INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN PROGRESSIVE EDUCATION & DEVELOPMENT

OPEN ACCESS JOURNAL

Vol 14, Issue 2, (2025) E-ISSN: 2226-6348

Skills Sets for Workforce In Fourth Industrial Revolution: Lifelong Learning In Digital Age

Aizuddin Saari, Nur Atiqah Jalaludin*, Mohamad Sattar Rasul, Ruhizan Mohamad Yasin

STEM Enculturation Research Center, Faculty of Education, Universiti Kebangsaan Malaysia

*Corresponding Author Email: nuratiqah.jalaludin@ukm.edu.my

To Link this Article: http://dx.doi.org/10.6007/IJARPED/v14-i2/25685 DOI:10.6007/IJARPED/v14-i2/25685

Published Online: 29 June 2025

Abstract

The World Economic Forum has identified the Fourth Industrial Revolution (4IR) as a transformative era characterized by the convergence of three major technological domains: digital, physical systems, and biological advancements. This revolution is expected to significantly impact societal structures and reshape the dynamics of the global labor market. The coming of the 4IR demands further action in recognising industry trends, employment demands, and opportunities that may occur in line with this revolution, particularly in terms of strengthening potential for 4IR aligned skills development. Existing and new jobs will demand different skill sets, which will modify and redefine how people work. Many countries are concerned about ensuring social equality, social inclusion, poverty reduction, and peace, and are dedicated to doing so. In this rapidly changing landscape, lifelong learning plays a critical role in ensuring that individuals remain adaptable and equipped with the necessary expertise to thrive. The continuous acquisition of skills, whether through upskilling or reskilling, is essential to meet the demands of automation, artificial intelligence, and digital transformation. Without a strong emphasis on lifelong learning, workers risk becoming obsolete in an increasingly technology-driven environment. This study aims to identify a strategic aspect in lifelong learning for skill development in 4IR. The data was collected using qualitative research methodology using a focus group. The focus group method involves stakeholders from the competence body, the Department of Skills Development Industry Lead Body (ILB) of various industries, and an academician from various TVET institutions participating in focus group discussions on the aspect of policies and governance for skills development in line with 4IR.The findings showed three strategic aspect that can be used as a guideline to develop the skills set for 4IR. This study is motivated by the global need to future-proof the workforce against 4IR disruptions. Despite widespread discourse, gaps remain in integrating lifelong learning into skills development, particularly within TVET. This study addresses that gap by providing strategic insights to strengthen upskilling, reskilling, and workforce adaptability in line with 4IR demands.

Keywords: Lifelong Learning, Skills Development, Fourth Industrial Revolution

Introduction

The fourth industrial revolution (4IR) has brought about significant changes in the workforce, necessitating a shift in skill sets to adapt to the demands of the digital age. As the landscape of work continues to evolve, there is a growing emphasis on lifelong learning and the acquisition of new skills to remain competitive in the 4IR. The workforce now requires high-level technical skills, higher-order cognitive skills, and human or interpersonal skills to effectively navigate the challenges posed by the 4IR (Mudzar & Chew, 2022). This shift in skill requirements is further underscored by the need for a combination of technical skills and soft skills, as highlighted in recent research (Saari et al., 2021). Moreover, the demand for problem-solving skills in technology-rich environments has become increasingly crucial in the digital era (De Wever et al., 2023).

The impact of the 4IR on the workforce extends beyond technical competencies, encompassing the need for an entrepreneurial mindset and the ability to leverage high-impact technologies (Saari et al., 2021). This aligns with the assertion that management and leadership will have to adapt to a new set of skills to succeed in the 4IR (Alade & Windapo, 2021). Furthermore, the evolving technological landscape has led to a redefinition of talent management challenges, necessitating strategic human resource management to address the transformational changes brought about by the 4IR (Gallardo & Collings, 2021).

