□□ ……	
		Reliable = U15	□□□ ……	
		Punctuality = U16	□□□ ……	
		Decision = U17	□□□ ……	
		Action = U18	□□□ ……	
		Result = U19	□□□ ……	
		Productive = U20	□□□ ……	
		Completion = U21	□□□ ……	
		Permission = U22	□□□ ……	
		Total		
Note				

WBL 3	Brain function and the skills needed to conduct a prototypical model	Define keyword code from the interview Skills – qualifications – characteristics prominently displayed	Frequency (f)	Percentage (%)
I-Explore = I-E (Code = 26 indicators)	Anterior right brain lobe Creativity and imagination	Competition = E01	□□□ ……	
		Future trends = E02	□□□ ……	
		Flexibility = E03	□□□ ……	
		Visionary = E04	□□□ ……	
		Long term = E05	□□□ ……	
		Innovation = E06	□□□ ……	
		Choice = E07	□□□ ……	
		Optional = E08	□□□ ……	
		Holistic = E09	□□□ ……	
		Intuitive ideas = E10	□□□ ……	
		Integration = E11	□□□ ……	
		Synthesizing = E12	□□□ ……	
		Infers = E13	□□□ ……	
		Speculation = E14	□□□ ……	
		Creativity = E15	□□□ ……	
		Conceptualizes= E16	□□□ ……	
		Taking risk = E17	□□□ ……	
		Bend the rule = E18	□□□ ……	
		Curious = E19	□□□ ……	
		Difference = E20	□□□ ……	
		Novelty = E21	□□□ ……	
		Imagination = E22	□□□ ……	
		Big picture = E23	□□□ ……	
		Possible options = E24	□□□ ……	
		Think out of the box = E25	□□□ ……	
		Open minded = E26	□□□ ……	
		Total		
Note				

WBL 4	Brain function and the skills needed to conduct a prototypical model	Define keyword code from the interview Skills – qualifications – characteristics prominently displayed	Frequency (f)	Percentage (%)
I-Preserve = I-PR (Code = 24 indicators)	Posterior right brain lobe Emotional and social dimensions	Training = R01	□□□ ……	
		Team = R02	□□□ ……	
		Relationship = R03	□□□ ……	
		Community = R04	□□□ ……	
		Communication = R05	□□□ ……	
		Culture = R06	□□□ ……	
		Recognition = R07	□□□ ……	
		Feeling = R08	□□□ ……	
		Emotional = R09	□□□ ……	
		Interpersonal = R10	□□□ ……	
		Support others = R11	□□□ ……	
		Spiritual = R12	□□□ ……	
		Sensitive = R13	□□□ ……	
		Sharing = R14	□□□ ……	
		Giving = R15	□□□ ……	
		Expressive = R16	□□□ ……	
		Cooperative = R17	□□□ ……	
		Collaborative = R18	□□□ ……	
		Conversational = R19	□□□ ……	
		Linguistic = R20	□□□ ……	
		Compromise = R21	□□□ ……	
		Synergies = R22	□□□ ……	
		Connection-network = R23	□□□ ……	
		Faith = R24	□□□ ……	
		<u>**Total**</u>		
Note				

<u>Part 3: Summary of the interview results analysis</u>

Function	Number of indicators displayed	Frequency	Percentage
I-C			
I-PU			
I-E			
I-PR			
Total			**100**

<u>Note:</u>

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APPENDIX D

Questionnaire Scope-2: Part 1

The Survey of Developing for Digital Entrepreneurship (DE)

In Secondary Students

Research Questionnaire

"The Development of Digital Entrepreneurship" among Secondary Students

Montfort College Secondary Section, Chiang Mai

(English Version – Scope 2 / Part 1: X1 / Code: RQ#S02P01X1-Q)

Instruction

1. This questionnaire is developed to gather information for the dissertation on the "Development of Digital Entrepreneurial Intelligence (DEI)" among secondary students at Montfort College Secondary Section, Chiang Mai. The research is conducted on collaboration with the International College, Department of Digital Innovation and Financial Technology at Chiang Mai University, where faculty members serve as consultants.
2. The researcher kindly requests your cooperation in providing truthful responses to all questions, as each piece of information is crucial for this research. All data collected through this questionnaire will be treated as confidential and will solely be used for research purposes related to the dissertation. Respondents are not required to specify their first and last names and/or addresses.
3. The questionnaire is divided into three sections across six pages:
   3.1 Part 1: General information about the respondents (3 items)
   3.2 Part 2: Questions on the development of digital entrepreneurship (40 items)
   3.3 Part 3: Additional suggestions

Should you have any queries about this questionnaire, please direct them to the staff member who distributed it to you. Once you have completed answering all questions, kindly return the questionnaire to the designated official.

We sincerely appreciate your cooperation in responding to this questionnaire.

Warinthrone Vasuwat
Doctoral student at International College
Department of Digital Innovation and Financial Technology
Chiang Mai University

Part 1: General information of the respondents (4 items)

Instruction: Please provide truthful information in the following set of questions regarding your personal details.

No.	General information	Remark
1.1	Current grade level	
	☐ Grade 7	
	☐ Grade 8	
	☐ Grade 9	
	☐ Grade 10	
	☐ Grade 11	
	☐ Grade 12	
1.2	Study program	
	☐ Science-Mathematics (Thai program)	
	☐ Science-Mathematics (English program)	
	☐ Arts-language	
	☐ Arts-Mathematics	
	☐ Arts-Music	
	☐ Arts-Business (English program)	
1.3	Sex	
	☐ Male	
	☐ Female	

Part 2: Questions regarding the development of digital entrepreneurship (40 items)

Instruction: Please answer the question by marking ✓ as true, using the following scoring criteria:

Level 4: The respondent has the most knowledge, abilities, and skills in this area.

Level 3: The respondent has many knowledge, abilities, and skills in this area.

Level 2: The respondent has low knowledge, abilities, and skills in this area.

Level 1: The respondent has the least knowledge, abilities, and skills in this area.

No.	List of questions regarding digital entrepreneur (DE)	Assessment level of digital entrepreneur (DE)				
		The most	Many	Low	The least	Remark
		4	3	2	1	
•	**Factor 1: Big data (x101): I-C**					
1	You have knowledge and understanding of big data.					
2	You can classify different types of big data.					
3	You are able to explain the steps involved in using big data.					
4	You can analyze the advantages and disadvantages of each type of big data.					
5	You can apply big data to various business operations.					
•	**Factor 2: FinTech (x102): I-C**					
6	You have knowledge and understanding FinTech.					
7	You can classify different types of FinTech.					
8	You are able to explain the steps involved in using FinTech.					
9	You can analyze the advantages and disadvantages of each type of FinTech.					
10	You can apply FinTech to various business operations.					

No.	List of questions regarding digital entrepreneur (DE)	Assessment level of digital entrepreneur (DE)				
		The most	Many	Low	The least	Remark
		4	3	2	1	
•	**Factor 3: Block chain (x103): I-PU**					
11	You have knowledge and understanding of blockchain.					
12	You can classify different types of blockchain.					
13	You are able to explain the steps involved in using blockchain.					
14	You can analyze the advantages and disadvantages of each type of blockchain.					
15	You can apply blockchain to various business operations.					
•	**Factor 4: Digital business laws (x104): I-PU**					
16	You have knowledge and understanding of digital business laws.					
17	You can classify different types of digital business laws.					
18	You are able to explain the steps involved in using digital business laws.					
19	You can analyze the advantages and disadvantages of each type of digital business laws.					
20	You can apply digital business laws to various business operations.					

No.	List of questions regarding digital entrepreneur (DE)	Assessment level of digital entrepreneur (DE)				
		The most	Many	Low	The least	Remark
		4	3	2	1	
•	**Factor 5: Internet of Things (IoT) (x105): I-E**					
21	You have knowledge and understanding of Internet of Things (IoT).					
22	You can classify different types of Internet of Things (IoT).					
23	You are able to explain the steps involved in using Internet of Things (IoT).					
24	You can analyze the advantages and disadvantages of each type of Internet of Things (IoT).					
25	You can apply Internet of Things (IoT) to various business operations.					
•	**Factor 6: Creative social media (x106): I-E**					
26	You have knowledge and understanding of creative social media.					
27	You can classify different types of creative social media.					
28	You are able to explain the steps involved in using creative social media.					
29	You can analyze the advantages and disadvantages of each type of creative social media.					
30	You can apply creative social media to various business operations.					

