Exploring Awareness of Labor Market Challenges in the Context of Automation and Robotization

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ABSTRACT	ARTICLE INFO

Background and Objectives: This study explores and evaluates the awareness of labor market challenges posed by automation and robotization within the framework of Thailand 4.0 among students and educators in various educational institutions in Thailand. It seeks to identify the sources and quality of information on this topic, investigate the role of educational institutions in imparting knowledge, and determine if universities adequately equip students with future-proof skills to face the demands of the evolving job market. The findings of this research will help identify areas that require improvement and inform policy decisions to address the potential threat of unemployment and unclaimed skills in the future labor market.

Methodology: This quantitative exploratory research adopts inductive reasoning and leverages statistical analysis through descriptive and inferential techniques, including calculating the Chi-square test of independence and the Spearman correlation test. Two distinct versions of the questionnaire tailored for educators and students, available in Thai to ensure clarity and relevance, were used. Six hundred and fifty-one participants, including students and educators representing 57 diverse educational institutions across Thailand, actively engaged in this data collection effort. Applying statistical techniques to the survey data, including descriptive statistics and inferential tests, yields valuable insights, effectively addressing our research questions.

Main Results: The research findings shed light on the level of awareness of the perceived labor market challenges associated with automation and robotization. A significant proportion of students (86.7%) were familiar with these challenges. However, only a tiny fraction (11.5%) has acquired this awareness through educational efforts by institutions, emphasizing the need for improvement. Most students inadvertently stumble upon information on these challenges through news and media sources, often considered superficial and needing more guidance for effective career planning. Furthermore, the study reveals a deficiency in university counseling services, leaving many students uncertain about their career prospects in a world influenced by automation and robotization.

Discussion: The study exposes concerning insights about the preparedness of educational institutions for the labor market challenges in the era of automation and robotization under Thailand 4.0. A significant proportion of students (40.6%) fear post-graduation unemployment, while a more substantial percentage (72.4%) anticipates their chosen professions becoming obsolete shortly after graduation, demanding urgent intervention. Furthermore, it highlights a lack of clear objectives within these institutions, casting doubts on the adequacy and relevance of current curricula. These findings necessitate a broader discussion on the challenges of automation and robotization in education.

Conclusions: While the study initially suggests that Thai educational institutions may not adequately prepare their students for the challenges of automation and robotization associated with Thailand 4.0, it is essential to recognize that the absence of explicit inclusion of technological disruptions within current curricula does not necessarily indicate failure on their part or a disconnect with the transforming labor market. Instead, it underscores the need for a more comprehensive evaluation. The study emphasizes the crucial role of educational institutions in shaping the future workforce and aligning themselves with the dynamic challenges of automation and robotization. Proactive steps, such as revising curricula, enhancing industry collaboration, and promoting lifelong learning, remain paramount. Neglecting to adapt to these changing conditions carries the risk of leaving a significant portion of the workforce unemployable and hindering Thailand's progress toward achieving its vision under Thailand 4.0.

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Introduction

The global labor market has undergone significant transformations in recent years, with the rising tide of automation and robotization making waves across various industries worldwide. Automation and robotization refer to using robots and automated systems to perform tasks previously carried out by humans (Davenport & Kirby, 2016). These processes involve using technology and machinery to streamline and optimize various functions across different industries. Automation and robotization are revolutionizing manufacturing, with robots performing repetitive tasks in automotive assembly lines, increasing efficiency, and reducing human labor requirements. Automated drones and robotic harvesters enhance crop monitoring and harvesting processes, optimizing labor allocation and productivity. The increasing adoption of automation and robotization across various sectors highlights the need to raise awareness among workers and students about the evolving labor landscape, emphasizing the importance of continuous skill development and adaptability. This awareness is crucial to ensure individuals are prepared for changing job requirements and can make informed career choices in industries influenced by automation and robotics. According to the World Economic Forum's 'Future of Jobs Report 2023,' these technological advancements are ushering in an era of profound change, affecting the very nature of work and employment (World Economic Forum, 2023).

While Thailand has yet to witness substantial AI-driven disruptions in its job industry, change is imminent. The country is vigorously implementing the Thailand 4.0 policy, a strategic initiative aimed at propelling Thailand toward digitization and emerging as a global leader in automation and robotics (Bangkok Post, 2017). This policy, supported by Frost & Sullivan's prediction that Thailand is poised to become a prominent market player, earmarks one-fifth of the world's automation and robotics market (Frost & Sullivan, 2018, p.238).

The implications of implementing such a policy are vast and touch upon multiple aspects of society, none more significant than the labor market. As the use of robots is slated to surge, the socio-economic fabric of Thailand is bound to undergo considerable shifts. Thus, it becomes increasingly crucial to assess the readiness of the community to confront the challenges posed by automation and robotization, particularly in managing the labor force rendered redundant by these technological advancements.

Paraphrasing the well-known adage 'Praemonitus, praemunitus,' which means 'forewarned is forearmed,' our research seeks to gauge the level of awareness among students on the cusp of graduating into a transformed labor market. The study is driven by the belief that the student's level of understanding is mainly contingent on the position of their universities and educators.

