Perception of Support for Robot-Based Teaching and Learning Innovation: A Case Study of Vocational College Students

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Abstract

This study aims to present the findings of a research conducted on the perception of vocational students. The research employed purposive sampling technique and included a sample size of 420 participants. The study specifically focused on investigating the level of support provided by administrators of vocational education colleges towards teaching and learning innovation through the use of robot-assisted instruction. The data were obtained through the utilisation of Likert Rating Scale questionnaires, Descriptive Statistics, and Multiple Regression Analysis (MRA). The findings of the study indicate that the participants' level of opinion regarding Fostering Robotics Knowledge/Skills (FRKS) and Innovative Outcomes in Robot-Based Teaching (IORBT) was consistently rated as "high." Furthermore, the examination of indicators pertaining to each aspect unveiled that the FRKS concerns encompassed the (4) Sufficient Resource (SRES) indicator, while the IORBT issues (2) were associated with the Socio-technical system's design (TECH&DESIGN) indicator, positioned at an intermediate level. This suggests that there remains a developmental deficit that needs to be addressed in order to achieve the "Very High" level as outlined in the management policy for government sector vocational educational institutions. The multiple regression analysis revealed that six factors were found to have a statistically significant relationship with the Independent Organisational Role Behaviour Test (IORBT). These factors include: (1) Organisational responsibilities and structure (ORS), (2) support from supervisors/department heads (SDHS), (3) awareness of the organization's impact on results (AORC), (4) reward and recognition (R&R), (5) availability of sufficient resources (SRES), and (6) freedom in the workplace (FRWO). There is a pressing need to expedite the implementation of measures in order to

synchronise with the prevailing business landscape, while also adhering to governmental policies aimed at cultivating a workforce that is adequately prepared for the advent of FRKS, thereby effectively addressing the evolving demands of the labour market.

Keywords: 1) support awareness 2) Teaching and Learning Innovation 3) Robot-Based Teaching 4) vocational college

Introduction

In today's turbulent business environment, innovation has become essential for survival, performance generation, and growth. The necessity for innovation is considered an organizational exit factor (Brand, Tiberius, Bican, & Brem, 2021). The focus of businesses is on innovation, technology, and robotics. They aim to reform production, improve production processes for goods and services used in stores and businesses, reduce and speed up production processes, reduce the cost of production or processes, and increase consumer satisfaction (Tien et al., 2021). The incorporation of technology and robotics in a variety of tasks with the aim of enhancing work efficiency appears to persist and reduce human participation. However, this is not the case. The diminution of human roles remains negligible. The current state requires an increase in potential and a redefinition of the role to include the individual responsible for strategizing, conceptualizing, supervising, and collaborating with technology and robotic systems to achieve optimal levels of efficiency and effectiveness (Hernandez-de-Menendez, Escobar Daz, & Morales-Morales, 2020).

The aforementioned alterations have led to a situation where organizations now have the expectation that their employees should exhibit flexibility, adaptability to uncertainty and change, possess the necessary skills and abilities, and yet still be able to function effectively as a cohesive unit. Employees are widely recognized as one of an organization's most valuable resources, playing a dual role as both innovators and consumers of innovation and technology (Kozio-Nadolna, 2020). These factors influence the perception of the national administration, which places a premium on advancing the nation through technology and innovation. It is essential to strategically plan and formulate national policies that place a premium on technological advancement and innovation. These policies should be communicated clearly and

comprehensively to students, university students, and the general public from the very beginning, thereby laying the groundwork for future success. The government has implemented policies and allocated resources to support the implementation of development plans, including preparations for a future industrial revolution.

The support model enables learners to effectively address current challenges while simultaneously cultivating their potential to become future workforce members capable of meeting societal demands. Governments are implementing policies to support human resources research and development, especially in the fields of engineering, technology, innovation, artificial intelligence, and robotics. The purpose of these policies is to improve working conditions by fostering knowledge, competence, and skills. (Rodboonsong & Sawasdee, 2020) The ultimate objective is to improve teaching and learning methods across all educational levels and promote the acquisition of knowledge. This includes educational and training programs at the technical, vocational, and pre-degree levels, with an urgent emphasis on fostering greater collaboration between the academic and business sectors (Office of the Education Council, 2020). Implementing educational mechanisms efficiently and effectively is essential for achieving learning outcomes consistent with human capital development strategies.

These approaches aim to equip individuals with knowledge, skills, professional competence, technological proficiency, logical thinking, and systematic problem-solving abilities. In addition, they foster creativity and innovation, instill desirable attitudes and values, encourage life and skilful planning, build a solid foundation for living, and promote peaceful coexistence within society (Ganjvar, 2022). This is consistent with the educational approach that emphasizes the importance of laying a solid foundation for the use of technology, innovation, artificial intelligence, and educational robots to generate knowledge from practical experiences (Frolova et al., 2020; Kaewcheed, 2020). The literature review revealed a relationship between the Fostering Robotics Knowledge and Skills (FRKS) factors and the facilitation of labor competency to meet the rising demand for robotic systems (Hernandez-de-Menendez, Escobar Daz, & Morales-Morales, 2020). The statement conforms to Thailand's guidelines for the conceptual design of education, as outlined in the National Education Plan for 2017–2018.

The proposed plan aligns with the fundamental principles delineated in the guidelines for education management, encompassing four primary principles: (1) guaranteeing universal access to education; (2) fostering inclusive education practices; (3) embracing the principles of sufficiency economy; and (4) fostering a shared dedication to education. The guidelines are implemented in parallel with the 2030 Sustainable Development Goals (SDGs). The "National Education Plan" integrates both local and national strategies within its conceptual framework (Office of the Education Council, 2020). For the successful implementation of the aforementioned approaches, it is imperative that vocational education institutions nationwide fully embrace and incorporate the fundamental principles and concepts. This may encompass the development of policies aimed at enhancing the curricula for education management, fostering the professional growth of teachers, and implementing efficacious pedagogical strategies. One aspect of educational practice involves the coordination of supplementary activities for students, which enables them to apply and enhance the skills, knowledge, and abilities they have acquired, ultimately leading to the attainment of a high level of proficiency (Bernacki, et al., 2020). The implementation of this initiative requires a well-defined goal of promoting increased cooperation between the academic and industry domains, as well as establishing alliances between academia and other research institutions to create networks focused on artificial intelligence and robotics.