In the context of the 4IR, the development of human resource capabilities is influenced by institutional pressures, which in turn, positively impact workforce skills, both technical and managerial (Alam & Dhamija, 2022). This highlights the interconnectedness of organizational dynamics and skill development in the digital age. Additionally, the integration of communication and computational capabilities with physical processes, as seen in Cyber-Physical Systems (CPS), forms the basis of the 4IR, further emphasizing the need for a holistic skill set that encompasses both technical and human-centric competencies (Fantini et al., 2020).

The digital revolution in the 4IR has also underscored the importance of digital literacy in supporting lifelong learning, particularly in providing easier access to information (Moonasar, 2024). As the 4IR continues to unfold, the role of education in developing globally competitive and functionally literate learners becomes increasingly critical, necessitating innovative and engaging pedagogical strategies (Baterna et al., 2020).

The motivation for this study stems from the growing concern that many existing workforce training systems remain misaligned with the fast-paced, technology-driven demands of the 4IR. Despite the global emphasis on reskilling and upskilling, practical frameworks that integrate lifelong learning into national skills strategies remain fragmented, particularly in the Malaysian context. This study contributes by identifying strategic aspects that can empower workforce development through continuous learning, institutional-industry collaboration, and policy enhancement. It fills a critical gap by providing empirically grounded recommendations that not only prepare individuals to meet future job market expectations but also strengthen Malaysia's competitiveness in the global economy.

In conclusion, the workforce in the 4IR requires a multifaceted skill set that encompasses technical proficiency, problem-solving abilities, an entrepreneurial mindset, and strong

interpersonal skills. Lifelong learning and the acquisition of new skills are pivotal in navigating the complexities of the digital age and ensuring the continued relevance of the workforce.

Theoretical Concept

The study focuses on the concept of lifelong learning in the context of the fourth industrial revolution (4IR). The 4IR has led to a significant transformation in the workforce, necessitating the acquisition of new skills and competencies to adapt to the demands of the digital era. This aligns with the constructivist theory, which emphasizes the critical evaluation of rapidly developing digital technologies within lifelong learning and their role in promoting access to practical and theoretical knowledge Mohammed & Kinyo (2020). The study also integrates the literature with logical beliefs to suggest appropriate management practices for Industry 4.0, highlighting the need for a dynamic response to the 4IR through open innovation and the dynamic combination of technology, market, and society (Iroha, 2023).

Furthermore, lifelong learning is intricately linked to the development of new competences, processes, and work cultures in the 4IR (Odewole et al., 2023). This necessitates a strong revision of traditional managerial approaches and the attainment of new competences and tools to align strategies and activities with the evolving labor features in the digital age. Additionally, the study on HRM 4.0 and the new managerial competences profile emphasizes the engagement of multiple rationalities, internal and external stakeholders, and reconstructive reflexivity concerning the interconnection between the digital age, HRM, and the generation of social value (Fregnan et al., 2020).

Moreover, the study on the expectations of employability skills in the 4IR highlights the industry's demand for communication, ICT or digital, leadership, interpersonal, and personal qualities skills, underscoring the need for a multifaceted skill set to navigate the changes in the workplace (Tajuddin et al., 2022). This is further supported by the identification of Fourth Industrial Revolution skills, such as creativity, critical thinking, problem-solving, emotional intelligence, people management, negotiation, decision-making, flexibility, and guidance of individuals, as essential for embedding in science curricula ("Embedding Fourth Industrial Revolution Skills in Science Curricula", 2023).

In conclusion, the theoretical concept in this study centers on the imperative of lifelong learning in the digital age, the development of new competences, and the acquisition of multifaceted skills to effectively respond to the challenges and opportunities presented by the fourth industrial revolution.