No.	List of questions regarding digital entrepreneur (DE)	Assessment level of digital entrepreneur (DE)				
		The most	Many	Low	The least	Remark
		4	3	2	1	
•	**Factor 7: Artificial intelligence (AI) (x107): I-PR**					
31	You have knowledge and understanding of artificial intelligence (AI).					
32	You can classify different types of artificial intelligence (AI).					
33	You are able to explain the steps involved in using artificial intelligence (AI).					
34	You can analyze the advantages and disadvantages of each type of artificial intelligence (AI).					
35	You can apply artificial intelligence (AI) to various business operations.					
•	**Factor 8: Cloud computing (x108): I-PR**					
36	You have knowledge and understanding of cloud computing.					
37	You can classify different types of cloud computing.					
38	You are able to explain the steps involved in using cloud computing.					
39	You can analyze the advantages and disadvantages of each type of cloud computing.					
40	You can apply cloud computing to various business operations.					

Part 3: Additional suggestions

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APPENDIX E

Questionnaire Scope-2: Part 2

The Survey of Developing for Entrepreneurship

In Secondary Students

Research Questionnaire

on "The Development of Digital Entrepreneurship" among Secondary Students at Montfort College Secondary Section, Chiang Mai

(English Version – Scope 2 / Part 1: X2 / Code: RQ#S02P01X2-T)

Instruction

1. This questionnaire is developed to gather information for the dissertation on the "Development of Digital Entrepreneurial Intelligence (DEI)" among secondary students at Montfort College Secondary Section, Chiang Mai. The research is conducted on collaboration with the International College, Department of Digital Innovation and Financial Technology at Chiang Mai University, where faculty members serve as consultants.
2. Some of the information in this test has been adapted from the DECA INC. TEST 2019 (Entrepreneurship and Small Business - ESB) of the MBA Research and Curriculum Center, Columbus, Ohio, USA. This material is for educational and job research purposes only. The researcher has no commercial objectives.
3. The researcher kindly requests your cooperation in providing truthful responses to all questions, as each piece of information is crucial for this research. All data collected through this questionnaire will be treated as confidential and will solely be used for research purposes related to the dissertation. Respondents are not required to specify their first and last names and/or addresses.
4. The questionnaire is divided into three sections across eight pages:

   4.1 Part 1: General information about the respondents (3 items)

   4.2 Part 2: Questions on the development of entrepreneurship (20 items)

   4.3 Part 3: Additional suggestions

   Should you have any queries about this questionnaire, please direct them to the staff member who distributed it to you. Once you have completed answering all questions, kindly return the questionnaire to the designated official.

   We sincerely appreciate your cooperation in responding to this questionnaire.

Warinthrone Vasuwat
Doctoral student at International College
Department of Digital Innovation and Financial Technology
Chiang Mai University

Part 1: General information of the respondents (3 items)

Instruction: Please provide truthful information in the following set of questions regarding your personal details.

No.	General information	Remark
1.1	Current grade level	
	☐ Grade 7	
	☐ Grade 8	
	☐ Grade 9	
	☐ Grade 10	
	☐ Grade 11	
	☐ Grade 12	
1.2	Study program	
	☐ Science-Mathematics (Thai program)	
	☐ Science-Mathematics (English program)	
	☐ Arts-language	
	☐ Arts-Mathematics	
	☐ Arts-Music	
	☐ Arts-Business (English program)	
1.3	Sex	
	☐ Male	
	☐ Female	

Part 2: Questions regarding the development of entrepreneurship (20 items)

Instruction – Please respond to the question by indicating the corresponding mark ○ on options A-D. This questionnaire consists of four multiple choices (A-D).

2.1 Factor 1: Business idea and business operation (x201: I-E) (5 items)			
No.	**Questions/Options**		**Remark**
1	**Limited liability, indefinite length of life, ease of expansion, legal entity, and transfer of ownership are considered advantages of a …………?**		
	A	sole proprietorship	
	B	partnership	
	C	trade union	
	D	corporation	
2	**Managers are more likely to be able to persuade employees to follow new procedures if the managers have ……….?**		
	A	organizational skills	
	B	credibility	
	C	enthusiasm	
	D	self-motivation	
3	**Which of the following statements is true about business startup requirements?**		
	A	New business owners usually need to register for patent protection.	
	B	The financial needs to start a new business depend on the nature of the venture.	
	C	Purchasing a franchise is usually easy and inexpensive for startup business owners.	
	D	Equipment is the least expensive requirement for a startup business.	

4	**An example of an internal change that could affect a business's sales forecast is a change in the ……..**		
	A	length of a national recession.	
	B	number of competitors in the market.	
	C	size of the sales force.	
	D	levels of consumer spending.	
5	**What is often the role of management in the achievement of quality in a business?**		
	A	To assign blame.	
	B	To lead the effort.	
	C	To judge the staff.	
	D	To eliminate conflict.	

2.2 Factor 2: Marketing plan (x202: I-PR) (5 items)			
No.	**Questions/Options**		**Remark**
6	**Channels of distribution benefit consumers by ….**		
	A	increasing profits for businesses.	
	B	lowering the prices of all consumer products.	
	C	raising the quality of all consumer products.	
	D	making a variety of products available to them.	
7	**To develop repeat business and customer loyalty, a business owner might ….**		
	A	update equipment.	
	B	increase prices.	
	C	ridicule the competition	
	D	offer a new service.	

8	**Products that appeal to the majority of customers are often sold through ……. marketing efforts.**		
	A	segmented	
	B	mass	
	C	demographic	
	D	psychographic	
9	**One reason why it is important to accurately forecast sales for a marketing plan is because the forecast is the basis of other …..**		
	A	business reports.	
	B	pricing strategies.	
	C	operational activities.	
	D	management techniques.	
10	**A product idea is feasible if it …..**		
	A	meets sales quotas.	
	B	creates a competitive advantage.	
	C	costs a lot to produce.	
	D	is a durable good.	

2.3 Factor 3: Financial plan (x203: I-C) (5 items)			
No.	**Questions/Options**		**Remark**
11	**Which of the following is an example of an intangible asset?**		
	A	Equipment	
	B	Inventory	
	C	Office building	
	D	Accounts receivable	
12	**Which of the following is a characteristic of a profit-and-loss statement?**		
	A	Is the same as a balance sheet	
	B	Summarizes expenses and revenue from sales	
	C	Shows the owner's financial position	
	D	Lists assets and liabilities	
13	**When determining financing needs, what factor should businesses consider that will help decide whether they can repay the debt?**		
	A	Liquidity	
	B	Depreciation	
	C	Equity	
	D	Inventory	
14	**Ethan is developing common-size financial statements so that he can compare financial performance across several different companies. Ethan is conducting …………… analysis?**		
	A	horizontal	
	B	vertical	
	C	ratio	
	D	trend	

15	**Which of the following is an example of a fixed operating expense?**		
	A	Insurance	
	B	Sales commissions	
	C	Advertising	
	D	Travel expenses	

2.4 Factor 4: Business project (x204: I-PU) (5 items)			
No.	**Questions/Options**		**Remark**
16	**Which of the following is an example of a manager developing a policy that impacts customer relations?**		
	A	Increasing use of security devices	
	B	Extending business hours on weekends	
	C	Revising bookkeeping procedures	
	D	Scheduling employees' work hours	
17	**Which of the following is a strategy for linking performance measures to financial outcomes?**		
	A	Analyzing click-through rates	
	B	Developing advertising budgets	
	C	Paying for direct-mail pieces	
	D	Maintaining sales receipts	
18	**To effectively manage a supply chain, what should companies do?**		
	A	Introduce frequent changes to the production process.	
	B	Ignore underperforming suppliers and distributors.	
	C	Monitor the performance of all supply chain partners.	
	D	Launch new products through multiple suppliers.	