Furthermore, it is imperative to establish a specialized administrative department with the primary aim of fostering a cohort of intellectually adept individuals equipped with a diverse range of knowledge, skills, and aptitudes. There is a suggestion that experts should be provided with managerial support in order to facilitate the establishment of a sustainable framework for technological advancement. The support should encompass various domains such as intelligent information technology, artificial intelligence and robotics, grants for research innovation, allocation of resources, and the recruitment of international experts and scholars possessing the requisite knowledge and skills (Office of the Education Council, 2020). According to the research, leaders within educational institutions have incorporated FRKS factors across a range of courses by utilizing nine variable factors. The factors that have been identified in this study as important for organizational effectiveness are as follows: (1) leadership (LEADS), (2)

organizational responsibilities and structure (ORS), (3) support from supervisors and department heads (SDHS), (4) availability of sufficient resources (SRES), (5) management and support for learning focus (MSLF), (6) freedom in work (FRWO), (7) opportunity to present working results to the organization (OPWRO), (8) awareness of the organization's influence on results (AORC), and (9) rewards and recognition (R&R). The analysis of prevailing theoretical frameworks and practical applications is crucial in modern education. The necessity of ongoing knowledge acquisition is emphasized through the utilization of authentic instructional materials (Hernandez-de-Menendez, Escobar Daz, & Morales-Morales, 2020).

In the contemporary educational context, the utilization of robots has emerged as a novel and innovative tool for teaching and learning. Due to the escalating need for expertise and competencies in the field of robot interaction, it is anticipated that it will assume a pivotal position within the educational curriculum. The aforementioned prominence can be attributed to the growing integration of robots in both everyday life and diverse organizational activities. Robots possess advanced cognitive abilities and automated functionalities that render them suitable substitutes for humans across a diverse range of domains. These domains encompass but are not limited to medical aid, transportation of goods, execution of manufacturing operations via robotic arms, sanitation operations, provision of food services, facilitation of medication and medical supply transportation, administration of library services, narration of stories, and dispensation of computer programming instruction (Vorametpasuk, 2020). As a result, it is expected within the realm of education that individuals who join the workforce will possess the essential technical skills, such as analytical, innovative, and creative thinking, in order to effectively collaborate with robotic systems in the production and provision of goods and services (Kaewcheed, 2020).

In relation to the anticipation of Innovative Outcomes in Robot-Based Teaching (IORBT) within the educational context, it is crucial for educational administrators to embrace the FRKS approach and assess the success of IORBT based on the following factors: (1) experience and organizational history (EXP&HIS), (2) socio-technical system design (TECH&DESIGN), (3) engineering activities (ENG&ACT), and (4) science techniques (SCI&TECH). The present study investigates the profound

influence of technology on engineering education in vocational institutions, with a specific emphasis on a case study conducted among the vocational and high vocational cohorts. This study specifically investigates the perspectives of educational institution administrators regarding the implementation of the learning and teaching system in alignment with government policy guidelines, as well as the FRKS and IORBT guidelines. Furthermore, this study examines the strategies employed by educational institutions to effectively tackle the obstacles presented by the ever-changing landscape of the education sector. The present condition of affairs will exert a substantial influence on the future advancement and growth of the nation. The continuous advancement of technology is in line with the objective of supporting students in acquiring technical knowledge and cultivating competencies in engineering and science education, thereby aligning with the demand of the labor market.

This study investigated students enrolled in the aforementioned educational programs, with a focus on analyzing the provision of feedback and evaluating perceptions in accordance with the outlined implementation protocols. Principal research objectives centered on elucidating the perspectives of vocational college administrators regarding FRKS (Feedback-Responsive Knowledge Systems) and IORBT (Implementation of Online-Based Teaching). The resultant findings hold substantial practical significance for the future management and enhancement of both FRKS and IORBT, with the overarching goal of advancing the field of educational administration to facilitate students in achieving their intended learning outcomes.

Literature Review

Teaching and Learning Innovation that uses Robots as a Device in Vocational College.

The continuous economic growth of Thailand, in conjunction with inflows of foreign investment, has led to a sustained need for a skilled workforce and human capital. In order to adequately address these demands, educational institutions must enhance their endeavors in cultivating human capital. The significance of managing vocational education in Thailand is progressively acknowledged as a pivotal undertaking (NxyH, C., 2023). According to Pan (2020) and Hernandez-de-Menendez, Escobar Daz, and

Morales-Menendez (2020), The integration of theoretical knowledge and practical application is a key focus in the management of vocational education. This emphasis is particularly placed on facilitating learning and acquiring experience in authentic workplace settings. The development and promotion of anticipated learning outcomes that seek to cultivate the technological and instrumental skills of robots are of utmost importance. According to Kaewcheed (2020), it is essential for individuals to possess a thorough grasp of hardware, software, and network fundamentals, alongside the ability to effectively employ a range of collaboration tools in their professional endeavors.

This imperative necessitates adherence to governmental policies that place emphasis on achieving success by means of establishing and overseeing vocational education initiatives, with the explicit aim of producing graduates who possess exceptional skills and knowledge that align with prevailing market needs. In addition, it is also important for curricula to undergo adaptation in order to foster the development of learning skills and innovation, particularly in response to shifts within industries and the overall growth of the economy (Borrageiro & Mennega,2023). This necessitates the implementation of management strategies for recruitment and the cultivation of human resources possessing knowledge, professional skills, technological expertise, logical reasoning, systematic problem-solving capabilities, creativity, innovation, desirable attitudes and values, effective life planning and life skills, and ability to foster harmonious societal coexistence. These challenges necessitate the implementation of effective and outcome-driven measures through the aforementioned educational mechanisms (Sharvashidze et al.,2023).