Methodology

Research Design

A qualitative research design within a focus group discussion (FGD) is used in the data collection procedures for this study. The FGD entails small groups of participants contributing to moderate group discussions on a certain topic (Bloor et al. 2001). This method is an economical, fast, and efficient method for obtaining data from multiple participants (Krueger & Casey, 2000). In this study, the focus groups assisted in identifying the most relevant issues to be discussed during the discussion session. Focus group discussion is a valuable qualitative research method for observing and understanding the depth and breadth of opinions, experiences, and attitudes related to a specific topic. The richness of the insights gained from

focus groups can complement the received data and provide a holistic view of the subject matter. Thematic Analysis (TA) is an accessible, flexible, and increasingly popular method of qualitative data analysis and provides a systematic and structured approach to analyzing qualitative data. Researchers follow a clear set of steps, including data familiarization, coding, theme identification, and interpretation, which helps ensure rigor and consistency in the analysis process (Braun & Clarke 2006).

Expert Participant / Panels

A total of 20 individuals participated in the focus groups session which consists of competence body which is Department of Skills Development (DSD) Malaysia, industry players from Industry Lead Body (ILB) appointed by DSD of various industry and an academician from the different TVET institutions. All the participants agreed and signed a consent letter to participate in the discussion. The DSD has also taken the initiative to introduce the Industrial Lead Bodies (ILB) that are involved in ensuring the National Occupational Skills Standard (NOSS) is developed in tandem with the respective industry's standards and requirements. This move will also forge more relationships between the DSD and the industry to inline the skills program development and enable double certification with cooperative Licensing Bodies. The DSD has set up Industry Lead Bodies (ILB) which represents specific industry sectors as strategic partners in determining the needs for the development of skilled workers, enhancing the acceptance of the skills- testing industry and becoming the driver of skilled worker development and training. Among ILB functions are the analysis of relevant occupations within specific industries, development of new the NOSS and periodic review of existing NOSS. The role and responsibility of ILB in this research as a panel in the FGD are to identify industry trends, job demands and possibilities that may arise in parallel with this revolution especially to strengthening potential for skills development in line with 4IR.

Data Collection Procedure

All participants of this study were actively involved in the discussion. Participants were divided into groups and also given a moderator who lead the discussion and two rapporteurs who worked to help, record the conversation and subsequently record the important content of the discussion. Moderator's Role to leads the focus group discussion and facilitate the conversation, encourage participants to express their thoughts openly, and ask probing questions to get deeper into their responses. The discussion lasted for four hours and each participant was given the opportunity to voice out their opinions and views. The instrument used in this study was a set of questions based on the objectives of this study.

Interview Protocol

The questions were checked and confirmed by the expert for a structured discussion. The moderator presents a set of questions or topics for discussion. These questions are carefully designed to explore various aspects of the subject matter. Participants are encouraged to share their opinions, experiences, and feelings. All the question were:(1)What type of skills you think is relevant for the 4th Industrial Revolution workforce?; (2)What industry sectors you expect to emerge or grow in the forthcoming of the 4th Industrial Revolution?; (3)What industry sectors you expect will be disrupted by the forthcoming of the 4th Industrial Revolution?; (4)How relevant and prepared is our TVET system and training skills provider for the 4th Industrial Revolution?; (5)How can your organization helps to develop the skills sets required together with the institution?; (6)What human resource skills does your organization

needs to develop in preparation for the 4th Industrial Revolution?; (7) What kind of IT challenges that TVET providers will face keeping up with the 4th industrial Revolution?. The moderator observe the discussion in real-time. This observation involves paying attention to verbal and non-verbal cues, such as body language, tone of voice, and facial expressions. These cues provide valuable insights into participants' emotions and attitudes. Focus groups allow researchers to observe how participants interact with each other. Group dynamics can influence the opinions expressed and provide additional context to the information gathered. Researchers can analyze these dynamics to better understand how the group's collective thinking evolves. Focus groups provide an opportunity for participants to explain their responses in depth. Researchers can ask follow-up questions to clarify and explore participants' perspectives further. At the end of the focus group, participants may be asked to provide feedback on specific ideas, concepts, or products. This feedback can be valuable for refining or improving the subject of interest. The data from focus group session was collected using recording audio and were transcribed and analyzed using thematic analysis to identify the theme and code aided by data analysis software, ATLAS.ti.

