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Skills That Matter: Qualitative Study Focusing on the Transfer of Training Through the Experience of Thai Vocational Students

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Ensuring the transfer of training and preparing students to gain skills required for their specific professions are at the heart of vocational education and training (VET). Accordingly, school-work alignment is a key determinant in the transfer of training. Today, vocational graduates with mechatronics-based skillsets are highly sought-after. It is thereby crucial for VET to develop relevant pedagogies that can equip students with the skills they need to ensure the transfer of training. Literature has suggested that soft skills are increasingly important, yet rarely has there been research focusing on the lived experiences of vocational students in this field. This study aims to understand the important skills—both hard and soft skills—for vocational mechatronics and robotics students in Thailand through their own experiences, by exploring what skills they acquired from school that are significant to them, and what skills they need when they practise their jobs. The study employed qualitative methods, drawing from 40 semi-structured interviews with vocational mechatronics and robotics students, who are in their last year in dual vocational training programmes from two prominent technical schools in Thailand. Findings reveal that the most significant skills that students acquired from mechatronics and robotics programme were technical knowledge and skills, creative and innovative thinking, teamwork, and perseverance. The most important skills for their future work, interestingly, were all soft skills considered to be necessary when it comes to practical work, namely, language and communication, adaptability and interpersonal skills, willingness to learn, and innovative thinking. Our data also yielded an understanding of some relations across skillsets and the culturally specific meanings ascribed to certain skills and skillsets. This research not only identifies important skills for vocational mechatronics students, but also why those skills are perceived as important and how they are applied in practice. Vocational mechatronics and robotics curriculum should pay more attention to soft skills development to ensure adequate skills of students for their work settings. We recommended that VET across different cultural contexts should explore the meaning and values of skills requirements according to their respective cultural group to make suitable curriculums for their specific contexts.

Keywords: transfer of training, soft skills, qualitative research, vocational educational and training, cultural aspects, Thailand

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INTRODUCTION

Vocational education and training (VET) primarily aims to equip youth with practice-oriented knowledge and skills required for specific types of occupations (Eichhorst et al., 2015). VET students are expected to possess adequate relevant knowledge and skills for their future professions. Hence, prior research has emphasised that the transfer of training is particularly crucial for VET, because the effectiveness of vocational training depends on the extent to which students are able to subsequently transfer what they have learnt in VET to practical application in the workplace (Tonhäuser and Büker, 2016). In this respect, various studies have also highlighted that school-work alignment, the relevance of curriculums, the resemblance of training and contents in VET to real work situations, and the perceived utility of the vocational training, are key determinants that impact the transfer of training to the workplace (Hinrichs, 2014; Tonhäuser and Büker, 2016; Hiim, 2017; Renta Davids et al., 2017). Therefore, it is imperative for VET to design curriculum and cultivate learning that meets the current skill and competence demands of each specific occupation to ensure that learning can be transferable.

This study particularly focuses on vocational mechatronics and robotics programmes, given that automatic and robotic systems are key for the technological advancement of manufacturing in various industries (Shmatko and Volkova, 2020). Vocational graduates with mechatronics-based skillsets are highly sought-after by employers. It is thereby crucial for VET to ensure the transfer of training and prepare students to gain sufficient skills to meet the demand of their future careers. Achieving this goal relies heavily on an understanding of which skills mechatronics students require. More studies are needed to explore this area because it is highly evident that technical or hard skills are of paramount necessity for workers in these high-tech domains, which is why theoretical knowledge and specialised practical skills are typically emphasised in technical-oriented educational programmes (Balcar, 2016). Recently, however, a growing body of research has argued that focusing merely on technical skills is not enough, since labour today demands skillsets that range far beyond the knowledge and hard skills within their specialisation (Rukumnuaykit and Pholphirul, 2016; Shmatko and Volkova, 2020; Adams and Sawchuk, 2021). Soft skills, such as critical thinking, creativity, communication skills, adaptability, and the ability to work in teams, are also crucial for high-tech domain workers, both in terms of their professional success and for personal fulfilment (PwC EU Services, 2020; Cinque et al., 2021).

Nevertheless, we have little understanding of the extent to which soft skills are necessary and how those skills are applied in mechatronics and robotics work settings. Most extant research has either identified a list of skills for the twenty first century for students in general [e.g., World Economic Forum (2015) and European Commission (2018, 2019)] or examined important soft skills in high-tech domain workers across different positions, but not specifically among vocational workers in the mechatronics and robotics field (Leitão et al., 2020; Sakurada et al., 2021). Furthermore, when it comes to non-Western and developing countries, where the development of a high-technologically skilled workforce is becoming paramount to strategies of economic development, research into skills needed for vocational mechatronics students is even more scarce.

In the context of Thailand, which is a developing country situated in Southeast Asia, the mechatronics and robotic programme of the Thai VET has become essential to the procurement of the manpower necessary for Thailand 4.0's technology-driven economy ambitions (Chomsuwan et al., 2020). However, a thorough policy discourse analysis has indicated that there has been a shortage in vocationally skilled workers in Thailand despite various policies aiming to increase the number of skilled labour workforce have been implemented over the past few decades (Chalapati and Chalapati, 2020). Our study further emphasises that the quality of vocational workers is also an important concern, because even if the number of vocational students can be increased, the problem of a skilled workforce shortage is likely to remain if those students do not have adequate relevant skills and knowledge required to work in their occupations. Hence, this study argues that it is particularly crucial to gain a more in-depth understanding about what skills are important for vocational mechatronics students who will become the key workforce of the future economy, not only in Thailand, but also in many countries worldwide.

Therefore, the central aim of this research is to understand the important skills—both hard and soft skills, for vocational mechatronics and robotics students through their own experiences, by exploring what skills they perceive to be necessary when they actually practise the job and whether the skills acquired from school are aligned with their practical needs at work. Specifically, the objectives of this research are three-fold:

(1) To examine the major skills that vocational students have acquired from mechatronics and robotics curriculum
(2) To identify the most important skills for the twenty first century that are necessary for mechatronics and robotic students' careers
(3) To make recommendations on how VET mechatronics and robotics programmes can strengthen the transfer of training through school-work alignment

This research contributes to our understanding of the important skills for mechatronics students, while also examining why those skills are perceived as important and how they are applied in practice. Findings stemming from VET students own perception can help us to further identify how VET mechatronics and robotics curriculums can be better designed and centred around vocational students' needs. Furthermore, the study sheds light on how different cultures may attach different meanings and attribute value differently to various important skills. Findings derived from the Thai context can contribute to our understanding of other similar countries that are confronting the demands of technologically driven industrial development and the challenges they face in terms of cultivating skilled labour.