As such, the study not only explores students' awareness but also delves into the knowledge of teachers and the relevance of university programs to the challenges of tomorrow. Educators play a pivotal role in preparing the future workforce, imparting enduring skills that enable graduates to collaborate effectively with machines while excelling in areas where devices fall short, a concept put forth by Maxim & Muro (2019) in their discussions on adapting education and training systems to the demands of the modern workforce.

Research Question

The researcher's personal experiences and direct engagements with educational institutions and students have played a central role in shaping the focus of this study. While teaching at universities in recent years, it became evident that there was a significant gap in addressing potential job market disruptions caused by automation and robotization. Surprisingly, none of the universities where the researcher had the opportunity to teach during this period offered specialized programs or dedicated lectures on the topic. Interactions with students revealed a common trend: though some had heard about the potential threat of job

displacement due to automation and robotization, many perceived it as a distant concern with little direct impact on their career prospects. These firsthand observations underscored the critical need to investigate this topic, aiming to bridge the knowledge gap and provide invaluable insights for students and educators. This aligns with Teddlie's (2009) concept that an investigator's reasons for conducting research are the authentic starting point for Social Science research.

The researcher's curiosity about the issue led to the discovery of critical figures appointed by the Resolution of the Council of Ministers of Thailand on 29.08.2017, tasked with promoting the development of the robotics and automation industry in the country. Government-initiated measures, outlined in a Cabinet resolution, aimed to foster the growth of the robotics and automation industry. These measures empowered the Ministry of Industry to execute a series of strategic actions, fostering collaboration among the nation's leading agencies responsible for transferring robotics and automation technology from the educational sector to the commercial production of robots. This comprehensive approach encompassed four critical missions: Certification, Industrial Prototyping, Human Resource Development, and Consultation & Technology Transfer. Collectively, they demonstrated unwavering government support. Hickman et al. (2022) observed that such government-initiated measures play a crucial role in shaping the industry's landscape of automation and robotics.

A pivotal initiative born from this resolution was the establishment of the Center of Robotic Excellence (CoRE), a cooperative network comprising several leading agencies dedicated to bridging the gap between robotics and automation technology in education and its application in commercial robot production. One of CoRE's responsibilities, in collaboration with prominent educational institutions specializing in Artificial Intelligence (AI), was to support workforce preparation and re-education through training workshops and create awareness on the topic. Unfortunately, these commendable efforts faced hurdles due to a shortage of qualified professionals, resulting in re-education rates falling short of expectations (Center of Robotic Excellence [CoRE], 2018). For instance, in 2018, the CoRE network successfully re-trained 500 educators and professionals. In contrast, the robotics development roadmap approved by the Thai Ministry of Industry in August 2017 envisioned retraining 5,000 individuals annually. In comparison, Japan prepared 80 times more specialists within the same timeframe under a similar roadmap. Simultaneously, CoRE collaborates with just over 20 out of 228 universities and 416 higher vocational institutions in Thailand, a scale the organization acknowledges as inadequate.

Drawing upon the insights provided by the author's examination of secondary sources that analyze the impact of automation and robotization on the labor market, including works by Anzolin (2021), Bachmann (2022), and Rogers III & Freeman (2019), a pressing issue comes to the forefront: the level of awareness among students and educators. This prompts the fundamental research questions:

1. Are students and educators aware of the perils of future job loss due to automation and robotization?

2. Do university programs adequately prepare students for the challenges of the future?

3. Does the topic receive sufficient attention from relevant authorities regarding informative coverage?

4. What jobs are perceived as being in danger of disappearing due to automation and robotization?

In essence, the study aims to shed light on the awareness among students and educators regarding labor market challenges brought about by automation and robotization, acknowledging the vital role of personal experiences, societal importance, and existing research in shaping this research endeavor.

Definitions

In this study, the term "educator" is employed to encompass not only lecturers and teachers but also administrative personnel within universities, as well as individuals directly involved in the field of education. This broader definition may encompass employees of various government organizations responsible for overseeing different facets of Thailand's education system, as Michael & Trines (2018) described.

Throughout this research, the terms "automation" and "robotization" are used interchangeably, drawing from the definitions provided by the Collins English Dictionary. Specifically, "automation" refers to delegating control over various operations or devices to automatic systems, often involving computers. Conversely, "robotization" pertains to substituting humans in roles previously believed to be exclusively within the domain of human performance, including tasks that require cognitive skills from the operator.