Data Analysis Procedure

In this study, researchers used theme analysis method to analyze the collected interview data. Theme analysis is one of the methods of identifying, analyzing and reporting patterns (themes) in qualitative data (Zhan et al., 2021). Data between study participants and data from various sources will be compared to determine appropriate categories and themes. This analysis process was done using Atlas.Ti software to manage and generate code for the theme.

The theme table is not determined from the beginning of the study, however, the data analysis process started from open coding to get as many themes and categories to be associated with the study phenomenon, followed by axial coding and selective coding. Therefore, managing and categorizing the data is the most important component throughout the study from the beginning to the conclusion stage of the study findings (Merriam, 2009). This analysis minimally organizes and describes the set data in detail. Hence, for this study, it refers to the findings and emergence of themes derived from the interview results. Theme determination can also be determined using Atlas.ti software.

Atlas.ti software has been developed specifically for research based on the Grounded Theory approach (Silverman, 2013). ATLAS.ti is a qualitative data analysis software program that allows any researcher to manage, encode, analyze, and extract processed data in a variety of simple methods, thus making the researcher’s data easier to understand (Abdullah & Chan, 2018). According to Gibbs (2007), the implementation of qualitative analysis requires a large amount of carefully and complex managed text, code, memos and notes. ATLAS.ti can help researchers to “explore hidden phenomena in data”, by allowing researchers to collect large amounts of data, including interview transcripts, PDFs, Microsoft Word documents, html, images, and even audio and video recordings. The data can then be coded and analyzed for themes and other information. In the context of this study, researchers used ATLAS.ti as a tool to easily manage data that were collected from the analysis of circuit surveys and interview data that were conducted with experts.

Results

The utilization of a qualitative research design in the study on "Skills Sets for Workforce in the 4th Industrial Revolution: Lifelong Learning in Digital Age" would provide valuable insights into the nuanced perspectives and experiences of individuals within the workforce. By employing a qualitative approach, the study could delve into the multifaceted nature of skills required in the 4IR, capturing the intricacies of human experiences and the dynamic interplay between individuals and the evolving digital landscape.

Qualitative research methods, such as focus group discussions and semi-structured interviews, would enable the exploration of the expectations, challenges, and opportunities faced by authorities, industrial players, educators, employers, and policymakers in the context of the 4IR (Saari et al., 2021; Muhammad et al., 2023). Through in-depth interviews and focus groups, the study could gather rich, contextual data on the skills and competencies deemed essential for navigating the digital age, providing a comprehensive understanding of the multifaceted skill sets required in the 4IR (Alam & Dhamija, 2022; Ivaldi et al., 2021).

Furthermore, a qualitative approach would facilitate the exploration of the impact of the 4IR on workforce skills and economic mobility, allowing for a nuanced understanding of the challenges and opportunities faced by individuals in developing countries (Muhammad et al., 2023). Additionally, qualitative research would be instrumental in identifying the specific skills gap within the construction industry, shedding light on the competencies required for productivity and efficiency in building construction projects (Hidayat et al., 2019).

Moreover, a qualitative research design would enable the study to capture the diverse perspectives of stakeholders, including workers, educators, employers, and policymakers, providing a holistic view of the expectations and challenges related to workforce skills in the 4IR (Muhammad et al., 2023). This approach aligns with the complexity of the digital age, allowing for a nuanced exploration of the multifaceted skill sets required to thrive in the 4IR (Saari et al., 2021; Alam & Dhamija, 2022).

In conclusion, the utilization of qualitative research methods would offer a comprehensive understanding of the multifaceted skill sets required for the workforce in the 4IR, capturing the diverse perspectives and experiences of individuals within the digital age.