Fostering Robotics Knowledge/Skills (FRKS)

The acronym FRKS denotes the attributes that enhance the development of proficiency in utilizing robotics systems. This study presents a theoretical framework that seeks to enhance the incorporation of robots as an educational instrument within educational establishments, with the objective of fostering innovation in pedagogy and knowledge acquisition. The objective is to provide individuals with the requisite knowledge, competencies, and capacities to anticipate and adjust to organizational innovation in the forthcoming period. The aforementioned objective is achieved by

placing a high priority on the process of acquiring knowledge, facilitating the exchange of innovative ideas, and effectively applying the knowledge gained in practical settings. These efforts contribute to the continuous growth and development of the organization (Khan & Khan, 2019). Organizations are obligated to offer assistance and foster a state of preparedness for achievement and innovation, by incorporating concepts from various domains. The FRKS framework has been developed through an extensive examination of the current body of literature, aiming to discern the fundamental components that organizations need to take into account in order to successfully promote and cultivate learning, creative thinking, and innovation in their activities. The primary goal is to generate novel outcomes that create value and enhance the organization's competitive edge. The role of individual competencies in promoting creative thinking and innovation is of great importance in the context of Flexible Remote Knowledge Sharing (FRKS) (Birasnav et al., 2023; Dodoo et al., 2023). The aforementioned attributes can serve as a concise representation of the subject matter.

(1) Leadership (LEADS) and FRKS

A substantial body of literature substantiates the importance of LEADS for contemporary organisations. The organisation derives advantages from a range of theoretical frameworks, including those pertaining to effective leadership traits, leadership behaviour, situational leadership, visionary and charismatic leadership, power dynamics, influence, and capabilities theory (Kozioł-Nadolna, 2020). The establishment of various links with leaders and the cultivation of effective leadership qualities have emerged as crucial catalysts for promoting innovation within an organisation (Hijjawi, 2021). The process of generating innovation necessitates the involvement of both individuals with innovative capabilities and organisational backing, rendering it a central objective for LEADS. LEADS must possess a clear vision and a strong inclination to utilise inventive and innovative approaches to enhance their competitive position (Hijjawi, 2021). Furthermore, it underscores the imperative of establishing and fostering preparedness for the advent of creativity and innovation within the organisation (Faulks et al., 2021).

Additionally, LEADS is a recognised variable that is known for its capacity to foster employee creativity and innovation by implementing strategies to motivate and provide assistance to employees in generating novel ideas and solutions. This statement highlights the significance of LEADS in promoting innovation endeavours and instilling a sense of commitment towards attaining goals through the execution of LEADS' responsibilities in initiating actions that result in the development of novel innovations within the organisation (Kozioł-Nadolna, 2020). In an industrial setting, LEADS operations are congruent with operational strategies that encompass the following elements: (1) a commitment to cultivating innovation within the organisation; (2) the provision of support for a work environment that fosters innovation, embraces employee errors, and facilitates effective communication. (3) structuring an organisation: flexibility, task-orientation, and the establishment of a vision and strategy for organisational development. and (5) important to focus on process improvement and establish a capability management system (Pratimapakorn, 2021).

(2) Organizational Responsibilities and Structure (ORS) and FRKS

Organisational support, as manifested through a collaborative work environment, is a crucial component of the formal support system within an organisation. The impact of interpersonal interaction within organisational structures, which is influenced by factors such as authority, responsibility, and leadership, plays a crucial role in promoting FRKS (Abbas et al., 2020). The Organisational Role Stress (ORS) framework, which encompasses the delineation of work processes and the allocation of tasks across various departments within an organisation, constitutes a component of the perceived elements of organisational support. These elements exert an influence on the behaviour and attitudes exhibited by workers (Saengchamnong & Viroonratch, 2020). The implementation of Organisational Resilience Strategies (ORS) has been found to have a positive impact on various aspects of organisational functioning, including job satisfaction, employee productivity, efficiency, and overall success in attaining continuous growth and development. ORS is regarded as an integrated system that aims to facilitate the achievement of organisational goals (Gamble,2020). The Operational Resilience Standard (ORS) also highlights the

importance of aligning management and technical levels to effectively address the organization's requirements. This alignment enhances the organization's ability to withstand threats, adapt to changes, and foster growth. Achieving these objectives relies on the effective implementation of both formal and informal elements of the organisational structure. This approach aims to enhance the working environment and optimise employee performance within the organisation (Alhamad et al., 2022).

(3) Support of Supervisor/ Department Head (SDHS) and FRKS

Based on the theoretical framework and management principles outlined in the literature on risk avoidance and action planning, the implementation of power dispersion and the formation of semi-autonomous teams within the organisational structure, under the leadership of key decision-makers (Faulks et al., 2021), enables the SDHS to effectively oversee and facilitate coordinated operations. This approach ensures the maintenance of real-time business operations and enhances the organization's ability to adapt and respond to daily fluctuations. The autonomous decision-making authority of SDHS in selecting the optimal course of action and its subsequent implementation can have an impact on FRKS and exert influence on innovative behaviours within the organisation (Dodoo, Surienty, & Al-Samarraie, 2023; Faulks et al., 2021). Social and digital human systems (SDHS) play a significant role in promoting employee engagement by encouraging a behaviour that prioritises learning. This behaviour facilitates the continuous exchange of knowledge, which is considered a crucial activity for fostering organisational readiness for innovation (Faulks et al., 2021). However, a significant hindrance to the aforementioned behaviours is constructed disengagement from Health Systems (SDHS) in the absence of knowledge, comprehension, and endorsement. This results in reduced involvement in decision-making processes, limited expression of viewpoints, and improper allocation of resources, thereby impeding the generation of innovation in a counterproductive manner (Mady, Arqawi, Al Shobaki, & Abu-Naser, 2020). Likewise, it is recommended that SDHS prioritise the establishment of employee trust through the cultivation of a constructive team-oriented work atmosphere, while also actively encouraging the development of virtues and trustworthiness among its staff members. Furthermore, a deeper comprehension of the significance and characteristics of

innovation by SDHS facilitates the process of effectively equipping and inspiring employees to engage in innovative practises (Kozioł-Nadolna, 2020).

(4) Sufficient Resource (SRES) and FRKS

In the context of innovation creation (Kozioł-Nadolna, 2020), the support of SRES is regarded as an essential element for attaining an organization's vision and objectives. The achievement of FRKS objectives can be facilitated through the implementation of appropriate budgetary measures and resource allocation, as well as the enhancement of knowledge, skills, and abilities (Dodoo, Surienty, & Al-Samarraie, 2023). Also, the provision of necessary resources is also crucial in ensuring success in this endeavour. In the given context, the Sustainable Development Goals (SDGs) pose a significant challenge for organisations tasked with the allocation and effective management of resources. Factors such as preparedness, inclusivity, ongoing innovation, and adequacy emerge as concerns in facilitating FRKS (Sapnirund, 2016).