19	**What type of promotional media is a business using when it sends out a postcard telling customers who recently purchased products that the business is adding a new line of products?**		
	A	Participative	
	B	Sales letter	
	C	Persuasive	
	D	Direct mail	
20	**Why do some businesses sponsor local events?**		
	A	To obtain publicity.	
	B	To create news.	
	C	To generate revenue.	
	D	To sell products.	

Part 3: Additional suggestions

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APPENDIX F

Questionnaire Scope-2: Part 3

The Survey of Developing for Digital Intelligence (DI)

In Secondary Students

Research Questionnaire

"The Development of Digital Entrepreneurship" among Secondary Students

Montfort College Secondary Section, Chiang Mai

(English Version – Scope 2 / Part 2: Y1 / Code: RQ#S02P02Y1-Q)

<u>Instruction</u>

1. This questionnaire is developed to gather information for the dissertation on the "Development of Digital Entrepreneurial Intelligence (DEI)" among secondary students at Montfort College Secondary Section, Chiang Mai. The research is conducted on collaboration with the International College, Department of Digital Innovation and Financial Technology at Chiang Mai University, where faculty members serve as consultants.
2. Some of the information in this questionnaire has been adapted from the Digital Intelligence Quotient 2020 of King Mongkut's Institute of Technology Ladkrabang, Thailand, and the DQ Framework 2018. This material is for educational and research purposes only. The researcher has no commercial objectives.
3. The researcher kindly requests your cooperation in providing truthful responses to all questions, as each piece of information is crucial for this research. All data collected through this questionnaire will be treated as confidential and will solely be used for research purposes related to the dissertation. Respondents are not required to specify their first and last names and/or addresses.
4. The questionnaire is divided into three sections across eight pages:
   4.1 Part 1: General information about the respondents (3 items)
   4.2 Part 2: Questions regarding the development of digital intelligence (20 items)
   4.3 Part 3: Additional suggestions

Should you have any queries about this questionnaire, please direct them to the staff member who distributed it to you. Once you have completed answering all questions, kindly return the questionnaire to the designated official.

We sincerely appreciate your cooperation in responding to this questionnaire.

Warinthrone Vasuwat
Doctoral student at International College
Department of Digital Innovation and Financial Technology, Chiang Mai University

Part 1: General information of the respondents (3 items)

Instruction: Please provide truthful information in the following set of questions regarding your personal details.

No.	General information	Remark
1.1	Current grade level	
	☐ Grade 7	
	☐ Grade 8	
	☐ Grade 9	
	☐ Grade 10	
	☐ Grade 11	
	☐ Grade 12	
1.2	Study program	
	☐ Science-Mathematics (Thai program)	
	☐ Science-Mathematics (English program)	
	☐ Arts-language	
	☐ Arts-Mathematics	
	☐ Arts-Music	
	☐ Arts-Business (English program)	
1.3	Sex	
	☐ Male	
	☐ Female	

Part 2: Questions regarding the development of digital intelligence (40 items)

Instruction: Please answer the question by marking ✓ as true, using the following scoring criteria:

Level 4: The respondent has the most knowledge, abilities, and skills in this area.

Level 3: The respondent has many knowledge, abilities, and skills in this area.

Level 2: The respondent has low knowledge, abilities, and skills in this area.

Level 1: The respondent has the least knowledge, abilities, and skills in this area.

No.	List of questions regarding digital intelligence (DI)	Assessment level of digital intelligence (DI)				
		The most	Many	Low	The least	Remark
		4	3	2	1	
•	**Factor 1: Digital identity (y101): I-E**					
1	You always use your real first and last name when creating a profile on digital media.					
2	You always use your real picture when creating a profile on digital media.					
3	You choose to ignore and not respond to others who have conflicting opinions regarding the use of digital media.					
4	You immediately stop communicating with other who display inappropriate behaviors in the use of digital media.					
5	You immediately stop communicating when you know that the person you are contacting is using a fake profile while using digital media.					

No.	List of questions regarding digital intelligence (DI)	Assessment level of digital intelligence (DI)				
		The most	Many	Little	The least	Remark
		4	3	2	1	
•	**Factor 2: Digital use (y102): I-E**					
6	Whenever you are studying or working, you will not access digital media.					
7	You can divide and allocate time to use digital media appropriately.					
8	Whenever you want to solve a specific problem, you choose to find reliable information from digital media sources.					
9	When you spend time with your family, you will avoid and refrain from using digital media.					
10	While you are driving, you will avoid and refrain from using electronic communication devices and digital media.					
•	**Factor 3: Digital safety (y103): I-PU**					
11	Every time you feel threatened on digital media, you will avoid and cease communication immediately.					
12	Every time you are harassed or bullied with unwanted words or images on digital media, you will avoid and cease communication immediately.					
13	Every time an unknown person requests personal information, you will avoid and cease communication immediately.					

No.	List of questions regarding digital intelligence (DI)	Assessment level of digital intelligence (DI)				
		The most	Many	Little	The least	Remark
		4	3	2	1	
14	You avoid using websites or digital media that contain pornographic, obscene, or sexually harassing content.					
15	You avoid using websites or digital media that contain content about violence or domestic and social abuse.					
•	**Factor 4: Digital security (y104): I-PU**					
16	You have knowledge and understanding of the dissemination of personal information on digital media.					
17	You set a password for your electronic communication devices and social media accounts every time to prevent access by fraudsters.					
18	You study various information before clicking on any link shared on digital media.					
19	You have knowledge and understanding of creating passwords/authentication for electronic communication devices used to connect to digital media.					
20	You log out your username and password every time you use digital media on a public communication device.					

No.	List of questions regarding digital intelligence (DI)	Assessment level of digital intelligence (DI)				
		The most	Many	Little	The least	Remark
		4	3	2	1	
•	**Factor 5: Digital emotional intelligence (y105): I-PR**					
21	You can control your emotions appropriately while using digital media.					
22	You often disseminate useful information to others while using digital media.					
23	You avoid showing negative emotions or feelings toward others while using digital media.					
24	You avoid sharing or forwarding information that negatively affects others while using digital media.					
25	You avoid making negative comments to others while using digital media.					
•	**Factor 6: Digital communication (y106): I-PR**					
26	You use appropriate and polite language when using digital media.					
27	You choose digital communication channels that are appropriate for the person and situation.					
28	You use official language when communicating via email with other people or organizations.					
29	You use digital media creatively to disseminate information.					

No.	List of questions regarding digital intelligence (DI)	Assessment level of digital intelligence (DI)				
		The most	Many	Little	The least	Remark
		4	3	2	1	
30	You apply digital media to increase efficiency in studying or working in daily life.					
•	**Factor 7: Digital literacy (y107): I - C**					
31	You have the ability to use various reliable search engines to find information on digital media.					
32	You have the knowledge and ability to use digital media for teleconferencing or online meetings.					
33	You can use digital media commercially to create income for yourself.					
34	You can use various digital media platforms to present information in your field of study or work fluently.					
35	You are proficient in using various types of digital media and can pass on your knowledge to others.					
•	**Factor 8: Digital rights (y108): I - C**					
36	Every time you publish information from someone else's source, you always refer to the source.					
37	Whenever you publish information on digital media, you do not violate the privacy rights of others.					

No.	List of questions regarding digital intelligence (DI)	Assessment level of digital intelligence (DI)				
		The most	Many	Little	The least	Remark
		4	3	2	1	
38	You avoid using pirated software.					
39	You avoid downloading pirated songs and movies.					
40	You avoid expressing opinions on digital media that violate the social and legal rights and freedoms of others.					

Part 3: Additional suggestions

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APPENDIX G

Questionnaire Scope-2: Part 4

The Survey of Developing for Entrepreneurial Intelligence (EI)

In Secondary Students

Research Questionnaire

"The Development of Digital Entrepreneurship" among Secondary Students

Montfort College Secondary Section, Chiang Mai

(English Version – Scope 2 / Part 2: Y2 / Code: RQ#S02P02Y2-Q)

Instruction

1. This questionnaire is developed to gather information for the dissertation on the "Development of Digital Entrepreneurial Intelligence (DEI)" among secondary students at Montfort College Secondary Section, Chiang Mai. The research is conducted on collaboration with the International College, Department of Digital Innovation and Financial Technology at Chiang Mai University, where faculty members serve as consultants.
2. The researcher kindly requests your cooperation in providing truthful responses to all questions, as each piece of information is crucial for this research. All data collected through this questionnaire will be treated as confidential and will solely be used for research purposes related to the dissertation. Respondents are not required to specify their first and last names and/or addresses.
3. The questionnaire is divided into three sections across 12 pages:
   3.1 Part 1: General information about the respondents (3 items)
   3.2 Part 2: Questions regarding the development of entrepreneurial intelligence (64 items)
   3.3 Part 3: Additional suggestions

Should you have any queries about this questionnaire, please direct them to the staff member who distributed it to you. Once you have completed answering all questions, kindly return the questionnaire to the designated official.