LITERATURE REVIEW

Hard Skills and Soft Skills

There are two distinct-yet-interrelated types of skills embedded in human capital that are key for the success of any given labour market, namely: hard skills and soft skills (Balcar, 2016). Hard skills, also known as technical skills (Shmatko and Volkova, 2020), refer to specific knowledge related to practical subjects based on scientific principles and capabilities to perform a particular job (Cimatti, 2016; PwC EU Services, 2020). Hard skills tend to be embodied in formal acquired qualifications and they are usually relatively easy to train for and measure (Balcar, 2016). For example, English grammar, accounting, programming, welding, robot operating systems, and the ability to regulate and control a machine, etc. (Balcar, 2016; Cimatti, 2016; Shmatko and Volkova, 2020).

In contrast, soft skills as a term can overlap or be used interchangeably with other similar concepts, such as non-technical skills, non-cognitive skills, socio-emotional skills, transversal competences, social competences, and life skills (Calero López and Rodríguez-López, 2020; Cinque et al., 2021). For example, Elfadil and Ibrahim (2022, p. 3) state that "soft skills are non-technical abilities that enable us to maintain self-control and have positive interactions with others." These types of skills are more related to individual patterns of behaviour, attitudes, traits, and personality that are not directly related to individuals' knowledge and not directly connected to a specific task (Cimatti, 2016). Therefore, soft skills are learnt behaviours based on individual's predispositions that can be acquired from psychological traits, preferences, experience, and background, which makes their development slower and more complex than hard skills (Balcar, 2016). For example, communication, teamwork, problem-solving, leadership, self-motivation, creativity, willingness to learn, emotional intelligence, social ethics skills, as well as the ability to work with people of different backgrounds (Balcar, 2016; Shmatko and Volkova, 2020).

Twenty First Century Skills

As mentioned in the earlier section that hard and soft skills can be intertwined. It has become increasingly apparent that developing either hard or soft skills is barely adequate to thrive in a rapidly changing and technology-driven world. Labour markets and employers of the twenty first century era require skills that encompass both hard and soft skills (Symonds et al., 2011; Van Kieu and Minh Tran, 2021). Hence, attempts have been made to identify what are considered to be important skills of the twenty first century that cover both hard and soft skills.

In this study, we reviewed the twenty first century skills from key international frameworks and Thai educational policy. These include: (1) the World Economic Forum (2015) report, which is a detailed analysis of the research literature to define the 16 most critical twenty first century skills; (2) the European Commission (2018, 2019) report on key competences for lifelong learning, which derive from the identification of common key competencies from various international frameworks; and (3) the Thai National Scheme of Education B.E. 2560–2579 (2017–2036), which addresses 3Rs and 8Cs as the twenty first century skills (Office of the Education Council, 2017). We then developed the twenty first century skillsets based on our literature review as the framework of the research, especially for interview questions design and data analysis. The list of twenty first century skills framework used in this research is illustrated in **Table 1**.

It can be seen from **Table 1** that different frameworks may have some skills that vary and overlap. It's worth noting that while some skills may not appear in a certain framework, this does not mean that the framework does not find those skills important at all. Yet some skills may not be distinctively highlighted in that framework when compared to others. Moreover, in some cases, one skill may combine a few different skills together.

In this study, we have attempted to accumulate twenty first century skills derived from credible sources to use as an analytical framework for this study. We identified 21 skills commonly needed for the twenty first century, covering both hard and soft skills. For instance, literacy, which is the ability to read and write, can be considered a "hard skill," as it has to do with concrete knowledge and the process of skills transfer is quite direct. However, communication and interpersonal skills are "soft skills," because these skills concern thoughtful reflection on how to respond to others, as well as the ability to appropriately and effectively convey messages to achieve certain purposes, involving traits, attitude, and behaviours that cannot be taught directly.

Additionally, it can be observed from **Table 1** that soft skills are a dominant feature of twenty first century skills. This is congruent with a growing number of studies which contend that soft skills have increasingly become more important for both future careers and life success (Heckman and Kautz, 2012; Cinque et al., 2021). Furthermore, the number of studies that underline the relevance of soft skills in vocational education has grown exponentially in the recent years, while the role of VET as a key vehicle for supporting the acquisition of soft skills for future workers has been given much attention (Calero López and Rodríguez-López, 2020; Khilji and Roberts, 2022). Hence, the focus on twenty first century skills, particularly soft skills, in this study can contribute to the reform and improvement of vocational curriculums, specifically in mechatronic and robotic programmes, to build capacity of future vocational workforces that meet labour market demands.

Skill Demands for Mechatronics and Robotics Workers

Hard skills usually take up the majority of required knowledge and skills listed for workers in high-tech domains due to the specialisation of those professions and the highly knowledge-intensive nature of high-tech industries (PwC EU Services, 2020). Recently, Leitão et al. (2020) have identified hard skills for machine automation professions that most impact a firm, such as programming, instrumentation and sensors, automated systems operation, design and system integration, modelling and simulation, and artificial intelligence (AI). According to Shmatko and Volkova (2020), knowledge and skills related

TABLE 1 | The twenty first century skills framework used in this study as compared to other key twenty first century skills frameworks.

Key twenty first century skills used as the framework of this study	World Economic Forum (2015)	European Commission (2019)	3Rs 8Cs (the Thai National Scheme of Education B.E. 2560–2579)
1. Literacy	Literacy	Literacy	Reading/writing
2. Numeracy	Numeracy	Mathematical	Arithmetic
3. Financial literacy	Financial literacy	Mathematical/Entrepreneurship	
4. Scientific literacy	Scientific literacy	Competence in science, technology and engineering	–
5. ICT and digital literacy	ICT literacy	Digital	Computing and ICT literacy/communication, information and media literacy
6. Cultural and civic literacy	Cultural and civic literacy	Citizenship	–
7. Communication (native language)	Communication	Literacy/personal, social and learning to learn	Communication, information and media literacy
8. Multilingual communication	–	Multilingual	–
9. Persistence, grit, resilience	Persistence/grit	Personal, social and learning to learn	–
10. Adaptability	Adaptability		–
11. Compassion and empathy	–		Compassion
12. Curiosity and eager to learn	Curiosity		Career and learning skills
13. Learning skills	–		
14. Entrepreneurship	–	Entrepreneur	
15. Creativity	Creativity		Creativity and innovation
16. Innovative thinking	Initiative		
17. Critical thinking and problem-solving	Critical thinking/problem-solving		Critical thinking and problem solving
18. Teamwork and interpersonal skills	Collaboration	Personal, social and learning to learn/entrepreneur	Collaboration, teamwork and leadership
19. Leadership	Leadership	–	
20. Social and cross-cultural awareness	Social and cultural awareness	Cultural awareness and expression	Cross-cultural understanding
21. Morality and professional ethics	–	Citizenship/Entrepreneur	–

to programming, assembly, digital skills, and specialised software, are most commonly expected from workers in the robotic industries. Moreover, the skills and competences for mechatronics workers acknowledged by the European Skills, Competences, Qualifications and Occupation (2020) are all hard skills, such as maintaining mechatronic equipment, installing mechatronic equipment, simulating mechatronic design concepts, and assembling mechatronic units.