(5) Managing and Supporting Learning Focus (MSLF) and FRKS

The occurrence of innovation necessitates deliberate efforts and is contingent upon external support, as it cannot manifest spontaneously. Moreover, the emphasis on acquiring knowledge fosters the development of imaginative and inventive tendencies (Pratimapakorn, 2021). Consequently, the implementation of the Management Strategy for Learning and Development (MSLF) assumes a pivotal role in the realm of human resource development. This strategy underscores a managerial perspective that places learning at the forefront and fosters a culture of ongoing learning, specifically within the context of Sustainable Development and Humanitarian Studies (SDHS). Moreover, it serves as a valuable tool for organisational decision-makers throughout the human resource development process. The promotion and cultivation of electronic competencies among employees can facilitate their active participation in electronic-related practises and activities (Alhamad et al., 2022). The Management of Strategic Learning and Fostering (MSLF) is a managerial procedure that cultivates a substantial emphasis on learning. It encompasses a variety of approaches that integrate both theoretical and practical knowledge. Furthermore, MSLF places particular importance on critical aspects

of learning management, experiences, contemporary technology system management, and networking. These elements are crucial for the development of skills in collaboration with businesses (Sapnirund, 2016).

(6) Freedom of Work (FRWO) and FRKS

FRWO is recognised as an additional factor that exerts a positive influence on FRKS and serves as a crucial determinant of organisational survival within the contemporary volatile business landscape (Brand et al., 2021). Organisations face a significant challenge in fostering and nurturing readiness in FRWO. This readiness encompasses an organization's ability to adapt, which is achieved by empowering employees with the necessary skills to perform their tasks effectively, ensuring technological readiness for daily operations, granting decision-making authority, encouraging the generation of innovative ideas, promoting active participation, and fostering a climate that encourages diverse opinions within the organisation (Brand et al., 2021; Orel, 2019). In substantiating this notion, individuals possessing creative and innovative aptitudes frequently exhibit a proclivity towards a lifestyle and work regimen distinguished by autonomy. Employees often engage deeply with specific geographical or environmental settings for limited durations, relying on infrastructure to sustain their individualised ways of life (Orel, 2019).

(7) Opportunity to Present Working Result to Organization (OPWRO) and FRKS

OPWRO, an acronym for Opportunities for Personal and Work-Related Growth, is commonly recognised as a strategic methodology designed to promote employee achievement and augment their impact within an organisational setting. The factor mentioned above has a significant impact on bolstering employees' confidence in their skills, demonstrating their abilities, and making meaningful contributions to the overall success of the organisation (Alnoor, Al-Abrrow, Abdullah, & Abbas, 2020). One additional noteworthy element of organisational perceived workplace relationship quality (OPWRO) pertains to its influence on employees' perceptions of organisational support, leading to increased levels of commitment and devotion to their work. When employees perceive themselves as

achieving success in their work and making significant contributions towards the attainment of the organization's objectives, they are more likely to demonstrate elevated levels of motivation and engagement. However, if employees perceive that the level of support provided by the organisation does not meet their expectations, it may lead to behaviours that could potentially affect their job performance. The construct commonly referred to as OPWRO is widely acknowledged as a significant variable that exerts a considerable impact on job performance. The aforementioned impact can be ascribed to the assimilation of knowledge, competencies, and proficiencies facilitated by the process of education and training. The variable under consideration is widely acknowledged to possess significant causal relationships between individual factors and the enhancement of job performance (Sapnirund, 2016).

(8) Awareness of Organization to Result Creating (AORC) and FRKS

The allocation of resources towards human capital is widely regarded as the most financially advantageous investment for an organisation. The acquisition of specialised knowledge and enhanced skills by employees enhances their value as assets and makes a substantial contribution to a company's competitive advantage (Sodirjonov, 2020; Yong et al., 2020). Employees who have a perception of the Attribution of Organisational Results and Consequences (AORC) will possess an understanding of how their work directly influences the overall performance of the organisation. Furthermore, they will evaluate their personal success based on multiple dimensions. The aforementioned perception plays a significant role in determining the level of success achieved by an organisation and is closely associated with the concept of FRKS (Politis & Grigoroudis,2022). The implementation of the AORC (Appreciation of Organisational Role and Contribution) programme fosters a heightened awareness among employees regarding their significance within the organisational structure. Employees perceive that they have attained a level of accomplishment in their professional endeavours, thereby making a substantial contribution to the overall success of the organisation. Additionally, it is worth noting that the organisation recognises, publicly acknowledges, and formally announces the employees' awareness of the support provided by the organisation (Goul et al.,2020).

Ultimately, the connection lies in the organization's inclination to offer employees ample opportunities to effectively utilise their knowledge, skills, and potential in demanding tasks that contribute to the advancement of the organisation (Aggarwal et al., 2022).

(9) Rewards and Recognition (R&R) and FRKS

The term R&R, or recognition and rewards, refers to the significance placed on acknowledging and compensating individuals for their achievements in diverse job domains. This encompasses both financial and non-financial forms of acknowledgment and incentives. Rest and relaxation (R&R) is identified as a noteworthy factor that stimulates employees, fostering increased commitment to their work and yielding positive effects on work performance (Weng et al.,2023). One facet of research and development (R&R) encompasses the process of effectively communicating or disseminating information to pertinent individuals or personnel within the organisation. This practise facilitates the dissemination of information to employees or staff members regarding the organization's endorsement of performance, resulting in mutual benefits for both employees and the organisation (Khassawneh & Mohammad,2022). Moreover, the proficient dissemination of information or news to pertinent stakeholders within the organisation serves to mitigate ambiguity and guarantees alignment among all individuals. The significance of rest and recuperation (R&R) is also evident in its capacity to optimise the value of employees through the facilitation of organisational support awareness, the influence on employees' feelings of fairness, respect, kindness, and support (FRKS), and the enhancement of employees' work performance. The cultivation of commitment and promotion of positive member behaviours within an organisation ultimately lead to enhanced job performance among employees (Paramita et al.,2020).