In this study, the researcher used thematic analysis method to analyze the collected interview data. Theme analysis is one method of identifying, analyzing, and reporting patterns (themes) in qualitative data (Braun & Clarke, 2006). The results from the focus group discussions have shown that there were three major strategic aspects that need to be considered by the Department of Skills Development (DSD) in strengthening and fostering human potential for skills development in 4th Industrial Revolution (Figure 1) which are Strengthening training and coaching programs through industrial collaboration and expertise sharing, Emphasizing upskilling and reskilling to enhance competencies and align with Fourth Industrial Revolution (4IR) advancements and last aspects is Developing future-ready skills through higher education programs and workforce for 4IR.

Strengthening training and coaching programs through industrial collaboration and expertise sharing.

Three aspects that emerged from the discussion involving collaboration between institution and industry, coaching or training using junior and senior employee training and implement insutrial attachment exposure programs for instructors to enhance industry-relevant skills.

The first aspect that emerge is collaboration between institution and industry. Collaboration with all the stakeholders involved such as universities, human resources and skills trainers, government and private sectors will facilitate the formation of knowledge with the support of experts and experienced persons in the industry that can give a right direction to the enthusiastic, intelligent students and making them experts of future. As panellist P1 said that,

" … we have establish our academic, collaborate with the university as well as HR and JPK. We also go with NOSS. In term of training of coz not every training program we can conduct thru the trainer that we have, of coz on and off we also engage with government agencies and private sectors.."

Coaching or training using junior and senior employee training is one of the important aspects mentioned by the panels. Comments made by the panels were all about establishing industry-institution collaboration through mentorship, exchange programs, and the integration of emerging technologies in teaching and learning, as mentioned by the panel P4,

"Concepts of coaching and learning and mentoring. So, coaching and learning refer to subject matter experts while mentoring refer to system expert for example junior employee can learn from senior how to do stuff whereas mentoring like senior can guide junior the systematic way."

Implement industrial attachment and exposure programs for instructors to enhance industry-relevant skills. aspect is no less important from the other two. It is stated clearly in which said by the panel P2 as:

"I feel that exposure to industrial attachment customize training to suit the particular person. New and senior worker should be exposed to the industrial attachment in order to learn new skill and technology…"

This shows that we clearly need exposure to industrial attachment, which plays a crucial role in tailoring training programs to meet individual needs. By immersing participants in real-world industry settings, these programs provide hands-on experience that enhances skill development in a practical and relevant manner. Both new and senior workers benefit from industrial attachment. For new employees, it serves as an opportunity to acquire foundational industry knowledge, familiarize themselves with workplace practices, and develop essential technical competencies. Meanwhile, for senior workers, industrial attachment offers a platform to stay updated with the latest industry trends, advanced technologies, and evolving best practices. This continuous learning process ensures that employees at all levels remain adaptable and competitive in an ever-changing industrial landscape.

Emphasizing upskilling and reskilling to enhance competencies and align with Fourth Industrial Revolution (4IR) advancements.

Two major aspects that emerged are lifelong learning in skills development and re-skilling and up-skilling employees' technology data skills. The first aspect that emerges are lifelong learning in skills development. In this era of globalization, we must furnish and provide our students and workers with channels to learn skills to continuously learn as part of the culture of lifelong learning because it is difficult to predict what kind of skills are required for the 4IR and enable them to adapt and adopt the new technology. The motivation and encouragement on what to learn and how to learn should be emphasized and this starts in the educational institution itself. Panelist P6 said that,

"… One thing about industry 4.0 something that very difficult to predict what are the skill requirement. That skills set they wiil be needed. What happens is we need to furnish our students and workers with the skills to continuously learnt,.continuously learning skills. That means having the motivation to learn and also knowing how to learnt .. "

Re-skilling and up-skilling employee's technology data skills is another important aspect in nowadays industries. In the case of some organizations, re-skilling and up-skilling employees are necessary because currently, the industry is getting more competitive as said by panel P1,

"…In the case organization we do reskilling and upskilling employees because now the industry more competitive. So, indirectly ordirectly whether you like it or don't like it we have to improving our productivity and the technology taking place as well…"

Hence, due to this, whether you like it or not, we have to improve our productivity and the technology in data skills that are taking place as well. Due to this, they have to improve their technology by all means. We have to look at how to develop our trainer, so the training programs should be progressively strong as well to keep in line with fourth industrial revolution in order to produce quality students.