We sincerely appreciate your cooperation in responding to this questionnaire.

Warinthrone Vasuwat
Doctoral student at International College
Department of Digital Innovation and Financial Technology
Chiang Mai University

Part 1: General information of the respondents (4 items)

Instruction: Please provide truthful information in the following set of questions regarding your personal details.

No.	General information	Remark
1.1	Current grade level	
	☐ Grade 7	
	☐ Grade 8	
	☐ Grade 9	
	☐ Grade 10	
	☐ Grade 11	
	☐ Grade 12	
1.2	Study program	
	☐ Science-Mathematics (Thai program)	
	☐ Science-Mathematics (English program)	
	☐ Arts-language	
	☐ Arts-Mathematics	
	☐ Arts-Music	
	☐ Arts-Business (English program)	
1.3	Sex	
	☐ Male	
	☐ Female	

Part 2: Questions regarding the development of digital intelligence (64 items)

Instruction: Please answer the question by marking ✓ as true, using the following scoring criteria:

Level 4: The respondent has the highest degree of personality, character, and behavior in this matter.

Level 3: The respondent has a high degree of personality, character, and behavior in this matter.

Level 2: The respondent has a low degree of personality, character, and behavior in this matter.

Level 1: The respondent has the lowest degree of personality, character, and behavior in this matter.

No.	Questions regarding entrepreneurial intelligence (EI)	Assessment level of entrepreneurial intelligence (EI)				
		The highest	High	Low	The lowest	Remark
		4	3	2	1	
•	**Factor 1: Leadership (y2001): I-C**					
1	You have a personality and behavior that demonstrate integrity in your daily life.					
2	You have a personality and behavior that show good decision-making in your daily life.					
3	You have a personality and behavior that demonstrate resoluteness in your daily life.					
4	You have a personality and behavior that show self-encouragement in your daily life.					

No.	Questions regarding entrepreneurial intelligence (EI)	Assessment level of entrepreneurial intelligence (EI)				
		The highest	High	Low	The lowest	Remark
		4	3	2	1	
•	**Factor 2: Planning skill (y2002): I-C**					
5	You have a personality and behavior that show goal-oriented focus in your daily life.					
6	You have a personality and behavior that show flexibility in your daily life.					
7	You have a personality and behavior that show efficiency in completing various tasks in your daily life.					
8	You have a personality and behavior that show forecasting abilities in your daily life.					
•	**Factor 3: Proactive skill (y2003): I-C**					
9	You have a personality and behavior that show perseverance in your daily life, never abandoning work.					
10	You have a personality and behavior that inspire others in your daily life.					
11	You have a personality and behavior that show collaborative skills in your daily life.					
12	You have a personality and behavior that demonstrate strategic thinking in your daily life.					

No.	Questions regarding entrepreneurial intelligence (EI)	Assessment level of entrepreneurial intelligence (EI)				
		The highest	High	Low	The lowest	Remark
		4	3	2	1	
•	**Factor 4: Analytical thinking (y2004): I-C**					
13	You have a personality and behavior that show reasonableness in your daily life.					
14	You have a personality and behavior that show systematic thinking in your daily life.					
15	You have a personality and behavior that show data analysis skills in your daily life.					
16	You have a personality and behavior that show concentration in your daily life.					
•	**Factor 5: Self-behavioral regulation (y2005): I-PU**					
17	You have a personality and behavior that show a focus on tasks in your daily life.					
18	You have a personality and behavior that show patience in your daily life.					
19	You have a personality and behavior that show consistency in your daily life.					
20	You have a personality and behavior that show persistence in your daily life.					

No.	Questions regarding entrepreneurial intelligence (EI)	Assessment level of entrepreneurial intelligence (EI)				
		The highest	High	Low	The lowest	Remark
		4	3	2	1	
•	**Factor 6: Risk reduction (y2006): I-PU**					
21	You have a personality and behavior that show financial skills in your daily life.					
22	You have a personality and behavior that show business ideas in your daily life.					
23	You have a personality and behavior that show marketing knowledge in your daily life.					
24	You have a personality and behavior that show the ability to work under pressure in your daily life.					
•	**Factor 7: Punctuality (y2007): I-PU**					
25	You have a personality and behavior that show preparative skills in your daily life.					
26	You have a personality and behavior that show scheduling in your daily life.					
27	You have a personality and behavior that show the ability to meet deadlines in your daily life, clearly setting time frames for completing work.					
28	You have a personality and behavior that show good time management in your daily life.					

No.	Questions regarding entrepreneurial intelligence (EI)	Assessment level of entrepreneurial intelligence (EI)				
		The highest	High	Low	The lowest	Remark
		4	3	2	1	
•	**Factor 8: Organizational skill (y2008): I-PU**					
29	You have a personality and behavior that show concision in your daily life, producing concise work without flattery.					
30	You have a personality and behavior that show policy enforcement in your daily life, operating according to carefully laid policies.					
31	You have a personality and behavior that show prioritizing tasks effectively in your daily life.					
32	You have a personality and behavior that show workflow analysis in your daily life, analyzing and working according to established steps.					
•	**Factor 9: Creativity (y2009): I-E**					
33	You have a personality and behavior that show positive attitudes towards others in your daily life.					
34	You have a personality and behavior that show being passionate about work in your daily life.					
35	You have a personality and behavior that show curiosity in your daily life.					

No.	Questions regarding entrepreneurial intelligence (EI)	Assessment level of entrepreneurial intelligence (EI)				
		The highest	High	Low	The lowest	Remark
		4	3	2	1	
36	You have a personality and behavior that show self-motivation in your daily life.					
•	**Factor 10: Innovativeness (y2010): I-E**					
37	You have a personality and behavior that show thinking outside the box in your daily life, avoid repetitive thinking patterns.					
38	You have a personality and behavior that show adaptation in your daily life, being able to apply your surroundings to benefit yourself.					
39	You have a personality and behavior that show an opportunity-focused mindset in your daily life, always setting and aiming for future opportunities.					
40	You have a personality and behavior that show an experimental approach in your daily life, performing various tasks seriously and clearly.					
•	**Factor 11: Visionary (y2011): I-E**					
41	You have a personality and behavior that show open-mindedness in your daily life, being accepting of different opinions and always staying up-to-date.					

No.	Questions regarding entrepreneurial intelligence (EI)	Assessment level of entrepreneurial intelligence (EI)				
		The highest	High	Low	The lowest	Remark
		4	3	2	1	
42	You have a personality and behavior that show synthesis in your daily life, being able to synthesize and connect things in the big picture.					
43	You have a personality and behavior that show analytical skills in your daily life, being able to analyze and classify things.					
44	You have a personality and behavior that show a future-oriented mindset in your daily life, always looking for opportunities to thrive in the future.					
•	**Factor 12: Risk-taking (y2012): I-E**					
45	You have a personality and behavior that show self-confidence in your daily life.					
46	You have a personality and behavior that show embracing failure in your daily life, not being afraid of making mistakes and accepting failures.					
47	You have a personality and behavior that believe in possibility in your daily life, seeing every situation as an opportunity and always believing in the possibility of survival.					
48	You have a personality and behavior that show fearlessness in your daily life, not fearing problems and obstacles.					