Innovative Outcomes in Robot-Based Teaching (IORBT)

From the perspective that *"the success of an organization must be created by the employees of that organization"*, it is widely recognised that in order to attain favourable outcomes and foster innovation, organisations must establish and endorse a range of elements that facilitate the cultivation of competencies among their personnel and

facilitate the generation of success and innovation within the (Paulus, 2000; Adam & Alarifi,2021; Pratimapakorn, 2021). Nevertheless, it is acknowledged that the attainment of success and the emergence of innovation cannot be universally ensured, as well as the fact that certain forms of innovation may not necessarily result in gaining a competitive edge. However, the effective management of innovation within an organisation presents prospects for attaining improved outcomes (Michael, 1990).This study is based on the concept of "*Areas influencing the management of technology and innovation*" of White and Bruton (2007). The utilisation of this framework serves as a guiding principle for the analysis of the technological and innovative management landscape within vocational education institutions in Thailand (Pratimapakorn, 2021).

(1) Experience and organizational history (EXP&HIS)

Teaching and learning undergo a process of accumulating experiences for learners, educators, and organisations, resulting in enhanced work methods, the cultivation of new awareness, and the fostering of the development of skills, understanding, and capabilities among personnel. It is widely believed that this phenomenon can lead to the development of improved work practises and the generation of novel techniques and innovations in the workplace, while also acknowledging the interconnectedness with the consequences arising from FRKS (Halberstadt, Timm, Kraus, & Gundolf, 2019). This study utilises various metrics, namely the acquisition and application of knowledge and experience by employees within the organisation. These metrics include the dissemination and utilisation of knowledge gained through employee learning, as well as the acquisition of knowledge and experience through problem-solving activities. The latter leads to the development of specialised problem-solving knowledge, which in turn creates opportunities for knowledge dissemination and storage within the organisation. The organisation facilitates a range of activities aimed at fostering the ongoing promotion of creative knowledge exchange.

(2) Socio-technical systems design (TECH&DESIGN)

The field of TECH&DESIGN encompasses the examination and enhancement of diverse organisational systems utilising a methodical and technically focused

methodology. The ability of organisations to effectively respond to technological advancements and innovative developments is crucial for improving their competitive edge and attaining success (Ayon & Dillon, 2021; Bayramova, Edwards, Roberts, & Rillie, 2023).

Moreover, TECH&DESIGN functions as a fundamental framework for cultivating innovation within an organisation. It is imperative for organisations and their constituents to acquire the ability to adapt to market challenges and prioritise innovative thinking, all the while maintaining a strong emphasis on achieving job-related objectives (Kozioł-Nadolna, 2020). This study evaluates TECH&DESIGN by employing the subsequent indicators. The organisation consistently enhances its products and services, modifying them over time in response to evolving socio-technical systems. The efficacy of knowledge and conventional work processes diminishes in response to alterations in socio-technical systems (Ayon & Dillon, 2021). Continuous improvement and change of work processes can be undertaken when it is determined that modifications in diverse contexts give rise to novel and substantial risks (Bayramova et al., 2023).

(3) Engineering activities (ENG&ACT)

ENG&ACT represents problem-solving in various production processes using engineering techniques and is part of IORBT (Mady et al., 2020; Tseng et al., 2021). The success of ENG&ACT is contingent upon the aptitudes of individuals possessing advanced theoretical knowledge and engineering expertise that surpasses basic foundational principles. This measure guarantees the augmentation of technical and engineering expertise within vocational education, thereby establishing a solid groundwork for the application of ENG&ACT in subsequent endeavours. This study evaluates the performance of ENG&ACT using the following indicators. The organisation has the capacity to consistently develop novel products by employing advanced engineering methodologies, thereby enabling it to efficiently respond to technological advancements. The organisation consistently engages in the advancement of its engineering systems, with a particular focus on the production sector. This sector necessitates ongoing enhancements and performance improvements in its production processes (Mady et al., 2020; Tseng et al., 2021).

(4) Science techniques (SCI&TECH)

The field of Science and Technology (SCI&TECH) encompasses the deliberate utilisation of scientific and technological management methodologies within an organisational context. The process involves comprehending the underlying principles and employing them as pragmatic directives to foster and augment the organisation. For example, it could encompass the enhancement of production efficiency, the implementation of economic concepts driven by innovation, or the utilisation of creative thinking, innovation, research, and development to augment competitive capabilities (Tohãnean et al.,2020; Silva et al.,2021). The support provided in the context of SCI&TECH aims to facilitate the acquisition of technical knowledge and the development of skills in the field. This is accomplished by harnessing the numerous benefits that science and technology (SCI&TECH) provide as essential foundations for education. When students are provided with knowledge and skill development that aligns with their current level and timing, and are complemented by suitable scientific and technological support, it results in the acquisition of personnel capabilities that are significant and relevant for the future (Hernandez-de-Menendez, Escobar Díaz, & Morales-Menendez, 2020).

This study assesses the measurement of SCI&TECH, which refers to an organization's proficiency in scientific methodologies and its capacity to utilise these methodologies to improve its operational processes. The organisation possesses the capacity to engage in product innovation by leveraging novel scientific techniques and incorporating newly acquired scientific knowledge into the process of product development (Hevner & Gregor, 2022). The utilisation of SCI&TECH serves as a means to augment the efficiency of production processes and stimulate economic growth driven by innovation. This is achieved through the application of creative thinking, research, and development to bolster an organization's competitive edge, while ensuring the harmonisation of all components within the organisation (Jabbarova, 2023; Silva, Pires, & Teles, 2021).