Literature Review

The history of the development of human civilization suggests that technology has always contributed to the growth of well-being and the improvement of people's living conditions. From the perspective of advances in science and technology, four distinctive phases of such enhancements have been identified, the so-called industrial revolutions (Kagermann et al., 2013). Furthermore, when the fourth industrial revolution, which is the continuation of the development of digital technologies, is unfolding before our eyes, the question of how it may affect the whole of humanity should not seem to raise any doubts - like how it was done before. Nevertheless, it is essential to understand that things are not as straightforward as they may appear, and the prevailing notion is that this time will be characterized by a unique outcome (Virgillito, 2017). Other industrial revolutions were nothing like this one, which has no precedent regarding speed and breadth of change, which also means significant challenges to people (Fuldauer, 2019). The increased role of automation and machines in all aspects of human activities, according to Hassan, Nordin, & Ashari (2016), constitutes the current industrial revolution and will result in a situation when machines endowed with specific cognitive skills would fully "replace humans in jobs we thought could only be performed by humans" (Fuldauer, 2019). According to Torres (2019), the new reality is that robots are already replacing people in many jobs; however, so far, all this has been mainly about automation or delegating repetitive tasks to robots, which has never raised questions about the complete replacement of humans with intelligence-driven machines. This novelty creates uncertainty, which, in turn, leads to the emergence of different, often conflicting, forecasts and theories on negative and positive developments as well as threats and opportunities for humankind caused by further robotization of workplaces (Danaher, 2017; Sachs et al., 2015; Smids et al., 2019). Among the most pressing are debates on the possible effects of robotization on employment and inequality, which are now blossoming among scholars (Virgillito, 2017). While optimists argue that further automation and robotization will be a boon to human civilization, pessimists claim it may be a disaster. Such deep division was clearly shown in the research-based report by Smith & Anderson (2014), where 1,896 experts, prominent analysts of the Internet realm, and those who closely follow technology trends were asked to evaluate the economic impact of advances in Robotics and AI on employment and labor market of the near future, before 2025. Whereas slightly more than half of these experts (52%) did not expect significant job displacements, another half (48%) were concerned that the rise of AI and robotization would result in higher income inequality, unemployment, and some breakdowns in the social order. What is especially important for current research is that many of these notable experts were exceptionally concerned about the readiness of educational institutions to meet the challenges of tomorrow and whether they are adequately preparing students for the "skills that will be needed in the job market of the future" (Smith & Anderson, 2014).

The standard argument for many techno-optimists is an idea of the 'liberation' of individuals from manual and monotonous work, often called 'higher value-added works,' which will ultimately result in a better work-life balance. The direct consequence of such 'liberalization' would be a reduction in outdated jobs with equivalent simultaneous creation of new job positions in such areas as business development, customer engagement, or something called by Schmitt & Orlov (2019) 'higher-level jobs.' There is also a belief that 'the automation process and technology will not displace, but rather work alongside humans' (Bangkok Post, 2017). A good example of advocacy for such co-existence between humans and machines could be Timothy Hornyak's book 'Loving the Machines.' The author explains the ease with which the Japanese can adapt robotic technologies in industries and at home through various cultural and historical factors, as well as a positive portrayal of robots in pop culture, harmonized relationship between business owners and unionized workforce, and positioning of robots as a remedy for solving some social issues (Hornyak, 2006). As a result, Japanese people do not feel threatened by the presence of many robots among them but take them as a necessity that will help make their society better.

On the other hand, utterly different development paths for automation and robotization are drawn by techno-pessimists. This approach is grounded in the "widespread fear that robots and AI will take jobs and throw millions of people into poverty" (Darell, 2018). For example, based on a two-year study, McKinsey Global Institute report predicts that by 2030, as many as 800 million jobs could be lost worldwide to automation, whereas intelligent agents and robots could replace as much as 30 percent of the world's current human labor (Manyika et al., 2017). The study states that advances in automation and robotics will drastically affect everyday working lives, whereas up to 375 million workers may need to switch occupational categories and learn new skills. Similar estimates of 25 percent, this time for the U.S. job market, are given by Muro, Maxim, and Whiton (2019). The authors suggest that 70 plus percent of current job task content is at risk of substitution, and further automation and AI will affect virtually all occupational groups in the future. According to another estimate by Frey and Osborne (2017), about 47 percent of US employment is at risk. Similar counts for Thailand were given by PricewaterhouseCoopers Consulting, which suggests that 45% of work activities will be automated soon (Bangkok Post, 2017). The same source concludes that the changes in the workforce are unprecedented, and the future of work is uncertain. While these changes will speed up production, they will also mean significant challenges to people.

Methodological Approach

This quantitative exploratory study employs inductive logic and is grounded in the analysis of quantitative survey data. It utilizes descriptive and inferential statistical techniques to uncover previously unknown aspects of the phenomenon under investigation. The research follows a mixed-methods sequential approach, where qualitative data obtained from secondary sources and one-on-one interviews with faculty members inform the construction of a survey questionnaire. The questionnaire, pre-tested in a pilot study, is subsequently employed to collect quantitative data from a broader sample of students and educators. This mixed-methods technique enhances the depth and breadth of the results, facilitating more robust inferences (Teddlie, 2009).

Given its exploratory nature, which seeks to discern the level of awareness rapidly and cost-effectively within the academic community, this study employs a non-probability sampling technique, a suitable approach for such research (Baker et al., 2013). In essence, the study combines elements of action research with survey research methods. Although its focus is on examining awareness levels, it is in accordance with the action research goal of enhancing educational practices, consistent with the idea that such research endeavors aim to create innovative methods for practice improvement, as proposed by Schmuck and Perry in 2006. The

survey questionnaire is selected as a data collection method, particularly well-suited for gathering information from large groups where standardization is essential (Westat, 2002).

Ethical considerations are paramount throughout this research. Ethical approval has been secured from the relevant review board before initiating data collection to ensure adherence to established ethical guidelines (Smith, 2019). Informed consent is diligently obtained from all participants, emphasizing their right to withdraw from the study at any point without facing repercussions. The research maintains the confidentiality and anonymity of participants during data reporting and analysis. Participant privacy and well-being are protected, ensuring that their involvement in the study results in no harm.