Developing future-ready skills through higher education programs and workforce for 4IR

The result of discussion developing future-ready skills through higher education programs and workforce for 4IR has three aspects, which are, Integration of 4IR technologies in higher education curriculum, implementing a learning management and curriculum empowerment to enhance technical and soft skills.

Integration of 4IR Technologies in Higher Education Curriculum is one of the important aspects mentioned by the panels. Comments made by the panels were all about how they need exposure to new technologies that are in line with the fourth industrial revolution, as mentioned by the panel P9,

"..because you are talking about 4.0 ir, so you can think about provider technology. Bringing provider technology and provider technology can tell about technology for the next 10 years so that our younger generation can know what will happen in the next 10 years..."

The next aspect that was discussed by the panelist is implementing a learning management system to deliver knowledge for all generations. Experience is what differentiates the current personnel with the new and old generations. Delivering knowledge is very crucial to make sure the experience in terms of knowledge will last. A panelist, P17 said,

''They invest to the industry, but when we talk about industry revolution, we can say it very difficult to industry to impliment and execute it because involve money, policy, incentive so i will suggest to JPK we should have one road map how to implement for the time being it is the stage of planning look at the stage of implementing monitoring for 4IR because not everybody know about it.''

It should be pathway for TVET graduates to technology based degree and not just stop at certain level only. There a must be a pathway created for our TVET graduates to go up to a technology based degree.

Digital skills to deliver knowledge can be said to be the ability to use digital devices, communication applications, and networks to access and manage information to be handed over to the old and newcomers. As we know, the new generations mostly depend on digital devices to make things happen and in getting new information, but not for the old generation. That makes the skill of using digital skills to deliver knowledge so crucial right now. We might say that digital communication is currently the best business to invest in.

Another aspect that was highlighted in the discussion is curriculum empowerment to enhance technical and soft skills. One comment made by the panel, P12, is that,

“to me, the things must be exist together. Not to say merge and one merges without both. Actually, both are important. Because in our educational system itself, it almost 70% are not interested in academic. They are more towards skills, you know. The excellent people only 30% who are moving toward academics. But, the rest, where are they? In the vocational, this is what TVET all about”

“in our passion to supply technical skills that can meet the challenges of industry 4.0, we shouldn’t be forgetting about our basic skills. Humanizing skills, humanizing aspect of our workers”

There is now more pressure on academic institutions to enhance both technical skills and soft skills of their students. Thus, the learning institution needs to look back to the policies, syllabus, the process, and the methodology on how to bring their students moving forward in the forthcoming revolution. Also, the institution needs to provide a clear career path or framework guidance for students to make sure they get clear directions after graduating. With well-planned training programs, it is possible to tune, shape and develop creativity and all skills needed among all students. This is important to make sure the produce of skilled workers with a combination of technical skills and soft skills is a need to fulfil the fourth industrial revolution.