Apparently, when it comes to the identification of skills required for the workforce in high-tech domains, technical skills seem to be predominantly illustrated in the extant literature and sources. However, high-tech firms today are in need of various skillsets, not only technical or hard skills, but also soft skills. Due to the complex nature of tasks required, various studies emphasise that workers in high-tech domains are required to optimise both hard and soft skills if they are to advance in their career within the present competitive labour market (Rukumnuaykit and Pholphirul, 2016; Shmatko and Volkova, 2020; Sakurada et al., 2021).

In fact, recent studies have begun to pay more attention to the importance of soft skills for high-tech domain workers. A recent analysis of the most demanded soft skills for technician occupations in industries within the Factory of the Future (FoF) are teamwork, capacity to adapt to new situations, and willingness to learn (Sakurada et al., 2021). Additionally, a study from Leitão et al. (2020) indicates soft skills that have a strong impact for FoF, such as adaptability, innovation, creativity, communication, emotional intelligence, and leadership. According to a report regarding the skills for industry in Europe, the most important soft skills for the FoF include adaptability, communication, teamwork, and a mindset for continuous improvement (PwC EU Services, 2020). Similarly, Shmatko and Volkova (2020) also found that the demand for social and personal skills for robotic engineers is growing significantly, such as communication, resistance to stress, creativity, teamwork, and willingness to continuously learn. In the Thai context, a study found that soft skills perceived to be important by Thai employers in general manufacturing sector include communication skills, social/team-working skills, leadership, adaptation, and problem-solving skills (Rukumnuaykit and Pholphirul, 2016).

However, gaps in the literature exist regarding the soft skills required for vocational mechatronics and robotics workers, especially in non-Western contexts. With this gap, it has been challenging to equip vocational mechatronics students with important skills for their careers. The following section discusses further the importance of the alignment between skills learnt in school and work requirements.

The Importance of School-Work Alignment on the Transfer of Training

The transfer of training is a term that seems to be overlapped with the transfer of learning and learning transfer, which refers to the ability to apply knowledge and skills learnt at one place to another, for example, vocational school to the workplace (Tonhäuser and Büker, 2016; Renta Davids et al., 2017). Ideally, an effective transfer of training happens when learners can apply the knowledge and skills they gained through their training in the real work setting (Brion and Cordeiro, 2018). Extant research has attempted to identify determinants that influence the transfer of training to improve the effectiveness and success of vocational training. While, research has found various determinants of transfer of training, school-work alignment is arguably one of the most important determinants. School-work alignment refers to the relevance of what students gain in their school to their work in practice. It is related to the transfer of training (Kilbrink and Bjurulf, 2012; Renta-Davids et al., 2014; Pineda-Herrero et al., 2015). According to Tonhäuser and Büker (2016), their comprehensive literature review has shown that a high practical relevance of content, and the degree of similarity between the learning and practical situations, have a positive influence on the transfer of training. Moreover, Hinrichs (2014) also found that when the training provided by school resembles real work situations, it significantly affects the transfer of training. Similarly, Renta Davids et al. (2017) found that school-work alignment is one of the significant factors that determines a high degree of the transfer of training in both hard and soft skills. Hence, they have suggested that VET need to ensure that students initially develop relevant competences at school to prepare them for work by providing learning experiences that are aligned with workplace activities.

However, there have still been concerns over the issue that the knowledge and skills learnt at training colleges is unaligned with or underutilised in the workplace (Veillard, 2012; Poortman et al., 2014). According to Brion and Cordeiro (2018), only a handful of training results in the transfer of knowledge, skills, or behaviours learned in the training to the actual work settings. Schaap et al. (2012) pointed out that students often experience difficulty in relating knowledge and skills that they learnt at school to the workplace, because VET focuses on students' learning processes and theoretical insights, while workplaces have other demands that require students to stretch their capacities outside their core occupational skills, such as serving customers, making profit, self-regulation, and efficient procedures. For example, Hiim (2017) contended that the Norwegian VET curricula content is perceived as not sufficiently relevant to the needs for qualifications in the actual vocations by both students and firms' perspectives. Adams and Sawchuk (2021) reported that many workers in the engineering field have to learn various new things that their college did not teach, specifically soft skills, given that their actual jobs require more than technical knowledge. Their findings showed that soft skills are not usually taught in engineering education, because they are not considered as core skills, but that the workers found soft skills to be key to success in their actual work. In the same vein, from an employer's perspective, many employers still find students do not have the right skills and attitude as they expect (Veillard, 2012; Rukumnuaykit and Pholphirul, 2016).

Given the importance of school-work alignment for the transfer of training, this study examines the major skills that vocational students have acquired from their training in relation to the skills they deem most necessary for their work. Hence, this study not only contributes to the identification of skills needed for mechatronics field of work, but also informs how VET schools can develop curricula that provides best learning strategies to meet future skill needs. As governments try to translate economic development goals (in this case Thailand 4.0) to their local contexts, qualitative and empirical research about the specific skills needed becomes essential in order to assist the creation of appropriate vocational training programmes. This research demonstrates how qualitative research engagements with students can help to assess skill needs and in turn help with the revision of curriculum.

The Thai Vocational Education and Training Mechatronics and Robotics Programme

Mechatronics is a new branch of engineering that has emerged and grown into a multidisciplinary field (Marzano et al., 2019). The term "mechatronics" was coined by a Japanese electric engineering company in 1969, which combined the word "mecha" from mechanism and "tronics" from electronics (Kyura and Oho, 1996, p. 10). Today, mechatronics is understood as a synergistic integration of mechanical engineering, electronics, computer science and control engineering (Lee, 2010). The components of mechatronics are fundamental for many of the smart components of machines, automation, and various systems that make human life easier (Ersoy, 2011).