Research Framework

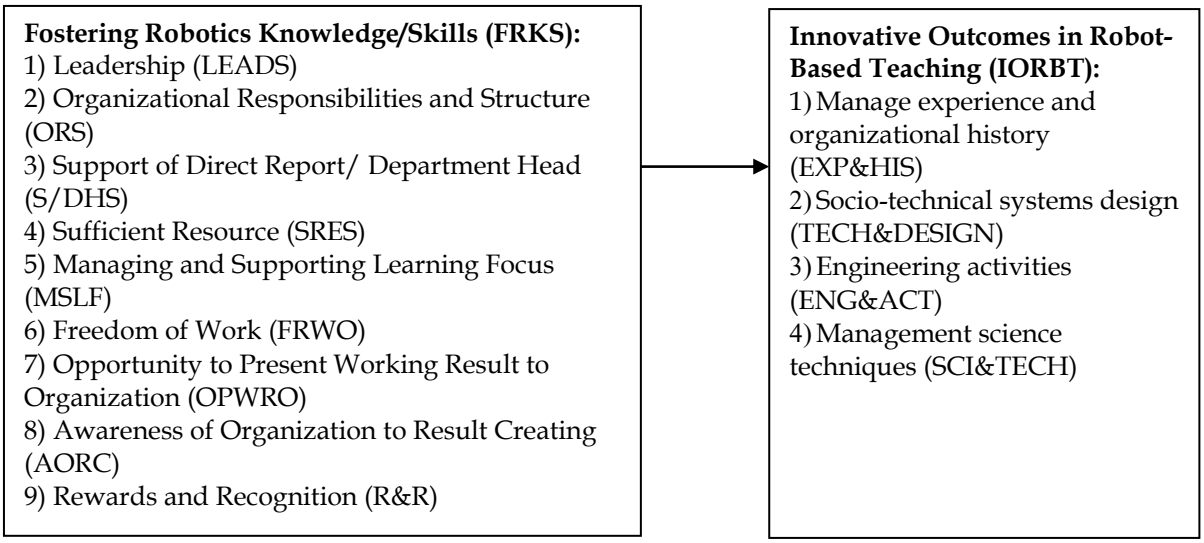

Figure 1. Research Framework

Research Methods

Population and Sample

The study employed a quantitative research approach, focusing on a population of vocational-level students who are affiliated with the regular school system under the Ministry of Education. The research was conducted in the year 2021, with a total of 1,379,761 students included in the study (Ministry of Education, 2023). The study utilised a purposive sampling method, which involved a total of 420 students at the vocational level in the Songkhla Province. Regarding the sample characteristics, the results revealed as follows:

(1) Most of them are male (89.29%). They are studying in the Industrial/Engineering technical college at a Vocation certificate (47.38%), a High Vocation certificate (41.43%) and a few in Bachelor's degree (11.19%).

(2) They are studying at the vocational level in the curriculum of "Robot Assembly, Robot Repair" (25.71%), "Mechatronics" (15.71%), "Mechanical Technician" (14.29%), "Electronics" (13.33%), "Electric" (12.14%), "Mechanical subject" (10.00%) and others, including "Robotic control subject", "Material handling equipment subject", "Car painting subject", "Subject of conveying materials for assembly", "Food processing subject", "Welding subject", respectively.

(3) Regarding learning situation, 72.90% agreed that it was learning to enhance skills rather than learning specific and related subjects. 68.57% have the status "Not learn about robot system, system that is part of robots, robot disassembly, or robots in different applications". 75.72% have the characteristics of learning methods as "Theory and practice together", and in the bilateral learning system where students go to study and work in factories. 54.05% of students wish to go to work in factories where robots are used.

Data Collection

A quantitative research questionnaire consisting of individual factors, and the level of individual FRKS opinions towards IORBT were used to study with Likert 5 Rating Scale, "1" = Min and "5" = Max, instrument quality check: IOC > 0.67, Cronbach's Alpha Coefficient. > .980 (Vanichbuncha, 2005).

Data Analysis

Descriptive Statistics, Inferential Statistics, and Multiple Regression Analysis (MRA).

Research Results

Opinions towards Fostering Robotics Knowledge/Skills (FRKS)

The results of comments on FRKS are shown in Table 1.

Table 1. Descriptive data of Fostering Robotics Knowledge/Skills (FRKS)

	Mean	SD	Level	Order
1) Leadership (LEADS)	3.61	1.16	High	2
2) Organizational Responsibilities and Structure (ORS)	3.60	1.13	High	4
3) Support of Direct Report/ Department Head (SDHS)	3.52	1.15	High	8
4) Sufficient Resource (SRES)	3.46	1.20	Middle	9
5) Managing and Supporting Learning Focus (MSLF)	3.67	1.14	High	1
6) Freedom of Work (FRWO)	3.59	1.12	High	5
7) Opportunity to Present Working Result to Organization (OPWRO)	3.57	1.13	High	6
8) Awareness of Organization to Result Creating (AORC)	3.54	1.14	High	7
9) Rewards and Recognition (R&R)	3.61	1.13	High	2
Overall	3.58	0.99	High	

The opinion towards Innovative Outcomes in Robot-Based Teaching (IORBT)

From Table 1, it was found that the opinions about FRKS overall were found to be in the "High" level (Mean = 3.58, SD = .99). The indicator with the highest value was MSLF (Mean = 3.67, SD = 1.14), followed by LEADS and R&R equally, ORS, FRWO, OPWRO, AORC, and SDHS at a "High" level, respectively. The lowest opinion was SRES (Mean = 3.46, SD = 1.20) at the "Middle" level.

The results of opinions towards IORBT are shown in Table 2.

Table 2. Descriptive data of opinion towards Innovative Outcomes in Robot-Based Teaching (IORBT)

	Mean	SD	Level	Order
1) Manage experience and organizational history (EXP&HIS)	3.52	1.05	High	2
2) Socio-technical systems design (TECH&DESIGN)	3.47	1.07	Middle	4
3) Engineering activities (ENG&ACT)	3.50	1.06	High	3
4) Management science techniques (SCI&TECH)	3.54	1.06	High	1
Overall	3.51	0.99	High	

From Table 2, it was found that the sample group had opinion towards IORBT overall at the "High" level (Mean = 3.51, SD = 0.99). In each factor, it was found that they had the highest opinion towards SCI&TECH (Mean = 3.54, SD = 1.06) and followed by EXP&HIS and ENG&ACT respectively at the same level while TECH&DESIGN is the least and ranks at the "Middle" level.