No.	Questions regarding entrepreneurial intelligence (EI)	Assessment level of entrepreneurial intelligence (EI)				
		The highest	High	Low	The lowest	Remark
		4	3	2	1	
•	**Factor 13: Interpersonal (y2013): I-PR**					
49	You have a personality and behavior that show active listening in your daily life.					
50	You have a personality and behavior that show conflict management in your daily life.					
51	You have a personality and behavior that show a sense of humor in your daily life.					
52	You have a personality and behavior that show respectfulness for others in your daily life.					
•	**Factor 14: Emotional regulation (y2014): I-PR**					
53	You have a personality and behavior that show humility in your daily life, being humble and not arrogant.					
54	You have a personality and behavior that show empathy in your daily life.					
55	You have a personality and behavior that show being courteous in your daily life, being polite and knowing the appropriate times.					
56	You have a personality and behavior that show kindness in your daily life.					

No.	Questions regarding entrepreneurial intelligence (EI)	Assessment level of entrepreneurial intelligence (EI)				
		The highest	High	Low	The lowest	Remark
		4	3	2	1	
•	**Factor 15: Communicational skill (y2015): I-PR**					
57	You have a personality and behavior that show negotiation skills in your daily life.					
58	You have a personality and behavior that show persuasion in your daily life.					
59	You have a personality and behavior that show the ability to influence others in your daily life, with your actions always affecting those around you.					
60	You have a personality and behavior that show cleared goals in your daily life.					
•	**Factor 16: Team building (y2016): I-PR**					
61	You have a personality and behavior that show sincerity in your daily life.					
62	You have a personality and behavior that show a common goal in your daily life, being able to clearly explain shared goals to others.					
63	You have a personality and behavior that show acceptance of provided feedback in your daily life, always listening to and accepting feedback from others.					

No.	Questions regarding entrepreneurial intelligence (EI)	Assessment level of entrepreneurial intelligence (EI)				
		The highest	High	Low	The lowest	Remark
		4	3	2	1	
64	You have a personality and behavior that show a defined role in your daily life, clearly defining and determining various roles at work without ambiguity.					

Part 3: Additional suggestions

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APPENDIX H

Questionnaire Scope-3

The Survey of Developing for Digital Entrepreneurial Intelligence (DEI)

Using Whole Brain Literacy (WBL) in Secondary Students

Research Questionnaire

"The Development of Digital Entrepreneurial Intelligence (DEI)"

Among Secondary Students

Montfort College Secondary Section, Chiang Mai

(English Version – Scope 3 / Part 1: Y / Code: RQ#S03P01Y-Q)

Instruction

1. This questionnaire is developed to gather information for the dissertation on the "Development of Digital Entrepreneurial Intelligence (DEI)" among secondary students at Montfort College Secondary Section, Chiang Mai. The research is conducted on collaboration with the International College, Department of Digital Innovation and Financial Technology at Chiang Mai University, where faculty members serve as consultants.
2. The researcher kindly requests your cooperation in providing truthful responses to all questions, as each piece of information is crucial for this research. All data collected through this questionnaire will be treated as confidential and will solely be used for research purposes related to the dissertation. Respondents are not required to specify their first and last names and/or addresses.
3. This research study is for educational and research purposes only. The researcher has no commercial objectives.
4. The questionnaire is divided into four sections across five pages:
   4.1 Part 1: General information about the respondents (Three items)
   4.2 Part 2: Questions regarding the development of DEI (64 items)
   4.3 Part 3: Questions regarding hobbies (One item)
   4.4 Part 4: Additional suggestions

Should you have any queries about this questionnaire, please direct them to the staff member who distributed it to you. Once you have completed answering all questions, kindly return the questionnaire to the designated official.

We sincerely appreciate your cooperation in responding to this questionnaire.

Warinthrone Vasuwat
Doctoral student at International College
Department of Digital Innovation and Financial Technology
Chiang Mai University

Part 1: General information of the respondents (3 items)

Instruction: Please provide truthful information in the following set of questions regarding your personal details.

No.	General information	Remark
1.1	Current grade level	
	☐ Grade 7	
	☐ Grade 8	
	☐ Grade 9	
	☐ Grade 10	
	☐ Grade 11	
	☐ Grade 12	
1.2	Study program	
	☐ Science-Mathematics (Thai program)	
	☐ Science-Mathematics (English program)	
	☐ Arts-language	
	☐ Arts-Mathematics	
	☐ Arts-Music	
	☐ Arts-Business (English program)	
1.3	Sex	
	☐ Male	
	☐ Female	

Part 2: Questions regarding the development of Digital Entrepreneurial Intelligence – DEI (36 items)

Instruction: Please answer the question by marking ✓ as true, using the following scoring criteria:

Level 4: The respondent has the highest knowledge, abilities, and skills in this area.

Level 3: The respondent has high knowledge, abilities, and skills in this area.

Level 2: The respondent has low knowledge, abilities, and skills in this area.

Level 1: The respondent has the least knowledge, abilities, and skills in this area.

No.	List of questions regarding digital entrepreneurial intelligence (DEI)	Assessment level of DEI				
		The highest	High	Low	The lowest	Remark
		4	3	2	1	
•	**Factor 1: Digital Entrepreneurship (8 aspects)** **You have the ability and can apply**					
1	Big data (I-C): Y101					
2	FinTech (I-C): Y102					
3	Block chain (I-PU): Y103					
4	Digital business laws (I-PU): Y104					
5	Internet of Thing (I-E): Y105					
6	Creative social media (I-E): Y106					
7	Artificial intelligence (I-PR): Y107					
8	Cloud computing (I-PR): Y108					
•	**Factor 2: Entrepreneurship (4 aspects)** **You have the ability and can apply**					
9	Business idea & operation (I-E): Y201					
10	Marketing plan (I-PR): Y202					
11	Financial plan (I-C): Y203					
12	Business project (I-PU): Y204					

No.	List of questions regarding digital entrepreneurial intelligence (DEI)	Assessment level of DEI				
		The highest	High	Low	The lowest	Remark
		4	3	2	1	
•	**Factor 3: Digital Intelligence (8 aspects)** **You have the ability and can apply**					
13	Digital identity (I-E): Y301					
14	Digital use (I-E): Y302					
15	Digital safety (I-PU): Y303					
16	Digital security (I-PU): Y304					
17	Digital emotional intelligence (I-PR): Y305					
18	Digital communication (I-PR): Y306					
19	Digital literacy (I-C): Y307					
20	Digital rights (I-C): Y308					
•	**Factor 4: Entrepreneurial Intelligence (16 aspects)** **You have the ability and can apply**					
21	Leadership (I-C): Y401					
22	Planning skill (I-C): Y402					
23	Perseverance (I-C): Y403					
24	Analytical thinking (I-C): Y404					
25	Self-behavioral regulation (I-PU): Y405					
26	Risk-reduction (I-PU): Y406					
27	Work under pressure (I-PU): Y407					
28	Time management (I-PU): Y408					
29	Creativity (I-E): Y409					
30	Innovativeness (I-E): Y410					
31	Visionary (I-E): Y411					
32	Passionate (I-E): Y412					
33	Interpersonal (I-PR): Y413					
34	Emotional regulation (I-PR): Y414					

No.	List of questions regarding digital entrepreneurial intelligence (DEI)	Assessment level of DEI				
		The highest	High	Low	The lowest	Remark
		4	3	2	1	
35	Communication skill (I-PR): Y415					
36	Team building (I-PR): Y416					

Part 3: Questions regarding the respondents' leisure activities/hobbies

Instruction: Please provide truthful information in the following set of questions.