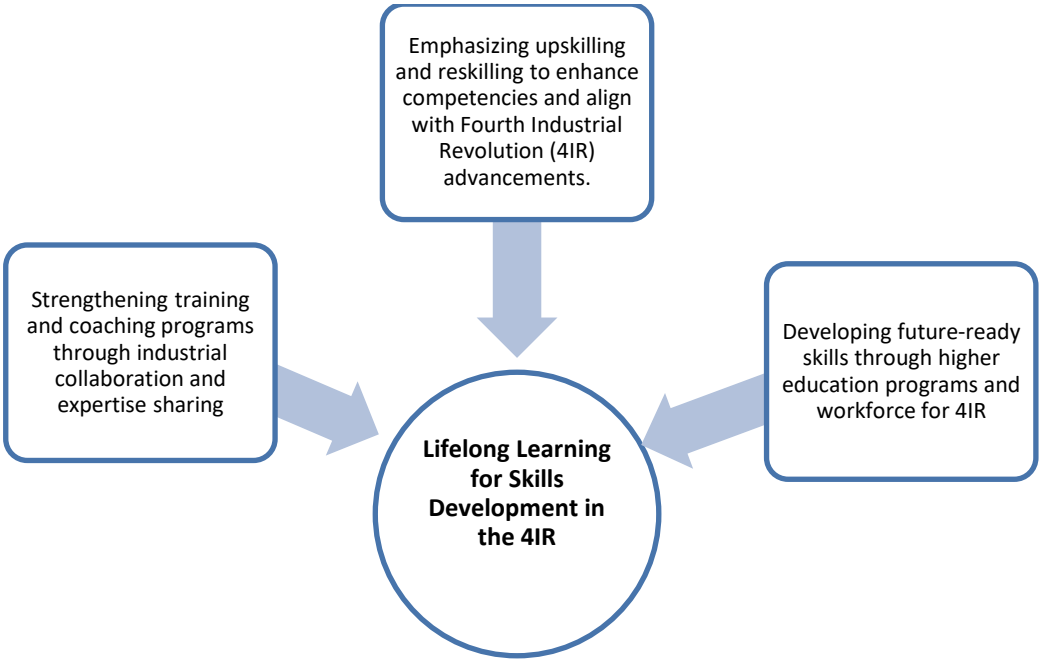

Figure 1: Three strategic aspects in lifelong learning for skills development in 4th Industrial Revolution

From the data analysis, there are 3 strategic aspects that can be used as a guideline for the Department of Skills Development with collaboration institutions and industry to strengthen human potential for Skill Workers in lifelong learning for skills set development in line with the fourth industrial revolution. The analysis has shown that strengthening training and coaching programs through industrial collaboration and expertise sharing has three aspects which are collaboration between institution and industry, coaching or training using junior and senior employee training and implementing industrial attachment exposure programs for instructors to enhance industry-relevant skills.

Today's era is a fully digital era in every sector, hence there is a need to strengthen training and coaching programs through industrial collaboration and expertise sharing is essential to developing a highly skilled and adaptable workforce. To remain competitive and relevant, industries and educational institutions must work together to develop innovative learning approaches that equip individuals with the skills required for the future workplace (Goueli, 2024). Beyond formal training, coaching and mentorship programs are critical for skill enhancement. By leveraging the expertise of experienced professionals, companies can facilitate knowledge transfer within the workforce. Senior employees play a vital role in mentoring younger or less experienced workers, accelerating their learning curve and fostering a culture of continuous improvement. These promote critical thinking, communication, and teamwork, essential skills for the 21st-century workforce (Uslan et al., 2024). Taken together, these findings suggested that the Department of Skills Development can create and organize any programs that can improve industrial experience of using high technology among workers.

The research clearly indicates the needs of emphasizing upskilling and reskilling to enhance competencies and align with Fourth Industrial Revolution (4IR) advancements. The

importance of lifelong learning in skills development and re-skilling and up-skilling employees' technology data skills was recognized. In the era of the Fourth Industrial Revolution (4IR), technological advancements such as automation, artificial intelligence (AI), data analytics, and the Internet of Things (IoT) are reshaping industries and job requirements. As a result, organizations and educational institutions must emphasize upskilling and reskilling to ensure that the workforce remains competitive and capable of adapting to emerging challenges (Ullah et al., 2025). The concept of lifelong learning has become essential in the 4IR era, as technological advancements continuously evolve, rendering traditional skill sets obsolete at an unprecedented pace. Unlike in the past, where a formal education was sufficient for a lifelong career, today's workforce must engage in continuous skill development to remain relevant (Brands et al., 2024). So, the Department of Skills Development are suggested to create self-development programs and enhance talent for employees such as re-skilling, up-skilling, and upscaling. Also, Policy should be implemented to prepare the aging society to face and contribute towards 4IR as the younger ones would be ready to accept 4IR demands in the future. The older group should be able to contribute economically to Malaysia and government should gear towards the innovation and well-being of 4IR and not leaving behind senior citizens.