Respondents

This research was conceived as an inter-university study, encompassing a diverse set of participants. The accessible population for this study comprises all students, teachers, and administrative staff from Thai universities, along with employees of government bodies whose roles directly relate to the field of education. In 2017, Thailand's educational landscape included 1,843,982 students across graduate and undergraduate levels (National Statistical Office, 2018). Additionally, 228 public and private universities employed 204,620 teachers and staff members in the same year (Joungtrakul, 2018).

Estimating the exact number of individuals in positions directly related to education was complex, encompassing a wide range of government organizations. Therefore, a pragmatic estimate of 300,000 educators was adopted to facilitate this exploratory research.

Given the study's nature, we ensured that the population sample's representativeness was optional. Hence, no demographic information, such as gender or age, was collected from the respondents. The principle of non-representativeness was also extended to the distribution of jobs for educators and the affiliation with specific universities, faculties, or majors of study for students.

The Taro Yamane method was employed to determine the sample size. The study aimed for a 95% confidence level and a 5% margin of error for the student population, leading to a sample size of 400 individuals. For educators, a 90% confidence level was sought, resulting in a sample size of 100 individuals.

Instruments

Two distinct yet interrelated questionnaires were employed to collect data from different segments of the participant population, i.e., students and educators. The questionnaires were designed to align with the research questions and objectives and undergo rigorous validation in a pilot study.

The pilot version of the questionnaires was initially drafted in English; however, it was observed that the response rates could have been better, mainly due to language comprehension issues. Consequently, the decision was made to make the final questionnaire versions available exclusively in Thai. Before distribution, the revised Thai versions underwent validation for clarity and comprehensiveness, encompassing face and content validity assessments. These validations were conducted in collaboration with 4th-year students and faculty members from Naresuan University International College, confirming that the Thai versions of the questionnaires were clear, comprehensive, and well-suited for the intended participants.

Furthermore, a comprehensive assessment of the research tool's reliability and content validity was conducted. To quantitatively evaluate the internal consistency of the tool's items, the researcher used Cronbach's α, resulting in a satisfactory score of $\alpha = 0.78$ (Nunnally, 1978). This measure ensures that the items collectively and effectively measure the intended construct.

Additionally, the researcher sought expert assessments of the tool's content and relevance to the research objectives through the Index of Content (IOC) method, which (with scores

ranging from 0.79 to 0.96 for all items) confirmed the tool's high content validity (Kaplowitz et al., 2004). These quantitative measures were complemented by a qualitative evaluation and sought recommendations from participants who trialed the research tool; key participant recommendations included providing clear instructions, maintaining logical question flow, incorporating feedback mechanisms, and developing comprehensive response options. Their qualitative feedback offered valuable insights into the tool's usability and any necessary refinements (Patton, 2002), contributing to its overall efficiency. This dual approach ensures that our research tool is reliable and robust, meeting the highest standards for data collection in our study.

The survey questionnaires comprised 11 questions for students and 10 for educators, including a mix of pre-defined response options and open-ended queries. These questionnaires were distributed offline and online, employing non-probability sampling techniques, including convenience, snowball, and self-selecting sampling. The researcher personally distributed printed copies and URL links to online questionnaires at specific physical locations, which included universities in Bangkok, Phitsanulok, and Hua-Hin. These locations were chosen due to the researcher's professional affiliations established through teaching, collaborative networking, and conference participation. Following this distribution, the initial recipients of the questionnaires played a crucial role in extending the reach of the surveys by sharing them with their friends and colleagues and within their professional networks and social communities. Simultaneously, paid social media advertising was used to target specific population groups across Thailand, facilitating the distribution and collection of surveys.

Procedures

To encourage participation, the questionnaire deliberately abstained from soliciting participants' personal or private information, except for fields of study for students and places of work for educators. The latter was not obligatory.

The gathering of responses spanned approximately three months, commencing in December 2019 and concluding in March 2020. Notably, students exhibited significantly higher online engagement than educators, resulting in a surplus of responses from this segment of the participant population. Subsequent scrutiny of the questionnaires focused on completeness, accuracy, and meaningfulness. Consequently, the researcher acquired 556 valid responses from students and 95 from educators.

Data Analysis

Before presenting the findings, it is vital to consider certain factors influencing the respondents' answers on the questionnaires distributed directly by the researcher offline, which was essential for initiating the survey.

Firstly, there appeared to be a noticeable reluctance, and in some cases, a fear among university administrative staff to provide negative comments to the questions, despite recognizing the gravity of the situation.

Secondly, teachers exhibited an apparent inclination to present reality more favorably and, at times, exaggerated their evaluation scores. On the other hand, students tended to respond positively to yes-no questions.

These observations were subsequently confirmed through statistical analysis, including comparing average responses between the online and paper versions of the questionnaires. This divergence aligns with the cultural significance of values such as 'face-saving' and 'criticism-avoidance' among the Thai people, as described by Komin (1990). However, considering the relatively small number of paper questionnaires ($N = 50$), it is reasonable to conclude that they did not significantly affect the overall pattern and tone of the responses.