Research Hypothesis

The study provided a comprehensive analysis of the results obtained from the Magnetic Resonance Angiography (MRA) test using the Enter method. The detailed study variables included IORBT, LEADS, ORS, SDHS, SRES, MSLF, FRWO, OPWRO, AORC, and R&R. Using MRA (Multiple Regression Analysis) and hypothesis testing to look at the data, it was found that the Pearson correlation between the independent variable and the dependent variable, as shown in Table 3, was between 0.62 and 0.81. This correlation value can be considered reasonable,

indicating a moderate but not excessively high level of association between the variables. It can be inferred that no evidence of multicollinearity was detected (Armstrong, 2019; Aroian & Norris, 2001). All variables exhibited statistical significance at the.01 level, making them suitable for MRA analysis. The results of the MRA analysis can be found in Table 4.

Table 3. The correlation coefficient among the studied variables

Variable	IORBT	AORC	SDHS	SRES	OPWRO	MSLF	FRWO	R&R	ORS
AORC	0.74**								
SDHS	0.75**	0.72**							
SRES	0.73**	0.68**	0.72**						
OPWRO	0.71**	0.65**	0.72**	0.72**					
MSLF	0.68**	0.65**	0.62**	0.66**	0.64**				
FRWO	0.74**	0.68**	0.69**	0.67**	0.72**	0.75**			
R&R	0.75**	0.68**	0.67**	0.74**	0.71**	0.66**	0.76**		
ORS	0.78**	0.75**	0.76**	0.74**	0.76**	0.64**	0.73**	0.77**	
LEADS	0.77**	0.72**	0.72**	0.75**	0.73**	0.70**	0.74**	0.77**	0.81**

Remark: n = 420 *p-value ≤ .05, **p-value ≤ .01

Table 4. MRA test results, FRKS variables affecting IORBT

Model	Un-Std. Coef.		Std. Coef.	t-test	p-value
	B	Std. Error	Beta		
Constant	0.467	0.095		4.907	0.000**
LEADS	0.085	0.043	0.100	1.944	0.053
ORS	0.144	0.047	0.166	3.090	0.002**
SDHS	0.134	0.038	0.157	3.493	0.001**
SRES	0.084	0.037	0.102	2.250	0.025*
MSLF	0.059	0.036	0.068	1.637	0.102
FRWO	0.085	0.043	0.096	1.977	0.049**
OPWRO	0.026	0.039	0.030	0.664	0.507
AORC	0.134	0.037	0.155	3.596	0.000**
R&R	0.101	0.042	0.116	2.434	0.015*
F-Test				128.53	
p-value				.000	
R				0.859	
R^2				0.738	
Adjusted R^2				0.733	
Durbin-Watson				1.983	

According to the findings presented in Table 4, the multiple regression analysis (MRA) results indicate a coefficient of determination (Adjusted R2) of 0.733 and a Durbin-Watson statistic of 1.983. The analysis revealed that there are six factors within the FRKS construct that significantly influence the IORBT variable. These factors are identified as Awareness of Organisation to Result Creating (AORC), Support of Direct Report/Department Head (SDHS), Sufficient Resource (SRES), Freedom of Work (FRWO), Rewards and Recognition (R&R), and Organisational Responsibilities and Structure (ORS). Based on the statistical findings, it is possible to formulate the equation for the Standard Coefficient in the following manner.

IORBT = 0.155 AORC + 0.157 SDHS + 0.102 SRES + 0.096 FRWO + 0.116 R&R + 0.166 ORS

Result and Discussion

1)The present study seeks to examine learners' perception of Fostering Robotics Knowledge/Skills (FRKS) and Innovative Outcomes in Robot-Based Teaching (IORBT) in vocational colleges. Through the analysis of descriptive data from both groups of factors, it has been found that learners' overall perception towards both factors is rated as "High." Nevertheless, there exists a discrepancy when juxtaposed with the projected outcomes delineated in the policy framework established by the government, which envisions the capacity to escalate advancements to a "Very High" degree. It is imperative to conform to the requirements of the labour market, wherein the significance of incorporating technology and robotics is progressively escalating (Poláková et al.,2023). The aforementioned findings also demonstrate a deficiency in attaining the educational institution's goals, which encompass the cultivation of human capital to address the substantial educational demands within the realm of vocational education in the nation (Meng & Sumettikoon,2022)

The emergence of a development gap in vocational education management has led to a specific focus on the importance of FRKS. This entails the need for both theoretical learning and practical application of robots' technological and instrumental skills in real-world contexts (Benvenuti et al.,2023; Hernandez-de-Menendez, Escobar Díaz, & Morales-Menendez, 2020; Kaewcheed, 2020). Nevertheless, when examining

the particular facets of FRKS, it becomes apparent that there is a pressing requirement for expeditious advancement, given that the perspectives on this issue are assessed as being of moderate significance. There are two key aspects that need to be considered in this context. The first aspect is Sufficient Resource (SRES) for FRKS, and the second aspect is Socio-technical systems design (TECH&DESIGN) for IORBT.

2) The findings from the MRA analysis indicate that there are six primary factors that contribute to the perception of support from vocational college administrators in the context of outcome support for IORBT. These factors, in order of their relative importance, are ORS, SDHS, AORC, R&R, SRES, and FRWO. The findings of each section can be analysed and interpreted in the following manner.

- The significance of Organisational Responsibility Structures (ORS) lies in the fact that different components, in accordance with their respective organisational responsibilities and structure, must effectively address Functional Responsibilities and Key Success Factors (FRKS). This ensures the transmission of outcomes to the Integrated Organisational Results and Business Targets (IORBT). Moreover, fostering a collaborative atmosphere within the organisation is a crucial aspect. The Operational Readiness Survey (ORS) serves as a significant indicator of the extent to which the management level and technical aspects of an organisation are in harmony to effectively address the requirements of the formal organisational structure. The implementation of strategies to foster progress and growth within an organisation can be effectively managed through the manipulation of its organisational structure (Alhamad et al., 2022). The perception of FRKS by ORS has a significant impact on the behaviour, interpersonal relationships, and attitudes of employees, ultimately leading to successful attainment of continuous growth and development, as well as the establishment of an integrated system to accomplish organisational objectives (Alhamad et al., 2022; Saengchamnong & Viroonratch, 2020). The concepts of authority, responsibility, and leadership play a crucial role in shaping the nature of connections and driving the functioning of FRKS (an acronym representing a specific organisational framework or system). These elements are instrumental in facilitating the execution of processes that contribute to the attainment of organisational objectives and the overall performance of the organisation (Abbas et al., 2020).