Next, the discussion revealed upon developing future-ready skills through higher education programs and workforce for 4IR consists of three aspects which are Integration of 4IR technologies in higher education curriculum, Implementing a learning management and curriculum empowerment to enhance technical and soft skills. The Fourth Industrial Revolution (4IR) is transforming industries, redefining job roles, and demanding new skill sets that blend technical expertise with adaptability and innovation. To prepare individuals for this evolving landscape, higher education institutions and workforce training programs must focus on developing future-ready skills. Partnerships between academia and industry can enhance educational outcomes and innovation, addressing the skills gap effectively (Ismail, 2024). While technical skills are critical in the 4IR era, soft skills such as critical thinking, problem-solving, creativity, adaptability, leadership, and communication are equally important. A future-ready workforce must possess a balance of both technical expertise and human-centric skills to navigate complex work environments. Programs that incorporate work based learning into curricula allow students to apply theoretical knowledge in practical settings, improving their employability and technical skills (Amish, 2024). Technical knowledge and skills alone have a short life span and job specific, thus may not be transferable to other trades. To sustain their contributions to organisational success, it is imperative for every employee to possess the motivation to enhance their skill set (Budiadi et al., 2024). When there was an economic crisis quite recently, many workers lost their jobs entirely through voluntary retirement or forced retirement. The employer retains some, and they, however, are required to undergo retraining to learn new skills and acquire new knowledge. New educational programmes are required to acquaint today's students and industry users with the topic and its associated difficulties (Baporikar, 2024).

Conclusion

The findings give insight in the TVET educationist and training centers to give emphasise to the three strategic plans that have been identified as a guideline to develop lifelong learning among skill workers in the industries to be able to adapt and give their full competencies in their work. Strengthening training and coaching programs through industrial collaboration

and expertise sharing, emphasizing upskilling and reskilling to enhance competencies and align with Fourth Industrial Revolution (4IR) advancements and lastly, it is also crucial developing future-ready skills through higher education programs and workforce for 4IR. These should be presented and mastered in all skill workers so that the workers can cope with the lack of the other and have the motivation and need to find the extra skills needed by their job as the situation in the workplace evolves over time. This study focuses only on identifying the aspects in lifelong learning for skills development that should be developed to prepare for the 4th industrial development. Future research on the specific 'know-how' and assessment of these aspects should be good to be further investigated. Lifelong learning is increasingly recognized as essential for skills development in the context of the Fourth Industrial Revolution (4IR).

This research contributes to bridging the gap between policy aspirations and workforce realities. It supports Malaysia's ambition to develop a high-skilled, adaptable labor force that can thrive in the face of 4IR disruptions, while also offering transferable insights for other countries navigating similar challenges. This paradigm shift necessitates a rethinking of educational frameworks to equip individuals with the competencies required to thrive in a rapidly evolving job market. It requires collaboration between governments, civil society, businesses, and international organizations to mobilize resources and drive sustainable development efforts.

The fourth industrial revolution (4IR) is the coming together of cyber networks, with physical networks, to create new autonomous systems also known as to be the first sustainable industrial revolution, governments and regulators will need to adapt quickly with the rapidly evolving 4IR landscape and provide the enabling environment, safeguards, investment, and oversight to guide the future that is being built. However, it is needed to strengthen and foster human potential thru lifelong learning for skills development in 4IR. The findings have shown three strategic plans that can be used as a guideline by the Department of Skills Development in order to develop skills for 4IR. Further study is needed to make sure these strategies can be used and implemented successfully.

Acknowledgements
This work was supported in part by Department of Skill Development, Ministry of Human Resources Malaysia, grant number; AKU220, The National University of Malaysia under the Program of STEM and Minda with Grant Code - GG-2019-076.

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