Demography of Respondents

The respondent pool for this study consisted of 651 individuals. Among this group, 556 respondents (85.4%) were students representing various academic years of study. An additional 55 respondents (8.4%) were educators, 28 (4.3%) held administrative positions within universities, and 12 (1.8%) were engaged in roles directly related to the field of education.

These participants were drawn from 57 distinct educational institutions across Thailand, transforming this research into an expansive inter-university study. It is worth noting that the institutional affiliation question was optional, resulting in information being provided only by 286 respondents (43.9%). This implies that the number of participating universities could be even higher than the recorded figure.

The top ten universities, based on the number of participants, included KMITL, Kasetsart, Thammasat, Naresuan, Burapha, Bangkok, Mahidol, Thai Chamber of Commerce, Chulalongkorn, and the National Institute of Development Administration. Interestingly, despite being the starting point for this study, Naresuan University ranked fourth in survey responses, which might suggest the effectiveness of the researcher's distribution strategy.

The breadth of the study is underscored by information regarding educators' places of work and students' fields of study. Respondents represented a total of 152 fields of study or faculties. As determined by the number of mentions, the top ten included Business Administration, Business Management, Linguistics, Economics, Accounting, Engineering, Marketing, Architecture, Law, and Medicine.

Of the 556 student respondents, 540 (97.1%) pursued bachelor's degrees, while the remaining were enrolled in master's degree programs. Among the bachelor's degree students, 109 (20.2%) were in their first year, 294 (54.4%) in their second year, 49 (9.1%) in their third year, 83 (15.4%) in their fourth year, and 5 (0.9%) in their fifth year. All master's level students were in their first year of study.

Findings

Are students and educators aware of the perils of future job loss due to automation and robotization?

The frequency analysis of responses to this question indicates that nearly all, specifically 606 (93.0%) respondents, were conscious of the impending risk of job displacement due to automation and robotization. Out of four population segments, only all members of the administrative staff of the educational institutions are aware of such a threat, as presented in Table 1 below.

Table 1. Awareness of the problem

Answer	Students	Teacher	Admin Staff	Related	Total
Yes	523	47	28	8	606
No	33	8	0	4	45
Total	**556**	**55**	**28**	**12**	**651**

The chi-square goodness of fit test was conducted to compare the occurrence of "yes" and "no" responses among various population segments, specifically students and educators, to the expected occurrence of similar levels of awareness. The significant deviation from the expected distribution confirmed a substantial difference in the levels of awareness among different population segments, $\chi2$ (3, $N = 651$) = 20.90, $p < .001$.

To validate these figures, respondents were also requested to provide additional details on how they became aware of the potential job loss due to automation and robotization in the future. The results are outlined in Table 2. While the educators' responses aligned with the earlier question, with the majority gaining knowledge before the survey, the students' responses indicate that 74 acquired this information during the survey, implying that some students may have provided exaggerated responses to the previous question. Consequently, this observation reduces the total count of those already aware of the risk of robot job displacement before the survey by 41 responses. Most of these "extra" responses came from students in their first and second years of the bachelor's program.

Table 2. The source of the information

Learned From	Students	Teacher	Admin Staff	Related	Total
Current survey	74	8	0	4	86
The news	308	37	17	8	370
Relatives	38	0	0	0	38
Educational institutions	92	10	6	0	108
Other sources	44	0	5	0	49
Total	**556**	**55**	**28**	**12**	**651**

Considering the data presented in Table 1, it can be inferred that the actual number of respondents who were already aware of the issue before the survey is 565 (86.7%), not 606 (93.9%) as initially indicated.

According to the survey protocol, respondents who indicated that their primary source of information on the issue was their educational institution were asked to provide details on how they acquired this knowledge. All 16 educators attributed their awareness to their professional activities. Among the students, 50 (54.3%) mentioned that they learned about the issue through dedicated lectures, 14 (15.2%) received the information from counselors during enrolment, and 28 (30.4%) came across it unintentionally. A chi-square test of independence was conducted to explore the relationship between the source of information within an educational institution and the recipient of such information. The association between these variables was significant only for students, $\chi2$ (196, $N = 556$) = 247.85, $p = .007$. Students were likelier than educators to obtain information about the problem from their educational institution.

Further analysis through cross-tabulation revealed that these 64 students who obtained information through targeted educational efforts represent 19 universities, which accounts for 33.3% of the total 57 universities that participated in the research. The top seven universities in this aspect are Chiang Mai, Chulalongkorn, Kasetsart, Mahidol, Rangsit, Suranaree University of Technology, and Thammasat. The chi-square test of independence confirmed a significant difference in responses between students and educators $\chi2$ (12, $N = 651$) = 175.28, $p < .000$.

Do university programs adequately prepare students for the challenges of the future?

A five-point Likert scale, ranging from "1" for "no, they are irrelevant" to "5" for "yes, they are up to date," was employed to gauge the perceptions of students and educators regarding the extent to which current university programs align with the challenges of the future. With a mean score of 2.72 ($SD = 0.89$) for this variable, which indicates a position between "yes" and "no," it becomes evident that respondents encountered challenges while responding to this

question. Evaluating something that either does not exist or remains unknown is indeed challenging. Considering that most respondents acquired information about the issue from outside of their educational institutions, it is highly likely that university programs do not fully align with contemporary requirements. Further details regarding central tendency and distribution variation between the responses of different population segments can be found in Table 3.