For VET in Thailand, mechatronics programmes are offered at two levels as an area of study under the banner of "industrial trade". At the certificate level (Por Wor Chor—equivalent to high school) the curriculum is called "mechatronics." Meanwhile, at the Diploma or Associate Degree level (Por Wor Sor), which is the level of the targeted informants in this study, the programme is called "mechatronics and robotics," as mechatronic and robotic fields are combined in the curriculum. Robotics is considered a major part of mechatronics, because it is a part of mechanical engineering, electrical engineering, and computer science, which overlaps with mechatronics and automation engineering (Marzano et al., 2019). The curriculum attempts to equip students with a higher vocational degree that offers more advanced skills and mechatronic skills in the context of robotic works. Students who wish to obtain a bachelor's degree in mechatronics need to enrol within a university. According to the Thai vocational education system, the mechatronics programme at the Certificate level is a 3-year programme, while the mechatronics and robotics programme at the Diploma level is a 2-year programme (Pasawano, 2019). Based on the current curriculum, hard skills constitute the majority of the knowledge and skills provided by the programme. Students have to study various subjects ranging from the mechanical, electrical,

electronic, computer, control and production subjects, while learning to integrate these subjects together for practical work (Chomsuwan et al., 2020).

Although much research has highlighted that soft skills are necessary for high-tech domain workers, some studies found that engineers and other highly technical professionals are usually unaware of the importance of soft skills (Naiem et al., 2015; Matturro et al., 2019). Hence, this research seeks to understand the extent to which soft skills are necessary for vocational mechatronics and robotics students, and if they are, what skills are perceived as most relevant.

MATERIALS AND METHODS

This qualitative research uses anthropological research methodologies to ascertain participants' perspectives on the skills that they value in relation to their vocational education and career trajectories. Data collection for this project started in March 2021 and analysis concluded in July 2021. We selected two technical colleges, one in Bangkok and one in Chiang Mai, as the settings for the study. The criteria for selecting these schools were based on their academic reputation as leaders in mechatronics and robotics training in Thailand and the use of curriculums that incorporate new technologies. These schools provide financial support for low-income students and welcome students who have migrated from different parts of Thailand, with a goal of imparting them with professional skills and connecting them to a VET-related network that will be essential to their future career.

In Thailand, there are a limited number of technical and vocational institutions that have mechatronics and robotics programmes in comparison to other industrial trades programmes. The two technical colleges selected in this study are preeminent institutions in the country. The college in Bangkok has the largest mechatronics and robotics programme in Bangkok, while the programme in the selected technical college in Chiang Mai is one of the largest mechatronics and robotics programmes in the Northern region of Thailand. They are both also of well-received academic standing, having become representative of young Thai vocational students in this field of expertise, and have won either national or international awards.

Participants

For Thailand, the automation and robotics industry has been identified as one of the "New S-Curve" industries, which are potential industries of the future that will be the engine of economic growth (Srisuchart et al., 2019). However, compared to other kinds of vocational programmes, there are still a very limited number of vocational mechatronics and robotics programmes since the automation and robotics is relatively a new industry. Thereby, more studies are needed to further develop vocational students in this field.

The researchers selected participants from Bangkok and Chiang Mai vocational schools because of their long history, having being established for more than 15 years. Students from both schools have won many domestic awards and are also active in joint MOU. Researchers recruited a total of 40 mechatronics and robotics students, 20 from Bangkok and 20 from Chiang Mai. Among these 40 students, five were females and 35 were males. The majority of the participants in this study were male due to the fact that mechatronics and robotics programmes in Thailand are dominated by male students.

The participants were in their final year of dual vocational training (DVT) diploma programme, which combines school training and formal work experience through apprenticeship. For the 2-year diploma level, students spend their first year learning in school and another year working on-the-job just like real employees at the company or factory. Students' work settings include, but are not limited to: assisting chief mechanics; operating automation systems, such as a programmable logic controller (PLC); and performing machine maintenance tasks. The technical college in Chiang Mai only provides DVT at the diploma level; however, before embarking on training at the diploma level, students have an apprenticeship for one semester at the certificate level. In terms of the technical college in Bangkok, students finished their DVT at the certificate level as well, which means that they have had another one and a half years of apprenticeship before entering the diploma level.

Overall, the participants in the study have had no less than 1 year of experience in real work settings to provide rich and insightful data for the study. They were all within the age range of 15–19 years old, engaged with school activities, observant, articulate, and willing to participate in the interviews for this research.

Data Collection and Analysis

This qualitative research utilised a 1-h semi-structured individual face-to-face interview. First, teachers from these schools would help recruit an initial set of students in both the mechatronics and robotics programmes. These included class or group leaders who were knowledgeable, articulate, and involved in research, as well as passionate about their study. Later, snowball sampling was used to expand the target group, whereby student leaders referred friends who fit the study criteria. The interviews took place at each of the vocational school meeting rooms or convenient places that participants preferred.

The researchers used semi-structured interviews to understand students' perceptions, experiences, and examples of skills they view necessary for their future. In order to assist students, we used the twenty first-century skills framework (see **Table 1**) as a guideline and a prompt for students. This helped to avoid confusion that students may have due to limited knowledge on how skill names are conventionally denoted. While students were familiar with different skills in practice, they were not always explicitly named. The twenty first century skills framework served as a prompt to facilitate the verbalisation of skill names. However, the researchers openly asked students to explain in more depth about each skill they have selected by themselves. The main questions for semi-structured interviews were as follows:

(1) Being in a mechatronics programme, what are the most significant skills that you have acquired (select from the twenty first century skills framework), and why are they significant for you?
(2) Based on your apprenticeship experience, what do you think are the most important skills for the twenty first century that you think are necessary for your future career (select from the twenty first century skills framework), and why do you find them important?

The researchers conducted pilot interviews with three vocational mechatronics and robotics students to test whether the interview questions were clear and understandable. After this pilot, some questions were revised, simplified, and rearranged in terms of sequence. Semi-structured interviews allowed the researchers to gain insights from participants' lived realities and specific experiences and stories, providing answers to the research objectives in rich data form (quotations). Audio was recorded for every interview. All interviews were transcribed, content analysis was used to identify emerging themes related to the research questions. The twenty first century skills framework based on our literature review was used as the analytical framework for the qualitative interviews to cluster the skill names determined as common themes. Each transcript was re-read at least three times. The first reading was to identify and highlight themes and sub-themes in each interview. Each researcher also took notes from the first impression of reading the transcript. The second reading compiled answers from all of the informants according to each of research question to better conceptualise and name common themes, while noting how each skill was being defined and described. The third reading aimed to capture sub-themes that emerged from commonalities, then analyse how they link together. Each researcher analysed identical transcripts independently, then results were jointly discussed to cross-check analysis. We then selected representative quotations embodying core themes for the analysis summary. As data were collected in Thai, the selected quotes were translated into English.