- Social determinants of health (SDH) play a crucial role in reflecting the effectiveness of policy responses and the implementation of policies in real-world settings. According to the established management structure, SDHS assumes the primary leadership role in executing plans and translating them into action. In order to ensure the smooth functioning of business operations, it is imperative to establish a coordinated understanding of strategic decision-making and human systems (SDHS). This coordination enables business entities to exercise autonomy in determining the most appropriate course of action, implementing said action, and exerting influence over the factors that impact their performance, particularly in relation to achieving organisational objectives (Dodoo, Surienty, & Al-Samarraie, 2023; Faulks et al., 2021; Kozioł-Nadolna, 2020). According to Faulks et al. (2021), the presence of SDHS remains influential in facilitating and promoting engagement in behaviours that prioritise learning, as well as fostering a continuous exchange of knowledge. The aforementioned concept serves as the foundation for the preparedness required to achieve success in alignment with the diverse objectives of the organisation. On the contrary, Mady et al. (2020) propose that the absence of knowledge, understanding, and support for the aforementioned behaviours can serve as a significant hindrance to the effectiveness of SDHS as a resisting factor.

- The recognition of FRKS (Firm-specific Knowledge and Skills) through AORC (Acquisition, Organisation, Retention, and Creation) reflects a cognizance of the significance attributed to human resources, thereby establishing it as a catalyst for generating economic outcomes within the organisation. The acquisition of specialised knowledge and skills by employees enhances their value as assets and facilitates their contribution to the organization's competitive advantage (Sodirjonov, 2020; Yong et al., 2020). This phenomenon is also associated with the existence of organisations that offer employees the chance to fully utilise their knowledge, skills, and diverse potentials in order to tackle challenging tasks and drive organisational progress (Babapour Chafi et al., 2021). Moreover, it has been observed that employees who possess a clear understanding of the importance of AORC have a direct impact on their work practises. These work practises, in turn, are closely associated with the operational outcomes of the organisation and ultimately contribute to its overall

success. This success is typically assessed through the utilisation of diverse performance indicators, as highlighted by (Przegalinska et al.,2019). Employees will develop a sense of self-worth within the organisation, and their subjective evaluation of work achievement plays a role in the organization's overall success by means of recognition, gratitude, and public acknowledgement within the organisational context (Yang et al.,2022).

- The acknowledgment of the significant role of rest and relaxation (R&R) as a motivating force is imperative, as it fosters a sense of dedication among employees, thereby resulting in positive effects on work efficiency. Nevertheless, rest and relaxation (R&R) can manifest in diverse ways that have an impact on both individuals and collectives. This encompasses activities that entail the dissemination or communication of information to pertinent parties or individuals within the organisation, with the aim of generating a broader awareness beyond the employees themselves. Furthermore, it facilitates the cultivation of organisational backing, which in turn fosters the generation of valuable output, thereby yielding benefits for both employees and the organisation as a whole (Mascareño et al.,2021). The significance of rest and recuperation (R&R) is instrumental in enabling organisations to enhance the value of influential employees within the framework of FRKS. Moreover, it fosters a sense of commitment and encourages behaviours that align with being exemplary members, ultimately resulting in improved work performance (Shahzad et al.,2023).

- The acquisition of adequate resources poses a significant challenge in the administration of educational institutions, particularly those that operate within limited budgets and resource constraints. These constraints directly affect the ability to obtain resources that have a direct impact on FRKS (Hernandez-de-Menendez, Escobar Díaz, & Morales-Menendez, 2020). When the Strategic Resource Allocation System (SRES) impacts the Financial Resource Key System (FRKS) in the public sector, it poses significant challenges due to constraints in budget and personnel. Therefore, it becomes crucial to provide necessary support to ensure that SRES aligns with the vision and goals of FRKS. Hence, it is imperative for educational administrators to devise effective approaches to managing Student-Related Emotional Stress (SRES), cultivating relationships with industry stakeholders, adjusting pedagogical

techniques, and securing appropriate forms of assistance (Dodoo, Surienty, & Al-Samarraie, 2023).

- The concept of Freedom of Work (FRWO) exhibits resemblances to Organisational Resources and Structures (ORS) as it relates to the tangible working conditions and their influence on the Freedom of Work Knowledge and Skills (FRKS)((Munir,2021). The concept of Organisational Role Stress (ORS) pertains to the structured elements of the work setting, whereas the construct of Functional Role Work Overload (FRWO) encompasses the practical circumstances and demands encountered in actual work situations. The presence of FRWO has been identified as a crucial factor that fosters the development of creativity and innovation (Orel, 2019). As a result, the concept of Future Readiness for Workforce Optimisation (FRWO) emerges as a notable preoccupation for organisations that prioritise innovation and endeavour to establish and sustain a framework conducive to such preparedness. The achievement of this objective can be facilitated through the effective management of employees within the organisation, ensuring that they possess the appropriate levels of FRWO, technological readiness, decision-making authority, capacity to generate innovative ideas in the workplace, and active engagement in participation and feedback processes, all of which are aligned with the organization's FRKS goals (Brand et al., 2021).

Recommendation and Suggestions for Future Research

The administrators of vocational institutions that adhere to the prescribed guidelines and policies for educational operations, which align with the subject matter of this study, can employ the methodologies and findings as strategies for investigating and enhancing FRKS, as well as assessing the outcomes of IORBT within their respective institutions. This study presents findings on the outcomes of interventions aimed at enhancing students' awareness to a "High" degree. Nevertheless, there remain notable deficiencies in attaining the government's objective of attaining a "Very High" level, which is anticipated to effectively cultivate human capital by means of innovative pedagogical approaches employing robotics. Moreover, the examination of the factors that provide support, specifically the six factors that contribute to the enhancement of FRKS, can be utilised in educational

establishments by contemplating the manner in which these factors can be incorporated to assist institutions in attaining their objectives.

In subsequent research endeavours, it is imperative to direct attention towards the examination of the difficulties and barriers encountered during the implementation of pedagogical approaches integrating robotics as educational instruments, with a specific focus on the viewpoint of vocational college administrators.

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