Table 3. Evaluation of university programs.

Respondents	*M*	*N*	*SD*	Interpretation of Likert-scale Scores
Students	3.47	556	.972	Somehow Yes
Teachers (educators)	3.40	55	1.226	Neither Yes nor No
Admin Staff (educators)	2.46	28	.881	Rather No
Related (educators)	1.58	12	.515	No, they are irrelevant
Total	**2.72**	**651**	**0.898**	**Neither Yes nor No**

It became evident that the level of direct involvement of respondents in the educational process had a notable impact on their evaluation of university curricula.

A chi-square test of independence was conducted to validate this observed difference in responses between students and educators in relation to this section of the questionnaire, yielding statistically significant results, $\chi 2$ (12, $N = 651$) = 121.13, $p < .001$. Furthermore, the Spearman correlation test results reinforced this finding by indicating a low and negative association among various population segments and their response (rs (12) = -.197, $p < .001$).

Does the topic receive sufficient attention from relevant authorities regarding informative coverage?

A five-point Likert scale, ranging from "1" (indicating no informative efforts) to "5" (indicating extensive efforts), was employed to gauge respondents' perceptions of the authorities' informative coverage regarding the issue. Applying a harmonious interpretation of the Likert-scale scores with an interval of 0.80, the mean score of 2.81 ($SD = 0.90$) indicates that most respondents view the government's informative efforts as either partially satisfactory or unsatisfactory. It is plausible that respondents refrained from negative assessments because their primary source of information was news and media coverage. Nevertheless, they could not express optimism in their evaluation due to the general nature of the information in the public domain.

Table 4. Evaluation of the informative coverage of the problem

Respondents	M	N	SD	Interpretation of Likert-scale Scores
Students	3.32	556	.787	Neither Yes nor No
Teachers (educators)	3.07	55	.900	Neither Yes nor No
Admin Staff (educators)	2.93	28	.858	Neither Yes nor No
Related (educators)	1.92	12	1.084	Rather not enough
Total	**2.81**	**651**	**0.907**	**Neither Yes nor No**

The Chi-square test of independence ($\chi2$ (12, $N = 651$) = 110.69, $p < .001$) and the Spearman correlation test (r_s (12) = -.170, $p < .001$) validate the significant difference and indicate a low and negative association between the responses of various population segments to this survey question.

What jobs are perceived as being at risk of disappearing due to automation and robotization?

Nearly all respondents, specifically 642 (98.6%), offered valid responses to this question. Many respondents provided two or even more job titles that they perceived as endangered due to the further development of automation and robotization. The frequency analysis revealed 93 distinct job positions suggested by respondents, with 54 mentioned in multiple responses. Notably, the list of the eight most frequently mentioned professions is consistent for students and educators, as depicted in Table 5.

Table 5. High-risk jobs that were commonly identified by both categories of respondents.

No	The Job Thought to be in Danger	No of respondents
1	Accountant	147
2	Salesperson	134
3	Bank officer	85
4	Factory workers	74
5	Translator	67
6	Unskilled labor	39
7	Cashier	34
8	Teacher	24

The general staff, a profession mentioned 54 times, is not included in the table because students only mentioned it. Additionally, 85 other job titles suggested by respondents received fewer than ten mentions each.

It is noteworthy that these findings align with the predictions made by PricewaterhouseCoopers Consulting Thailand, which also anticipates that accountants, bank officers, and factory workers will be among the first to be impacted by digital disruption in Thailand due to the rise of automation technology and AI (Bangkok Post, 2017). This alignment not only underscores the credibility of the research data but also indicates that respondents have a good understanding of the potential consequences for the labor market resulting from such disruption.

Discussion

The high number of respondents ($N = 565$, 86.7%) who claimed to know about the risks of losing jobs to automation and robotization in the future must be treated with caution. Following the quantitative, outcomes-based evaluation approach, the high rates can be interpreted as a great success without any problems in this area. Nevertheless, when using a qualitative, process-based evaluation approach, it is essential to consider the cultural characteristics of Thai people, who tend to respond with 'yes' rather than directly saying 'no' when addressing questions (Katz, 2011; Leelaharattanarak, 2015; Witkowski & Wolfinbarger, 2001). As such, the number of those who were well acquainted with the topic before the survey will likely be smaller. Support for this idea is evident in the distribution of responses to the final question of the questionnaire, which asks whether respondents would have chosen a different specialty had they been familiar with the subject before enrolling in university. Only

49 (8.8%) respondents were confident in the correctness of their life choice, whereas 196 (35.3%) individuals would go for an alternative, and 311 (55.9%) would need some more information. This indirectly confirms the researcher's assumption that a significantly higher number of students needed to be more familiar with the substance of the issue even prior to the survey.

Furthermore, it is essential to note that the country has been actively pursuing Thailand's 4.0 policy for over four years. The vast majority of respondents (77.4%) are students with 1-3 years of study who, according to this policy, should have been familiarized with the problem. Suppose we continue to assume that the numbers were accurate and that most respondents were aware of the risks. In that case, there remains a question about the quality of this information and whether the respondents possessed the knowledge to effectively utilize it in preparing themselves to address the challenges posed by automation and robotization. Moreover, a puzzling issue arises: if 301 (54.1%) of students believe that the profession they are studying for will become obsolete upon graduation, why are they not taking action to improve their prospects? Many also believe they must change their profession within the first five years after graduation.