Ethical Considerations

Regarding our ethical protocol, participants under 18 years of age were required to have parental or teacher approval and a signed written consent form allowing them to participate. All participants were asked for their permission to record the interview, were informed that their participation will be anonymous, and were told that they can discontinue participation at any time. Ethical protocol complied with CIOM 2016, with all necessary approvals (COA No.050/2564).

RESULTS

The findings are divided into two parts. First, students' perceptions of significant skills they have acquired from vocational mechatronics and robotics programme. Second, their perceptions of the most important skills they need in their work context based on their first-hand experience through apprenticeship. Each abbreviation refers to an identification code: the letters indicate the location, with [BK] standing for Bangkok and [CM] standing for Chiang Mai, followed by the number referring to the interview.

Significant Skills Acquired From Vocational Mechatronics and Robotic Programme

Analysis of interview data reveals four major themes highlighting skills that students have gained the most from the current curriculum, including: (1) technical knowledge and skills, (2) creative and innovative thinking, (3) teamwork, and (4) perseverance, which are described as follows.

Technical Knowledge and Skills

The skills that first came to mind for most students were technical skills related to mechatronics specialisation, such as mathematics, electronics, programming and coding, and other practical skills and knowledge related to machine and robot operation. For example, two students illustrated:

> *BK15: "Numeracy and mathematic skills are the most primary skills I have gained. I use them to operate electrical circuits and control robots. It is basic knowledge and everyone in our programme must have. Robots cannot start on themselves. Everything has to be calculated, the degree of arc, power strengths, knots' distance, formula, all composes to make robots run."*

> *CM5: "Of course, I have learnt mathematics because anything with robotics needs calculation. Like calculating how to control the robots from one place to another, knowing the formula, and how to write a programme."*

Students can clearly see the relation between technical knowledge they have learnt at school and the need to use it at work. For example, one student stated that:

> *CM3: "The foundation of technical knowledge is a must! Because my work involves working with machine and line production. I can't just trial and error on the work site. We need to have a firm theoretical knowledge, such as calculation, formulation, and coding to set the accurate command or code. Then, we can go on and execute it."*

The sentiment of the proceeding quotes was echoed across almost all of the interviews we conducted, revealing that technical or hard skills seem to be the most distinct skillsets that students gain from their training and that these skills are perceived to be both practical and fundamental. Professional knowledge and skills constitute major components to ensure that vocational students will have competency in fundamental skills and knowledge required to handle mechatronic and robotic tasks. Aside from these skills, many interviewees identified other skills in their responses as well. These are presented in the subsequent sections.

Creative and Innovative Thinking

Most participants in this study expressed that creative and innovative thinking was a key skill they have acquired from school. They explained that due to the nature of this discipline, which involves modern technology, school projects and activities,

as well as skills competitions, encouraged students to experiment with new ideas. Students also felt that creative and innovative thinking skills were necessary for their work.

> *CM19: "We have gained quite a lot of creativity during our study. There are a lot of activities that sharpen our creativity and encourage us to come up with new ideas at our school. Creative and innovative thinking are definitely needed when we work, because when we develop our own project, if our ideas are creative, we can advance and get ahead of others."*

Interestingly, students often mentioned creative and innovative thinking skill along with curiosity and willingness to learn. One student pointed out that:

> *BK3: "This course has uncovered the curiosity within me. Curiosity also leads to creative and innovative thinking as well as a willingness to learn. For example, seeing a robot runs and do some different activities makes me curious so much about how it works. It is so cool! Then, I wanted to be able to write code to programme a robot as well. Therefore, I'm driven to learn more and find ways to do it. Once I learn the basic knowledge about how to programme a robot, then I can think creatively further from what I already know."*

Based on the point made by student BK3 above regarding a linkage between having a basic knowledge and creative thinking, this point was echoed by other students who noted that creativity and innovation need to go hand in hand with a firm foundation of technical knowledge. For instance, one student addressed that:

> *BK7: "I have gained creativity from this programme. However, to come up with innovative ideas that is also possible to achieve in reality, it takes two things: knowledge and imagination. A firm foundation of knowledge plus creativity will lead to continuous improvement or new initiations. For example, if I have an electronic board, it's just an empty board. But it is the coding I write that makes the board become worthy, because the code determines what that board can be used for. And we can use our knowledge and creativity to design the function of this board for new purposes."*

Apart from the nature of mechatronics and robotics programmes that foster students' curiosity, teachers also play an important role in building creativity and innovative thinking skills. Students mentioned that mechatronic teachers often challenge students with new exercises and the use of "what if" questions.

> *BK9: "My teachers always stimulated our creativity by asking us the 'what if' questions. For instance, when I prepared to participate in a mechatronic skills competition, my teachers asked me: 'what if we can make a more compressed and easier to carry streamer.' Usually a steamer is long, big, and not meant for carrying around. So, I had to use my creativity to find a new way in making this happen."*

The interview data indicated that one of the key reasons why the mechatronic and robotic programme leads to the development in students' creativity and innovation is because the programme is full of novel things for students such that it sparks excitement and curiosity for them to learn more or find out the answers. This is also complimented by teachers who encourage students to think outside the box.

Teamwork

Most participants mentioned that studying in mechatronics and robotics programme have groomed them to be able to work in teams, because one of the primary learning methods in this programme is through group-project-based activities. Moreover, content analysis shows sub-elements of soft skills hidden within "teamwork skills," including leadership, communication, and helping one another.

> *BK3: "This programme taught me how to work with others, because we always have group work in our class. For example, we work at different machine stations and each station does a different function. We need to communicate a lot to have smooth and continuous work between stations. This is the most important skill. The ability to work in teams and collaborate well with others will absolutely be helpful for my career. When I graduate from this school, I will know how to conduct myself. I will know how to work and live with others (อยู่เป็น)."*

> *BK7: "Through project-based learning, I have improved my leadership skills. My friends voted me to be the leader of the group. As a leader, I had to make decision for the team. Meanwhile, I also learnt to help my team members when problems occur in our project."*

Based on the interview data, the method of group-project-based learning in the mechatronics and robotics programme encourages students to learn to play their parts in teams, while being synchronised with others to finish the project. This skill was valued by the students and perceived to be beneficial for when they will have to work in the real world.