No,	Questions	Remark
1	Hobbies/leisure activities: (Z1)	
	☐ Sports	
	☐ Music	
	☐ Art	
	☐ Technology	
	☐ Others (please specify)...	
	☐ None	

Part 4: Additional suggestions

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APPENDIX I

International Conference Paper

The original Article was published in

AU Virtual International Conference 2020

Entrepreneurship and Sustainability in Digital Era

Assumption University

30th October 2020

Title

THE DEVELOPMENT OF HIGHER SECONDARY BUSINESS SKILLS LEARNING MODEL USING WHOLE BRAIN LITERACY (WBL) AMONG TENTH GRADE STUDENTS MONTFORT COLLEGE SECONDARY SECTION, THAILAND

Warinthrone Vasuwat[1*] , Nopasit Chakpitak[2]

Tanarat Rattanadamrongaksorn[3] and Piyachat Udomwong[4]

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Cited

http://www.assumptionjournal.au.edu/index.php/icesde/article/view/4950/3040

THE DEVELOPMENT OF HIGHER SECONDARY BUSINESS SKILLS LEARNING MODEL USING WHOLE BRAIN LITERACY (WBL) AMONG TENTH GRADE STUDENTS MONTFORT COLLEGE SECONDARY SECTION, THAILAND

Warinthrone Vasuwat[1*], Nopasit Chakpitak[2]
Tanarat Rattanadamrongaksorn[3] and Piyachat Udomwong[4]

[1-4]*International College of Digital Innovation and Financial Technology, Chiang Mai University, 239 Nimmanhaemin Road, Suthep,Muang,Chiang Mai, 50200 Thailand*
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Abstract

This research aim to study, analyze and develop business skills learning model in Grade 10, Montfort College Secondary Section: Chiang Mai, Thailand. The proposed method was to analyze characteristics and develop business skills learning model based on needs of higher secondary students - parents and those who succeed in the business field in Thailand. The proposed method was developed by employing Whole Brain Literacy (WBL) theory. Then, collected data were analyzed to determine characteristics of subject groups and required skills to be developed. The Finding from this study revealed that significant factors used for developing business skills learning model is accord with the most required skills for subject are creative and adaptive skills which mean and S.D. values were 36.63 and 5.51, respectively. The least required skills for subject are team building and communication skills which mean and S.D. values were 19.70 and 6.73, respectively.

Keywords: Whole Brain Literacy, Business Skills Learning Model, Brain Map, Brain Based Learning.

Introduction

Rapid development of technology and innovation has resulted in social revolution, changes in economic structure, people's learning styles both inside and outside the classroom, as well as decision on future careers. Nowadays (2020), the global society is passing 4G: Information Society into 5G era (society 5.0): Super Smart Society. OECD (2018) is predicted that in 2030, learning styles in schools and attitudes towards occupation around the world will be completely changed. New subjects will be added to study programs in many schools and universities (UNESCO, 2017). Also, weird, new, and unpredictable jobs will be created. Most students are likely to be self-employed, start a start-up business, and do an online marketing or e-commerce. They will prefer not to apply for a routine work. Additionally, relevant studies revealed that the number of students who can earn money by themselves while studying at secondary school and university has been increasing (UKCES, 2014).

This study aims to develop business skill learning model for tenth grade based on Whole Brain Literacy (WBL) theory. The study is conducted on tenth grade students in Montfort College: Secondary Section, Thailand. The study was designed in order to find significant factors used for developing business skills learning model. The study included the needs of developing learning styles and business skills according to students and parents' needs and future trends.

Literature Review

Tayko and Talmo (2010) presented WBL as a tool for leaders, managers, executives, and supervisors to manage their thoughts, feelings, tasks and time in order to be more creative and productive for their sustainable system. The four-brain model, referred to as the thinking styles of brain functioning, can be analyzed as I-control (I-C): thinking about certainty and stability, I-explore (I-E): thinking about ingenuity and creativity, I-pursue (I-PU): thinking about results and productivity and I-preserve (I-PR): thinking about relations and integration.

Whole Brain Literacy (WBL) helps to manage thinking, feeling, and other things in life for better, more creative and productive (Tayko, et al., 2017)

Lynch (1986) explained Whole Brain Literacy (WBL) is a modern educational philosophy that analyzes cognitive process, response, and human learning resulted from brain functions in 4 lobes for the human development to understand oneself, others,

CONFERENCE PROCEEDINGS

AU VIRTUAL INTERNATIONAL CONFERENCE 2020

ENTREPRENEURSHIP AND SUSTAINABILITY IN THE DIGITAL ERA

AUTHOR
Graduate School of Business – Assumption University of Thailand

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Certificate of Participation

THIS IS TO CERTIFY THAT

WARINTHRONE VASUWAT

has participated and presented an acadmic research paper titled

"The Development of Higher Secondary Business Skills Learning Model Using Whole Brain Literacy (wbl) Among Tenth Grade Students Montfort College Secondary Section, Thailand"

at the AU Virtual International Conference 2020 on
Enterpreneurship and Sustainability in the Digital Era
held on the 30, October 2020
at Assumption University of Thailand

K. Phothikitti

Asst. Prof. Dr. Kitti Phothikitti
Dean, Graduate Studies
Dean, Graduate School of Business
Assumption University of Thailand

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presented to

WARINTHRONE VASUWAT

for the research paper titled

"The Development of Higher Secondary Business Skills Learning Model Using Whole Brain Literacy (wbl) Among Tenth Grade Students Montfort College Secondary Section, Thailand"

at the AU Virtual International Conference 2020 on Enterpreneurship and Sustainability in the Digital Era held on the 30, October 2020 at Assumption University of Thailand

K. Phothikitti

Asst. Prof. Dr. Kitti Phothikitti
Dean, Graduate Studies
Dean, Graduate School of Business
Assumption University of Thailand

APPENDIX J

International Journal Published Paper – 1

The original Article was published in

Academy of Entrepreneurship Journal

(AEJ – SCOPUS Q3)

Volume 27, Special Issue 5, 2021

Title

THE EFFECTS OF DIGITAL LITERACY ON ENTREPRENEURIAL LEARNING AMONG THAI SECONDARY STUDENTS

Warinthrone Vasuwat, Chiang Mai University

Nopasit Chakpitak, Chiang Mai University

Tanarat Rattanadamrongaksorn, Chiang Mai University

Piyachat Udomwong, Chiang Mai University

Cited

https://www.abacademies.org/articles/the-impact-of-entrepreneurial-learning-competency-using-leadership-enhancing-activities-among-thai-students.pdf

THE IMPACT OF ENTREPRENEURIAL LEARNING COMPETENCY USING LEADERSHIP ENHANCING ACTIVITIES AMONG THAI STUDENTS

Warinthrone Vasuwat, Chiang Mai University
Nopasit Chakpitak, Chiang Mai University
Tanarat Rattanadamrongaksorn, Chiang Mai University
Piyachat Udomwong, Chiang Mai University

ABSTRACT

The objectives of this research are aimed to study the relationship between leadership skills affecting entrepreneurial learning competency through Leadership Enhancing Activities (LEA) process in students in secondary school. The population in this study included 100 tenth grade students, which were divided into a control group and an experimental group, 50 students each. The instruments used for data collection were classified and based on two aspects: A leadership aspect considering four aspects including speaking communication, proactive, teambuilding, and self-confidence, in which the data were collected by a four-point Likert's Scale questionnaire developed from related studies, and Entrepreneurial learning competency aspect considering six aspects including the entrepreneur, business management, starting a business, business operations, marketing and sales, and financial management, in which the data were collected from Entrepreneurship and Small Business (ESB) Test. The finding of the study revealed that the mean of leadership in the experimental group increased by 43.43 % and the percentage of entrepreneurial learning competency increased by 32.39 % after the experiment, respectively. Thus, the result confirmed that LEA had a significant impact on entrepreneurial learning competency among secondary students and LEA is recommended for entrepreneurial learning in secondary school.

Keywords: Leadership Skill, Entrepreneurial Learning Competency, Communication, Proactive, Teambuilding, Self-Confidence

INTRODUCTION

Nowadays, there has been a rapid change in secondary learning system followed by the 21st learning dimension and social 5.0 era, where not only is general knowledge in class emphasized, but activity and skill development and enhancement corresponding to future career is also highlighted. According to issues and trends in education for sustainable development, Agenda 21 to Target 4.7 (Alexander et al., 2018) stated that Sustainable Development Goals: SDG4 (Quality Education) had aimed to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. In 2030, SDG4 will be related to 8 out of 17 targets (UNESCO, 2016) which will achieve direct link among such areas as economic vitality, entrepreneurship, job market skill, and level of education.

Moreover, OECD (2018) suggested the key transformative competency to be prepared for creating a new value of education in 2030 as stated that, "People should be able to think creatively, develop new products and services, new jobs, new processes and methods, new ways of thinking and living, new enterprises, new sectors, new business models and new social models".