A few words about educators, especially teachers, are necessary. Shocking, in the researcher's opinion, is that for 8 (14.5%) of them, the study matter was utterly unknown before the survey. Adding to the concern is the fact that 37 (67.2%) of teachers learned about the problem from the news rather than through educational institutions or deliberate efforts by authorities or education stakeholders. All this reinforces the researcher's concern that governing bodies and universities are inadequately addressing these concerns. Therefore, the alignment of university programs with future challenges is of little relevance, likely the reason why most respondents could not score such compliance satisfactorily, with a mean score of 2.72. Only 27 (49.0%) teachers believe that the university curriculums are meeting the requirements of tomorrow. In Thai culture, individuals respond with 'yes' rather than 'no' when answering direct questions. Consequently, it is reasonable to infer that educators may have fewer optimists.

Regarding how the educators evaluate the prospects of their jobs, they believe they will only survive ten years, whereas 71 (74.7%) worried that it would disappear or undergo changes within the next five years. To respond to these challenges, 65 (68.4%) individuals want to invest time and effort into their professional development. In contrast, 15 (15.8%) believe such a necessity will arise in the next five years. Only five teachers and ten admin staff (15, 15.8%) are confident they will not need to do anything regarding their professional development.

Only 108 (19.1%) respondents learned about the risks to the labor market from education institutions: 94 students, 10 teachers, and 4 admin staff. While for all teachers and admin staff, such learning resulted from work-related activities, only for 64 (11.5%) students, it resulted from a purposeful educational effort by institutions. These 64 students represent 19 (33.3%) universities. In contrast, the top seven (excluding KMITL and Naresuan universities from where the survey took place) are Chiang Mai, Chulalongkorn, Kasetsart, Mahidol, Rangsit, Suranaree University of Technology, and Thammasat universities. Five of these are amongst the top ten Thai universities, per the uniRank (2023) ranking, and three are members of the CoRE collaborative network, which may explain why students and educators from these universities are better informed than their counterparts in other places. It also hints at exclusivity and inequality, which may reign in the educational system.

Thailand and the rest of the industrial world are only on the verge of the fourth industrial revolution, which portends tremendous changes to all areas of human activity. Some of these changes originate from the broader use of automation and robotization for business and personal needs. Following its new economic model, Thailand 4.0, the country aims to be one of the world leaders in producing industrial robots. It plans to increase automation and robots significantly soon (Thailand Board of Investment, 2019; Prachatai, 2018). This, in turn, will

likely result in significant disruptions to the workforce, which, according to Darell (2018), is predicted by all major studies conducted in recent years. The changes to the workforce, which are already taking place before our eyes in some parts of the world, are unprecedented, and the future of work is uncertain, echoes Fuldauer (2019). However, it seems that the Thai high officials do not fully share this universal concern; otherwise, how can one explain the expression by Deputy Permanent Secretary of the Ministry of Labor, Mrs. Petcharat Sin-auay, that "There have not yet been layoffs from the introduction of robots, and it cannot be known if there will be mass layoffs in the future" (Prachatai, 2018). She is echoed by the Chairman of the Federation of Thai Industries (FTI), Mr. Chen Namchaisiri, who believes that 'It is unlikely to have a sharp rise of unemployment because most of those who are to be affected by the shift from human workers to robots are unskilled foreigners' (Bangkok Post, 2017). Unfortunately, Mr. Chen did not explain how unemployment will omit that 83.5 % of the Thai workforce, which, according to a recent World Bank survey, are unskilled (The Nation, 2016). On the other hand, Secretary-General of the National Economic and Social Development Board (NESDB), Mr. Porametee Vimolsiri, suggests in Bangkok Post (2017) that 'the market itself can take care of this future transformations.' Most likely, such a frivolous attitude also reigns in the field of education, which could explain the findings and conclusions made from it.

Delimitations and Limitations

The inter-university study aimed to collect data from students and educators across all universities in Thailand. However, this ambitious goal was unattainable due to limited resources and time constraints. Consequently, the research team had to work within a reasonable timeframe, which affected the number of responses, reducing them to the necessary statistical minimum. Additionally, the research encountered difficulties when surveying educators, prompting a revision of the initial confidence level for this group from 95% to 90%. As a result, the sample size for educators became smaller.

Given that the primary focus of this study was quantitative, it would have been more appropriate to employ a "probability sampling technique as a primary method of selecting large, representative samples," as suggested by Babbie (2007, p.192). Nevertheless, the research opted for non-probability sampling techniques due to the earlier constraints.

Throughout the survey's initial offline mode, the researchers observed specific challenges related to the respondents' characteristics, possibly influenced by the cultural traits of the Thai people. Respondents appeared to struggle when responding to close-ended items with clear "yes/no" options. This observation raises concerns that the use of close-ended questions in the research may have compromised the precision of the instruments, potentially affecting the research findings.

It is important to note that the scarcity of available resources led to the use of quantitative methods to collect data from a larger sample of students and educators.