Perseverance

Lastly, several students commonly mentioned the terms like persistence (วิริยะ), patience (อดทน), and diligence (ขยันหมั่นเพียร) to describe the key skills that they have developed through this programme. The findings suggested that the training within the programme fosters students to develop these competences. Since the training, such as refining the iron, requires hard work and repetitive actions, students gradually learn to become more patient and persistent. They also put an emphasis on diligence as the factor that drives curiosity forward.

> *BK5: "In my first year, there is a job skill training subject (วิชางานฝึกฝีมือ). I can still remember how I had to refine a large cube of iron into small pieces. I think the rationale behind the training is that they want to train you to be patient. If we pass this training, we can be really tough."*

> *BK2: "I have acquired persistence and diligence from this programme. To me, curiosity will be useless if you don't take action to do things that you want to know. So, persistence and being diligent is very important to master a skill. You must practise doing it again and again. Be patient, try hard, and try to do your best."*

In summary, our results show which important industry-relevant skills mechatronics and robotics programmes have already helped students acquire. The most common skill that came first to students' minds is technical knowledge and skills, which suggests that those technical skills are undoubtedly a necessary foundation for students. However, the other three skills

were soft skills that students felt that they had gained from school and also found practically significant in the context of their work. These skills were creative and innovative thinking; teamwork; and perseverance.

Moreover, data gained from student perspectives in our study not only help pinpoint a list of skills, but also yield an understanding of some of the logical relations across the four major themes, as well as examples of ways in which skills complement one another. We found that creative and innovative thinking is stimulated by curiosity and underpinned by a firm foundation of technical knowledge. Additionally, what moves creativity forward is perseverance and diligence, because without dedication, hard work, and bringing ideas into action, innovation can hardly be accomplished.

The results in this part may have some implications for vocational programmes in other yet similar areas to mechatronics and robotics in other countries, as well as how the curriculum can ensure the cultivation of these skills. For example, our findings pointed out that teachers play an important role in stimulating students' thinking, especially by asking "what if" questions to encourage students to think beyond what they already know.

The Most Important Twenty First Century Skills for Mechatronics Students' Future Careers

For the second in-depth interview question, students were asked what skills they considered to be the most important twenty first century skills for their work. The interview data analysis indicated three skillsets, including (1) language and communication, (2) adaptability and interpersonal skills, and (3) willingness to learn and innovative thinking, which are further explained below.

Language and Communication

Nearly all participants in this study addressed the importance of foreign language and communication as the most necessary skill for work, because this would contribute to career advancement. Moreover, students linked language skills to the expansion of knowledge because they would be able to study from more resources in other languages, such as English and Chinese, and not only have to rely on Thai language resources.

BK14: "I choose communication to be the most important skill for the twenty first century, because speaking fluently in many languages will allow an advantage over others. For example, I can do marketing and establish new foreigner customers, bring them into my company. Better language skills will contribute to better presentations in convincing and gaining new customers."

BK8: "If we make it into a high rank position, language skill is a must. Being a manager, you have to use language in order to contact, build connection, explore and articulate your ideas in building new inventions."

CM20: "Language skills are very essential, especially English and Chinese. Since most parts and machines are imported, the instruction and manuals are in their original languages, mostly either English or Chinese. If we can read it, we will be able to use it properly and efficiently."

However, despite the importance of language and communication skills, most students pointed out that they were not provided with adequate skills from college. Students expressed that the way language skill is taught at school does not serve what they need to use at work, because it either involves too much grammar, or is less intensive. This has caused major difficulties and obstacles for their work.

BK4: "I think the most lacking skill for mechatronics students is language and communication, particularly in English. Personally, I would rate my English communication skill that I gained from school 3/10. This is hardly enough for work. I found it was difficult for me to do my job, because all the manuals are in English. Having low English skill also limits my learning ability. If I could understand English better, I would be able to gain more skills and knowledge."

CM11: "Our college put emphasis on teaching grammar too much. This is the reason why we can't communicate in foreign language. We also don't know the technical terms in English that we need to use at work. The school should teach us language for practical use rather than memorising grammar principles."

It can be observed from the views of students that mastering language and communication skills consist of two levels. The first level is language skills in the sense of hard skills, which means the knowledge about vocabulary and grammar that would be sufficient for basic use of speaking, writing, and reading, especially manuals. However, the second level involves soft skills, which is more related to communication skills. Good communication goes beyond language literacy and is about the ability to express ideas, conduct presentations, and perform customer service. Unfortunately, the results show that current mechatronics and robotics programmes in Thailand do not have school-work alignment when it comes to language and communication skills, particularly English and other foreign languages given that the language skills learnt at school seem not to match with what students need to use at work.

Adaptability and Interpersonal Skills

Most participants indicated that interpersonal skills are the most important skills for work because mechatronics work does not consist of individual tasks; thereby, they need to be able to work well with other people working on various functions. Interestingly, to establish good interpersonal skills, the students also mentioned other skills that they thought are interrelated, such as the adaptability, emotional regulation, and patience. The students addressed that all these skills complement one another. For instance, adaptability is crucial to being in different environments and dealing with diversity.

BK1: "Working with others is essential in the real work context. Because we have to communicate with many departments. I learnt from my experience that working in an engineering field, our jobs do not finish at the design of a programme or product within our department. We have to work with the technicians, equipment purchasing, stocking departments, as well as sales and marketing who will present the product to the customers. Sometimes, we need to talk to the customers to find their needs."

CM4: "We need to have adaptability skills in working with other people. Like when I enrolled in this programme, most of my friends are male. But at work, I have to collaborate with people of various gender–females, males, and LGBT. Also, we have to adapt to the new work environment too. If we can't adapt, we will be the black sheep and it is not fun to be in that position. It makes our work life even harder."

Furthermore, students stressed that patience and emotional regulation are also core skills related to working with others. This is because in real work settings, they need to face a lot of pressure and deal with different types of people. Moreover, patience is seen as essential for mental strength at work.

BK6: "I think emotional regulation is fundamental for interpersonal skills because you are working with different people with diverse personalities. Sometimes we have to wait, sometimes we have to patiently explain to them. Every step is sensitive, detailed and we have to control our emotion because there is a lot of pressure."

CM19: "Patience is so important in working under pressure from various stakeholders or even from ourselves. We have to meet the deadline, time limitation, too many irons in the fire (overcoming huge amount of work). If we don't have patience, we will easily become discouraged and give up on work."

During the interviews, students also mentioned that in Thai society, there are certain cultural and value aspects to consider in regard to interpersonal relationships.