Also, Incheon Declaration and SDG4 – Education 2030 Framework for Action, (UNESCO, 2015) has focused on global education framework in 2030 which is referred to

Academy of Entrepreneurship Journal (Print ISSN: 1087-9595; Online ISSN: 1528-2686)

Abstract

The Impact of Entrepreneurial Learning Competency Using Leadership Enhancing Activities among Thai Students

Author(s): Warinthrone Vasuwat, Nopasit Chakpitak, Tanarat Rattanadamrongaksorn, Piyachat Udomwong

The objectives of this research are aimed to study the relationship between leadership skills affecting entrepreneurial learning competency through Leadership Enhancing Activities (LEA) process in students in secondary school. The population in this study included 100 tenth grade students, which were divided into a control group and an experimental group, 50 students each. The instruments used for data collection were classified and based on two aspects: A leadership aspect considering four aspects including speaking communication, proactive, teambuilding, and self-confidence, in which the data were collected by a four-point Likert's Scale questionnaire developed from related studies, and Entrepreneurial learning competency aspect considering six aspects including the entrepreneur, business management, starting a business, business operations, marketing and sales, and financial management, in which the data were collected from Entrepreneurship and Small Business (ESB) Test. The finding of the study revealed that the mean of leadership in the experimental group increased by 43.43 % and the percentage of entrepreneurial learning competency increased by 32.39 % after the experiment, respectively. Thus, the result confirmed that LEA had a significant impact on entrepreneurial learning competency among secondary students and LEA is recommended for entrepreneurial learning in secondary school.

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Letter of Acceptance

9 June 2021

Dear Warinthrone Vasuwat, Chiang Mai University, Thailand

Your manuscript entitled: ***"THE IMPACT OF ENTREPRENEURIAL LEARNING COMPETENCY USING LEADERSHIP ENHANCING ACTIVITIES AMONG THAI STUDENTS"*** has been selected for publication in: Academy of Entrepreneurship Journal (Print ISSN: 1087-9595; Online ISSN: 1528-2686) (Volume 25, Special Issue 5) In order for your manuscript to be published, you must accomplish thefollowing:

1) You need to resubmit the final formatted version of your article before **June 16, 2021** upon which we'll be sending you the Galley proof.

2) Once you receive the Galley Proof from our end and along with your revision, you have to send us the article back with-in 48 hours. Please note that the revisions are only allowed in case you find any grammatical, punctuation, sentence formation errors. Revisions towards altering the methods, figures, facts, and data from tables aren't allowed. Any breach of the later point may enforce rejection of the said article.

3) As a small change towards payment, there are no membership fees applicable. However, you need to pay the amount raised and sent as an attachment with this e-mail towards article processing charges. In order to know the details regarding payment, please visit the author's guidelines of anyjournal.

4) Each author must read and agree to the terms mentioned above to publish their articles.

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If you have any questions about the publication process, please email the Publisher. If you have any questions about the membership, new deals, new projects, article related issues, please email the Executive Director. We look forward to receiving your materials and we congratulate you on your work!

Sincerely,

Professor Dr.Kittisak Jermsittiparsert

Guest Editor

APPENDIX K

International Journal Published Paper – 2

The original Article was published in

Journal of Management Information and Decision Sciences

(JMIDS – SCOPUS Q2)

Volume 25, Special Issue 2, 2022

Title

THE EFFECTS OF DIGITAL LITERACY ON ENTREPRENEURIAL LEARNING AMONG THAI SECONDARY STUDENTS

Warinthrone Vasuwat, Chiang Mai University

Nopasit Chakpitak, Chiang Mai University

Tanarat Rattanadamrongaksorn, Chiang Mai University

Piyachat Udomwong, Chiang Mai University

Cited

https://www.abacademies.org/articles/the-effcts-of-digital-literacy-on-entrepreneurial-learning-among-thai-secondary-students.pdf

THE EFFECTS OF DIGITAL LITERACY ON ENTREPRENEURIAL LEARNING AMONG THAI SECONDARY STUDENTS

Warinthrone Vasuwat, Chiang Mai University
Nopasit Chakpitak, Chiang Mai University
Tanarat Rattanadamrongaksorn, Chiang Mai University
Piyachat Udomwong, Chiang Mai University

ABSTRACT

The aim of this research was to examine the relationship between digital literacy affecting entrepreneurial learning among Thai secondary students. The population in this study included 322 people. The instrument used for data collection were 1) the instrument measuring digital literacy of the population consisting of nine factors: digital right, digital access, digital communication, digital safety, media and information literacy, digital etiquette, digital health, digital commerce, and digital law; and 2) the instrument for measuring entrepreneurial learning consisting of six aspects: the entrepreneur, business management, starting a business, business operations, marketing and sales, and financial management. According to the study, it was revealed that the three factors of digital literacy - media and information literacy, digital safety, and digital law - statistically significantly affected and positively influenced entrepreneurial learning (The significant level < 0.05). Moreover, the variations that affected entrepreneurial learning of the study population can be explained for 72%. Thus the study confirmed that digital literacy effected to entrepreneurial learning among Thai secondary students.

Keywords: Digital Literacy, Digital Learning, Digital Curriculum, Entrepreneurial Learning, Entrepreneurial Competency

INTRODUCTION

Digital skills or digital literacy is an important indicator used for evaluating and verifying the development standards of an organization at the international and national level. Currently, both for-profit and non-profit organizations have initiated the development and implementation of digital literacy framework to support being citizens in the 21st century or digital citizenship.

The UNESCO's Annual World Report 2009, *Information Society Policies* (UNESCO, 2009), highlighted the major challenge policy makers are experiencing: the widening of the digital divide or the lack of improvement in the area of digital literacy in developing countries. In a large number of developing countries, digital literacy has become a national priority.

In addition, in 2015, United Nations Educational, Scientific and Cultural Organization (UNESCO-UN) established the Sustainable Development Goals (SDGs) for the total of 17 goals. Digital literacy is also considered as a sub-goal, which is stated in the goal 4.4.2 declaring that digital literacy is one of the important skills leading a country to be sustainable, create prospective jobs, and brings about business competency (UNESCO, 2015).

The researchers have gathered the importance of digital literacy from various national and international organizations where a competency framework or digital literacy curriculum is developed for their organization's development, which were described as follows.

Citation Information: Vasuwat, W., Chakpitak, N., Rattanadamrongaksorn, T., & Udomwong, P. (2022). The effects of digital literacy on entrepreneurial learning among thai secondary students. *Journal of Management Information and Decision Sciences, 25*(S2), 1-10.

Journal of Management Information and Decision Sciences (Print ISSN: 1524-7252; Online ISSN: 1532-5806)

Abstract

The Effects of Digital Literacy on Entrepreneurial Learning among Thai Secondary Students

Author(s): Warinthrone Vasuwat, Nopasit Chakpitak, Tanarat Rattanadamrongaksorn, Piyachat Udomwong

The aim of this research was to examine the relationship between digital literacy affecting entrepreneurial learning among Thai secondary students. The population in this study included 322 people. The instrument used for data collection were 1) the instrument measuring digital literacy of the population consisting of nine factors: digital right, digital access, digital communication, digital safety, media and information literacy, digital etiquette, digital health, digital commerce, and digital law; and 2) the instrument for measuring entrepreneurial learning consisting of six aspects: the entrepreneur, business management, starting a business, business operations, marketing and sales, and financial management. According to the study, it was revealed that the three factors of digital literacy - media and information literacy, digital safety, and digital law - statistically significantly affected and positively influenced entrepreneurial learning (The significant level < 0.05). Moreover, the variations that affected entrepreneurial learning of the study population can be explained for 72%. Thus the study confirmed that digital literacy effected to entrepreneurial learning among Thai secondary students.

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Letter of Acceptance

9 September 2021

Dear Warinthrone Vasuwat, Chiang Mai University, Thailand

Your manuscript entitled: ***"THE EFFCTS OF DIGITAL LITERACY ON ENTREPRENEURIAL LEARNING AMONG THAI SECONDARY STUDENTS"*** has been selected for publication in: Journal of Management Information and Decision Sciences (Print ISSN: 1524-7252; Online ISSN: 1532-5806) (Volume 24, Special Issue 2) In order for your manuscript to be published, you must accomplish thefollowing:

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2) Once you receive the Galley Proof from our end and along with your revision, you have to send us the article back with-in 48 hours. Please note that the revisions are only allowed in case you find any grammatical, punctuation, sentence formation errors. Revisions towards altering the methods, figures, facts, and data from tables aren't allowed. Any breach of the later point may enforce rejection of the said article.
3) As a small change towards payment, there are no membership fees applicable. However, you need to pay the amount raised and sent as an attachment with this e-mail towards article processing charges. In order to know the details regarding payment, please visit the author's guidelines of anyjournal.
4) Each author must read and agree to the terms mentioned above to publish their articles.