Recommendations

The delimitations and limitations encountered during this study provide valuable insights to inform future research endeavors. To gain a more comprehensive understanding of awareness and perceptions regarding labor market challenges stemming from automation and robotization, future studies should broaden their scope to encompass a more diverse and extensive population. This inclusive approach should involve students, educators, and professionals directly affected by these technological shifts, enabling a holistic comprehension of labor market challenges within this evolving landscape.

Also, future research should move beyond quantitative outcome-based evaluations and consider qualitative, process-oriented, and quality-based assessments to gain deeper insights

into the presentation and implications of pertinent information. Conducting longitudinal studies may uncover best practices that can be adopted on a broader scale.

Furthermore, exploring the high school context, particularly at the Matthayom level, holds promise. This is a critical juncture where students make pivotal decisions about their academic and professional paths. Providing timely, relevant information at this stage can significantly influence students' future choices, aiding them in making well-informed decisions.

Moreover, comparative studies, whether among Thai universities or across international institutions, can identify leaders, set benchmarks, and unearth best practices in higher education. This approach offers invaluable insights for enhancing educational systems.

Addressing challenges such as inadequate university counseling services and uncertainties surrounding career prospects is paramount. To prepare the workforce for the future economy, educational institutions should revamp curricula, bolster counseling services, and collaborate closely with governments and businesses. Expanding universities' roles to encompass retraining the existing workforce should be a central focus of future research efforts.

Conclusion

The conducted research found that the majority of the surveyed 565 (86.7%) reportedly knew about the problem before the survey, which is undoubtedly an excellent result. However, a close look at these findings, particularly at how this knowledge was acquired through the focus of current research, revealed that only a tiny fraction of all students (64, 11.5%) had learned this information due to a purposeful educational effort by institutions. In contrast, the rest learned it inadvertently from friends, relatives, news, or elsewhere. Considering that these 64 students represent 19 (33.3%) engaging universities, it is straightforward to conclude that only 24.5% of all Thai universities somehow convey the information to their students. On the other hand, the research data suggests that most respondents (370, 56.8%) learned about the problem from the news and public media. However, almost none of the respondents favored this information effort on the authorities' side, rating it as very superficial and one that does not allow any connection between the problem and how to deal with it. In this regard, the informative effort of the collaborative network of Thai universities is also doubtful. The network, led by the CoRE in its brief existence, has been seemingly unable to convey the importance of this issue to all concerned, including government agencies. All these suggest that informative coverage of the problem in media and universities must be more effective.

Even more disheartening is that only 14 (2.5%) students were informed about the expected changes to the job market by the university counselor or recruiting specialist during enrollment. This quantity correlates very well with those 11 students whose choice of major was prompted by the same recruiters. Since these 14 students represent only 5 out of 57 universities that took part in the research, one could conclude that it is highly likely that only 8.7% of all Thai universities have a well-tuned system of counseling, whose purpose should be helping prospective and current students in making informed choices about their majors or career paths. Concerning the focus of the current research, such an informative decision would be the choice of profession, which will be in demand in the future labor market. Another possibility is that most universities do not provide such services to their students, leaving them unprepared to navigate the increasingly complex world of work (Escobari et al., 2019). As a result, 538 (96.7%) students had to rely solely on deliberate or spontaneous decisions at enrolment. This could explain the disappointment and hopelessness of 226 (40.6%) of them, who already realized, during their studies, the improbability of working by profession after graduation. Slightly more, 301 (54.1%) students believe the profession they studied for would not be relevant to the market's requirements after graduation. At the same time, another 102

(18.3%) students thought that the profession they studied for would disappear within five years after graduation.

Nevertheless, the absence of relevant university programs can explain why 72.4% of students could be unemployed immediately after graduation. At least in favor of this, all the respondents unanimously agreed that current university programs do not align with future requirements. In contrast, administrative staff and those related to the educational field were even more negative in their assessments. A few critical conclusions arise from this: (1) educational institutions in Thailand need to take the challenges of automation and robotization seriously, and (2) they still offer outdated curriculums and inefficient support and counseling services.

According to Frost & Sullivan (2018, p.39), due to the lack of alternatives for the development of society towards its further digitalization, automation, and robotization, the most crucial role in shaping the process of division of labor market between human workers, robots, and algorithms, will be a workforce planning. In this regard, the companies must be ready for extensive re-skilling. In contrast, governments need to develop relevant programs and policies, suggests Leaser (2019). A unique role here is assigned to educational institutions, whose job is to help the businesses and government transition to an innovation-led economy; they have a moral obligation to educate students better than they do now. Universities need to transform themselves to serve a changing society and a profoundly changed world. Mainly, with an eye on the findings presented in this paper, universities should review and re-design their curriculums to ensure that their programs are relevant to the needs of the future labor market as well as transform faculty-based counseling services to student-centric; recommendations that are pretty similar to those stated in Agenda 1 of Thailand 4.0 model. Subsequently, to address the worries (or real problem) of 72.4% of students who feel insecure about the future of their chosen professions, universities should simplify the system of changing the majors, especially for those with 1-2 years of study. In turn, authorities, especially those responsible for guiding the transition to a digital-driven economy, should promote the concept and provide practical measures and tools to help individuals shape their future.

Acknowledgments

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