BK6: "In my experience, I had to adapt myself when I was an intern. I sawasdee (a humble greeting Thai gesture) everyone. I kept in mind that I was a junior or a newcomer and I welcome all their guidance and feedback. I know what role I should play to contribute to a pleasant workplace environment. I always asked if anyone needed a hand. I worked with a smile. These interpersonal acts were really worthwhile in the end."

BK8: "For some Thais, it is hard to separate work disagreement from personal issues. Therefore, I think that interpersonal skills in working with other people is most important. Although we have disagreements when working, it should not be mixed with personal dislike and causing future interpersonal conflict."

It can be seen that although interpersonal skills, which are one of the most common and well-known soft skills identified elsewhere, were also found to be important for Thai mechatronics students in this study, what determines good interpersonal skills can vary across different cultures. This is because different societies have their own patterns of values that are related to relationships, manners, and communication. Especially in a collective society, like Thailand, one should manage oneself in accordance with group norms.

Willingness to Learn and Innovative Thinking

Several students emphasised that to become a worker in high-tech domains, the skill that they need are willingness to learn and thirst for knowledge, because they need to keep up with new knowledge and technology. Due to the fast-paced nature of technology, rapid changes, and emerging challenges in today's environment, workers of the twenty first century need to have thirst for knowledge and a mindset that is oriented toward a willingness to learn. Students stressed that in order to think innovatively, one need to have up-to-date knowledge and skills as well. It is interesting to find that students also link willingness to learn with innovative thinking skills.

CM18: "Willingness to learn is so important in my field. Today rapid technological advancement requires us to not stop learning. Otherwise, our knowledge would be limited to what we learn in school. In 3–5 year-time, things are going to change. If we don't improve ourselves, our knowledge will be obsolete. We can't be innovative if we stop learning."

BK10: "The world is facing new challenges, such as pollution and the scarcity of energy resources. Innovation and new technology will need to be oriented toward conserving nature and the environment, such as renewable energy, solar power, and things like that. Therefore, the most important skill for the future in my field would be innovative thinking and thirst for knowledge, because we need to acquire new knowledge all the time to come up with innovation to solve new problems."

To summarise, while the first question is more about important skills students have acquired from school, the results derived from the second question lend us more insight about the important skills for their future career, regardless of whether or not they learned them at school. We identified three major themes of skillsets. However, it is worth noting that these three skillsets from our findings could be separated into six individual skills. Based on the in-depth data gained from semi-structured interviews, students usually mentioned more than one skill together, because of the interconnectedness they drew across certain skills. Hence, the results in this section also show some logical relationships and connectedness between skills as well. For instance, literacy (language learning) was seen as going hand in hand with communication skills; adaptability was taken as an important competency for building interpersonal skills; and in order to have innovative thinking, an eagerness to learn was seen as essential.

DISCUSSION

The aim of this research is to understand the important skills—both hard and soft skills, for vocational mechatronics and robotics students through their own experiences, by exploring what skills they perceive to be necessary when they actually practise the job. This qualitative study offers a deeper understanding as to how and why certain skills are particularly important for them. Such understanding may help vocational mechatronics and robotics programmes realise the goal of successful transfer of training by providing learning that is relevant to students' skills requirement for their work, which is also the key goal of VET.

For the first research objective—to examine the major skills that Thai vocational students have acquired from the current mechatronics and robotics curriculum—four skills were determined to be the prime skills that participants gained from their college. These were: (1) technical skills, (2) creative and innovative thinking, (3) teamwork, and (4) perseverance. In terms of the second research objective—to identify the

most important skills for the twenty first century that are necessary for mechatronics and robotic students' future careers—we discovered three skillsets that were perceived to be the most important. These included: (1) language and communication (2) adaptability and interpersonal skills, and (3) willingness to learn and innovative thinking. It can be clearly seen from this study that soft skills are extensively appreciated by mechatronics and robotics students. Overall, the soft skills identified in this study as most critical for mechatronics and robotics works are congruent with literature derived from contexts other than Thailand, reporting a need for soft skills in the technological related industries and high-tech domain workers, such as teamwork, creativity, communication, flexibility and ability to work under pressure (Leitão et al., 2020; Shmatko and Volkova, 2020; Goulart et al., 2021; Sakurada et al., 2021). Similar to other research conducted in countries where English is not the native language, such as Malaysia (Ting et al., 2017) and Russia (Shmatko and Volkova, 2020), we also found that Thai students highlighted English proficiency as a top important skill required for employability and career advancement. Moreover, most soft skills highlighted in the results of this study are oriented toward social skills, such as teamwork, communication, and interpersonal skills. Such finding is congruent with a study among IT students in Brazil (Goulart et al., 2021). Thus, it can be inferred that despite advancements in digital technology, human skills are still important even among those who work with IT and robots.

Given that all vocational students in this study have had first-hand experience in the mechatronics and robotics industry through their apprenticeship, they can foresee the importance of these soft skills in the real-world work environment. It seems apparent from the interview data that while technical skills are necessary, soft skills are also strongly needed to work efficiently, particularly as students envision in their future career growth and success in the long run. However, there have been concerns over VET curriculums, especially in developing countries such as Vietnam (Van Kieu and Minh Tran, 2021) and Pakistan (Khilji and Roberts, 2022). These concerns claim that teaching focused on hard skills still takes up the majority of the curriculum, leading to deficits in soft skills building, which should be addressed by VET stakeholders. In this regard, the findings in this study contribute to VET programmes in similar fields, suggesting that curriculums should be designed to integrate the cultivation of these soft skills for their students, while ensuring that vocational education matches real-world work requirements and enhances the transfer of training through better school-work alignment.

Moreover, we also found that although the same concept was mentioned, for example interpersonal skills, it was being defined and put to use differently from how it may be deployed within Western society. For these students, interpersonal skills centred around the ability to control ones' emotions, consider other people's feelings, and be humble and helpful to the group as much as they can. This definition mirrored self-identification of VET students shaped by Thai social values and being members of a collective society. In addition, "adaptability" as a skill concept was identified differently from the literature focusing on Western contexts. While, adaptability in Western cases stresses resilience and the importance of adapting oneself to technological change (Shmatko and Volkova, 2020), to these Thai students, adaptability is oriented toward adapting oneself to fit into the collective culture in the workplace. Without the capabilities of qualitative research methodologies, researchers could not explore such cultural-specific concepts.