If you have any questions about the publication process, please email the Publisher. If you have any questions about the membership, new deals, new projects, article related issues, please email the Executive Director. We look forward to receiving your materials and we congratulate you on your work!

Sincerely,

Professor Dr.Kittisak Jermsittiparsert

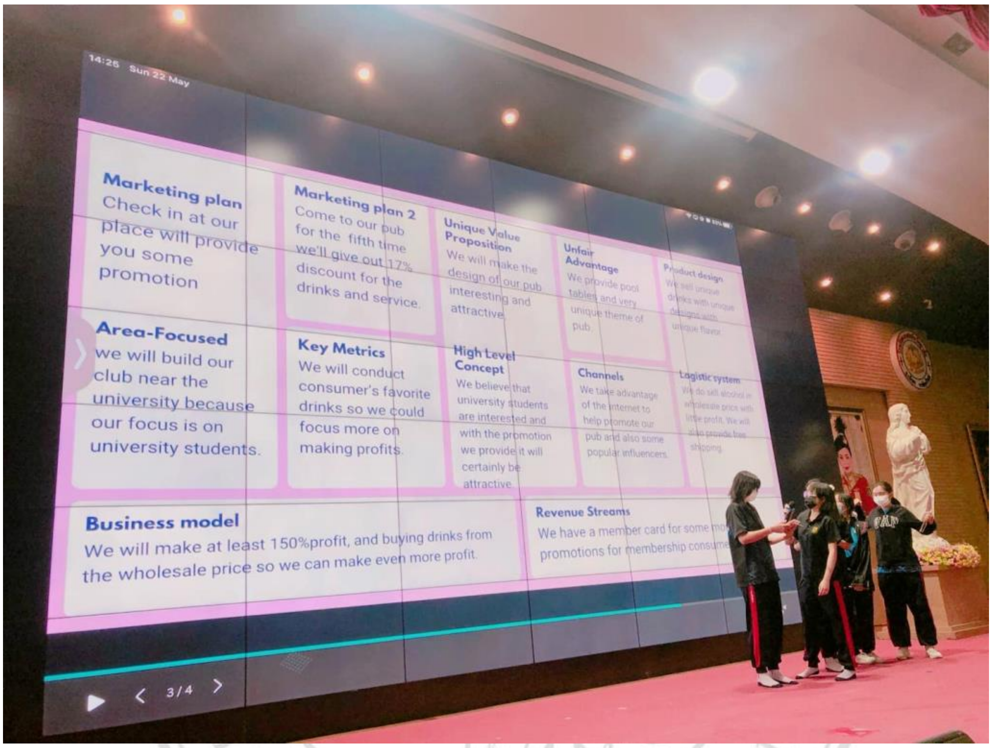
Guest Editor

APPENDIX L

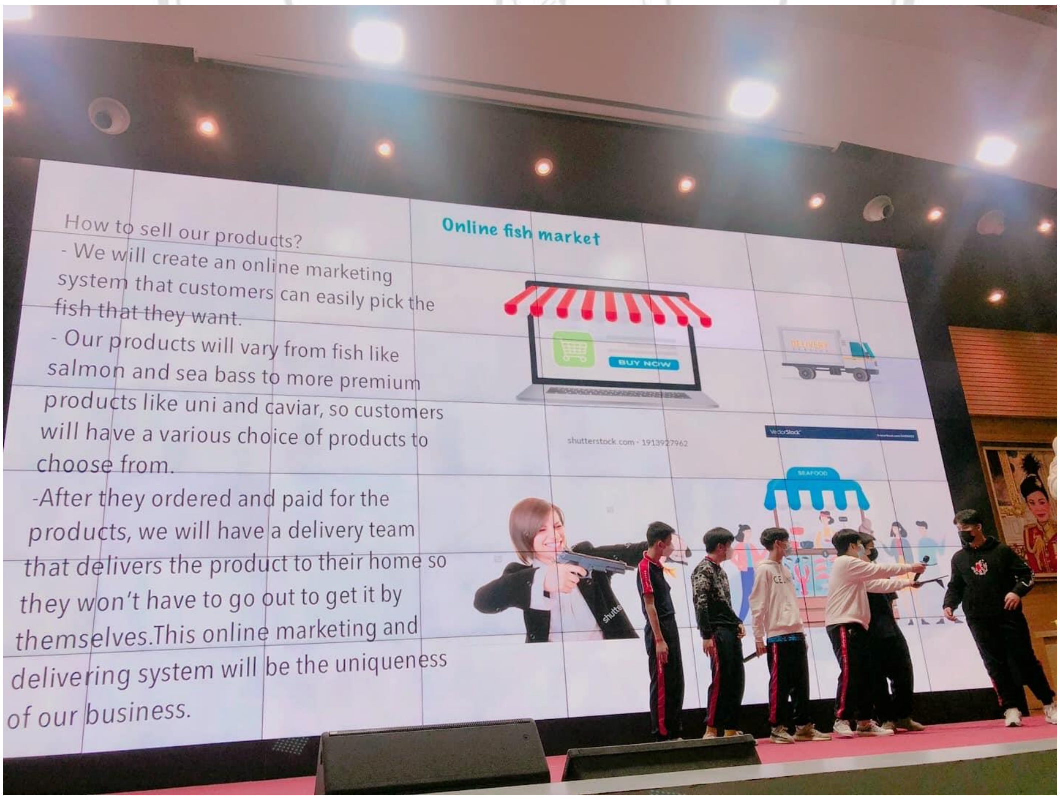
DEI – WBL Prototype Activity in Experimental Research

Appendix L 1.1 Experimental Research using DEI-WBL Prototype: I-E Period Week 1 – 9: 43 Hours – The development of Creativity and Imagination with Business Idea and Operation, creative social media, 3D Printing, IoT, AI and VR etc.

Appendix L 1.2 Experimental Research using DEI-WBL Prototype: I-PR Period Week 10 – 12: 18 Hours – The development of Emotional and Social Dimension with Marketing plan, Online survey, Digital content design and Cloud computing etc.



Appendix L 1.3 Experimental Research using DEI-WBL Prototype: I-C Period Week 13 – 17: 24 Hours – The development of Analytical and Logical Thinking with Financial plan, Big Data and FinTech etc.



Appendix L 1.4 Experimental Research using DEI-WBL Prototype: I-PU Period Week 18 – 20: 15 Hours – The development of Movement and Self-Control with Business Project, Block Chain and Digital Business Laws etc.


โครงการยกระดับมาตรฐานผลผลิตและผลิตภัณฑ์สมุนไพรเพื่อขับเคลื่อนเศรษฐกิจ
และสังคมฐานรากหลังโควิดด้วยเศรษฐกิจ BCG ตำบลบ่อเหล็กลอง อำเภอลอง จังหวัดแพร่
BORLEKLONG


ะผลิตภัณฑ์สมุนไพรเพื่อขับเคลื่อนเศรษฐกิจ
BCG ตำบลบ่อเหล็กลอง อำเภอลอง จังหวัดแพร่
ฐานรากหลังโควิดด้วยเศรษฐกิจ BCG (U2T ระยะที่ 2)
พ.ศ. 2565
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Appendix L 1.5 Experimental Research using DEI-WBL Prototype: Extra Activity 1 Week 1 – 11: 11 Hours – Business Trip, Business Internship etc.

Appendix L 1.6 Experimental Research using DEI-WBL Prototype: Extra Activity 2 Week 12 – 20: 9 Hours – Leadership, Proactive skill etc.

CURRICULUM VITAE

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2024: Doctor of Philosophy in Digital Innovation and Financial Technology, Chiang Mai University, Chiang Mai, Thailand
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Experience
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- School Board of the Director (Montfort College Secondary Section)
- Assistant Head of Academic Affairs (English Program - Montfort College)
- Head of Montfort Junior Entrepreneur Track (M-JET) Center (Montfort College)