In terms of the last research objective, to make recommendations on how VET mechatronics and robotics programmes can strengthen the transfer of training through school-work alignment, based on the overall findings, our research sets forth the following recommendations regarding skills development for mechatronics and robotics programme for VET. Firstly, given that students extensively emphasised the importance of soft skills in the workplace, VET mechatronics and robotics programmes should give more attention to soft skills development that adheres to students' practical needs to promote school-work alignment, which is a significant factor for the transfer of training. Theoretical and technical knowledge taught at school should be aligned with the actual work context and should be coupled with practise. For example, language skills should be customised for mechatronics and not focus over extensively on grammar, but more on communication in real life work specific contexts. Our findings reflect that when school focuses too much on theoretical foundations, which in this case is grammar, it becomes difficult for students to relate and make practical use of the knowledge they learnt at school in the workplace (Schaap et al., 2012).

Secondly, since previous studies have identified various skills for the future, we contend that although all those skills are undoubtedly significant, the degree to which each skill perceived to be important is varied depending on the context and culture. Given that there has been a list of key skills for the future developed by prominent resources, for example, the twenty first century skills by the World Economic Forum (2015) and skills for industry 4.0 by the European Union (PwC EU Services, 2020); however, the findings from this study indicate that in the context of vocational mechatronics, students perceived certain skills are significantly important for them in particular. Hence, students in different fields and contexts are likely to view the degree of importance toward each key skill for the future differently. More importantly, our findings discover certain detailed elements within skills concepts among Thai students that may be different from other contexts, such as interpersonal skills in Thai culture discussed earlier in the second objective, it is recommended that VET in different cultures should explore the meaning and values of skills requirement according to each cultural group to make suitable recommendations and determine culturally sensitive approaches for their curriculum and teaching.

Lastly, findings from this study highlighted that both hard and soft skills tend to be effectively developed through project/problem-based learning and participating in VET competitions. We gained insights from students' experience regarding their preferences toward effective learning methods for developing each skill. Our findings confirm that assigning students to work in groups and use project-based learning is one of the most effective ways to simultaneously develop diverse and holistic skills, such as teamwork, communication, leadership, while learning technical knowledge and skills

(Patange et al., 2019; Chomsuwan et al., 2020). Additionally, our findings are in line with Nguyen et al. (2019) that participating in skill competitions is perceived to be a preferred learning environment for advancing student's creativity and skills. Unlike transfer of training from vocational training to workplace, unexpected challenges that arise from competitions also stimulate spontaneous creativity which goes beyond theoretical knowledge and classroom learning.

CONCLUSION

Ensuring the transfer of training and preparing students to gain practice-oriented knowledge and skills required for their future professions are at the heart of VET. Accordingly, school-work alignment and the resemblance of contents in VET to the real work situation are key determinants that impact the transfer of training. This study focuses on exploring skills that are perceived as significant for mechatronics and robotic students, because such understanding provides the foundation to ensure that knowledge and skills taught in vocational mechatronics curriculum reflect the practical needs in the work context. Moreover, mechatronics is a particularly interesting field to explore due to its technological machine specialisation, it is often assumed that this vocational field tend to involve mostly with technical or hard skills. However, a growing body of research has argued that focusing merely on technical skills is not enough. Yet, we have little understanding of the extent to which soft skills are necessary and how those skills are applied in mechatronics and robotics work settings.

In summary, we agree that technical skills are foundational to curriculums and job demands for mechatronics and robotics students, but soft skills are also crucial. In fact, participants in this study emphasised the importance of various soft skills, such as creativity, teamwork, perseverance, communication, adaptability, and interpersonal skills, in their professional work. Not only does our research highlight how these two types of skills complemented each other, but it also reflects how these students experience, value, and need to use these soft skills in their work. Moreover, although we appreciate other previous research that has identified a list of soft skills through survey questionnaires and systematic literature reviews, our research furthers this knowledge by utilising qualitative research method to gain an emic perspective (the vocational students' experiences) and promote an understanding of the cultural meanings they give to each skill concept. Insight from these findings sheds light on how students have acquired those skills, why they value them, and the vocational learning methods they felt suitable for the development of various skills.

However, this research has some limitations. The study was designed to focus on a small scale of vocational mechatronics students in dual apprenticeships programme from two technical colleges in Thailand. It would be beneficial for future research to include more participants from more colleges, while also collecting data from both students and employers from mechatronics industries to gain more insight regarding skill demands in this sector. Although empirical qualitative research allows researchers to explore the individual experiences of what informants find to be meaningful, resulting in the generation of insightful, rich, and thickly descriptive data, within a limited 1-h interview period, some informants spent their time providing many examples relating to certain skillset-experiences they find relevant to the questions. These unexpected insights were very important for the analysis. However, it also decreased the time to address the questions they found disinteresting.

The twenty first century skills guideline also helped students to identify and name skills; however, it also obstructed an exploration of how these skills/skillsets might have been named according to their age and/or VET culture. Although the researcher did ask follow-up questions to probe at emic understandings, most students maintained that the twenty first century skills concepts denoted on the prompt encompassed what they had in mind. Lastly, it is evident that the context bound nature of qualitative research renders results that cannot be generalisable. This is because findings vary across time, populations, contexts, and cultures. Since our study found valuable insights demonstrating that different cultural contexts may perceive the importance of skills and give meaning to each skill differently, this opens up a new arena of cross-cultural comparative research that links cultural reality to practice. Most importantly, researchers highly encourage further research needs on pedagogical implications. Not only to study how these skills can be holistically taught efficiently in practice, but also how to train future VET teachers and how to incorporate students' perspective into curriculum design.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the National Research Council of Thailand's Spearhead Strategic Plan on Social Aspects of Khon Thai 4.0. Restrictions apply to the availability of these data, which were used under license for this study. Data are available from the authors with the permission of the National Research Council of Thailand's Spearhead Strategic Plan on Social Aspects of Khon Thai 4.0. Requests to access the datasets should be directed to CT, chulanee00@hotmail.com.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Research Ethics Review Committee for Research Involving Human Research Participants, Health Sciences Group, Chulalongkorn University (COA No. 050/2564). The informants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CT was the head and KS was the main researcher of the research project mentioned in the Acknowledgments section. Data collection was performed by the research team within the project, including CT and KS. CT was the major contributor in writing Materials and Methods, Discussion, and Conclusion

parts, while KS mainly contributed to Introduction and Literature Review parts of this manuscript. KS drew up a list of the preliminary codes, selected the most important and relevant data, and clustered them in categories. CT guided the content analysis and meaning making from the narratives, as well as provided input for the storyline. Both authors were involved in planning the entire research process together, contributed to the writing of Results section, and read and approved the final manuscript.

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