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READY FOR THE REVOLUTION? ANALYZING FACTORS INFLUENCING IR 4.0 READINESS AMONG KUALA KANGSAR COMMUNITY COLLEGE STUDENTS

Shawal Fikri Sihab[1,*], Manisah Abd Hamid[1], Wei Boon Quah[2,3]

[1]Unit Culinary, Kuala Kangsar Community College,Jalan Dato Maharaja Lela, Kampung Penaga, 33000 Kuala Kangsar, Perak, Malaysia,

[2] Faculty of Educational Studies, Universiti Putra Malaysia, Jalan Universiti 1, 43400 Serdang, Selangor, Malaysia,

[3]Human Resource Management Division, Ministry of Higher Education,Jalan P5/6, Presint 5, 62200 Putrajaya, Wilayah Persekutuan Putrajaya, Malaysia

[*]Corresponding author, shawal.fikri@mail.cckk.edu.my

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ABSTRACT

This study examines the relationship between IR 4.0 Readiness and three competencies—Digital Skills, Problem-Solving Skills, and Communication Skills—among students at Kuala Kangsar Community College. A quantitative approach was used, collecting data from 48 full-time students via a questionnaire. Pearson Correlation Analysis and multiple regression analysis assessed the relationships and predictive power of these skills on readiness. Findings indicate that Digital Skills have a moderate, statistically significant positive correlation with IR 4.0 readiness ($r = 0.330$, $p = 0.022$), suggesting that students with stronger digital skills are better prepared for IR 4.0. Problem-Solving Skills show a weaker, non-significant correlation ($r = 0.277$, $p = 0.057$), while Communication Skills exhibit an even weaker, non-significant correlation ($r = 0.195$, $p = 0.184$). The multiple regression model revealed a weak combined effect, explaining only 12.4% of the variance in readiness and lacking statistical significance ($F = 2.074$, $p = 0.117$). These findings underscore the importance of digital literacy for IR 4.0 readiness and suggest that educational curricula should prioritize digital skills while also integrating problem-solving and communication competencies to align with industrial needs. This study highlights digital literacy as essential for workforce preparation in the context of IR 4.0.

Keywords: IR 4.0 Readiness, Digital Skills, Problem-Solving Skills, Communication Skills, Workforce Preparation

INTRODUCTION

The concept of the Fourth Industrial Revolution (IR 4.0) introduced by Professor Klaus Schwab, integrates digital, physical, and biological domains, with reliance on technologies such as Artificial Intelligence (AI), Augmented and Virtual Reality (AR/VR), Big Data, and the Internet of Things (IoT) (Schwab, 2017; World Economic Forum, 2017). Malaysian higher education, following the Malaysian Higher Education Blueprint (2015-2025) (Ministry of Higher Education, 2015), is evolving to incorporate IR 4.0 technologies to ensure graduates meet future industrial demands. The Community College Kuala Kangsar (CCKK), for example, has adopted the TVET 4.0 Framework introduced by the Department of Polytechnic and Community College Education (JPPKK), aligning educational programs with the National Policy on Industry 4.0 (Industry4WRD) (Sani, 2019).

Despite these advancements, a notable gap remains: Malaysian graduates often lack the essential skills required for IR 4.0 readiness, contributing to elevated unemployment rates among new graduates (Baker, 2016; Sazali, 2019). This gap emphasizes the need for educational institutions to equip students not only with technical skills but also with critical non-technical competencies, such as problem-solving and communication, which are necessary for thriving in IR 4.0 environments.

This study addresses this gap by examining the readiness of KKCC students for IR 4.0, with a particular focus on both technical and non-technical skills. Unlike prior studies, which have primarily explored isolated aspects of skill readiness, this research aims to provide a comprehensive analysis of how these skills collectively influence students' preparedness for the technological shifts brought by IR 4.0. The findings are intended to guide curriculum adjustments that will better prepare students for the complex and evolving job market, thereby ensuring that the educational framework remains relevant and effective.

LITERATURE REVIEW

The readiness of students for Industry 4.0 (IR 4.0) requires a multifaceted set of skills, encompassing digital, problem-solving, and communication competencies. These skills collectively form the basis of a holistic approach to prepare students for the demands of IR 4.0 environments, where both technical and non-technical skills are essential.

DIGITAL SKILLS

Digital skills are central to IR 4.0 readiness, with prior studies consistently linking these competencies to students' adaptability to technological advancements. Research by Zulkarnain et al. (2021) highlights that digital literacy, including data interpretation and technology utilization, is crucial for navigating IR 4.0 challenges. Supian et al. (2022) further emphasize that while technology skills are imperative, there is a significant gap in their practical application within real-world contexts. Studies focused on engineering students underscore the direct relationship between digital competencies and IR 4.0 preparedness, underscoring the need for curricula that adapt to these evolving technological demands (Ramli et al., 2022). Additionally, nursing students' studies, such as those by Aspihan et al. (2021), suggest that digital literacy integration in education is vital for

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readiness in health and related sectors, reinforcing the broader applicability of digital skills across disciplines.

PROBLEM-SOLVING SKILLS

Problem-solving skills have emerged as a key factor in fostering work readiness for IR 4.0, especially within vocational and technical education. Nisa et al. (2021) reveals that students with higher problem-solving skills demonstrate better preparedness for industry challenges, a sentiment echoed in Yao's (2021) study on adaptability requirements for IR 4.0. Engineering and nursing students with strong problem-solving abilities are shown to adapt more readily to IR 4.0's demands, advocating for curricula that integrate problem-solving training (Ramli et al., 2022). Furthermore, Abdellatif and Zaki (2020) identify problem-solving skills as critical for psychological resilience and academic success, suggesting these skills as mediators for overall readiness in IR 4.0 contexts. Problem-based learning methods, highlighted by Hidaayatullaah et al. (2020), have proven effective in honing these skills, making them essential for navigating the complexities of IR 4.0.

COMMUNICATION SKILLS

Communication skills, especially in digital contexts, are essential for employability in IR 4.0, where both technical and soft skills are valued. Halili et al. (2022) note that communication is among the top employability skills required for IR 4.0 readiness, aiding students in work-based learning and adaptability to a changing industrial landscape. Njuguna and Jjuuko (2020) also underscore the importance of online communication for professionalism in digital environments, which is crucial for fields like mass communication. Communication skills also play a pivotal role for educators, as Lai et al. (2020) demonstrate that these skills facilitate the adoption of IR 4.0 teaching methodologies. The effectiveness of digital education in enhancing communication skills in medical students, as shown by Kyaw et al. (2019), further supports the inclusion of communication training in preparatory IR 4.0 education.

HUMAN CAPITAL THEORY

The conceptual framework shown in Figure 1, which examines the influence of digital skills, problem-solving skills, and communication skills on students' readiness for Industry 4.0, is grounded in Human Capital Theory. This theory posits that skills and competencies are valuable investments that enhance an individual's productivity and adaptability in the workforce (Becker, 1993). In the context of Industry 4.0, Human Capital Theory underscores the need for students to acquire these specific skills to increase their readiness for a rapidly evolving, technology-driven environment. Thus, the framework's hypotheses (H01, H02, H03) align with this theory by proposing that each skill independently contributes to overall readiness, positioning these competencies as 'capital' that strengthens students' preparedness for future work challenges.

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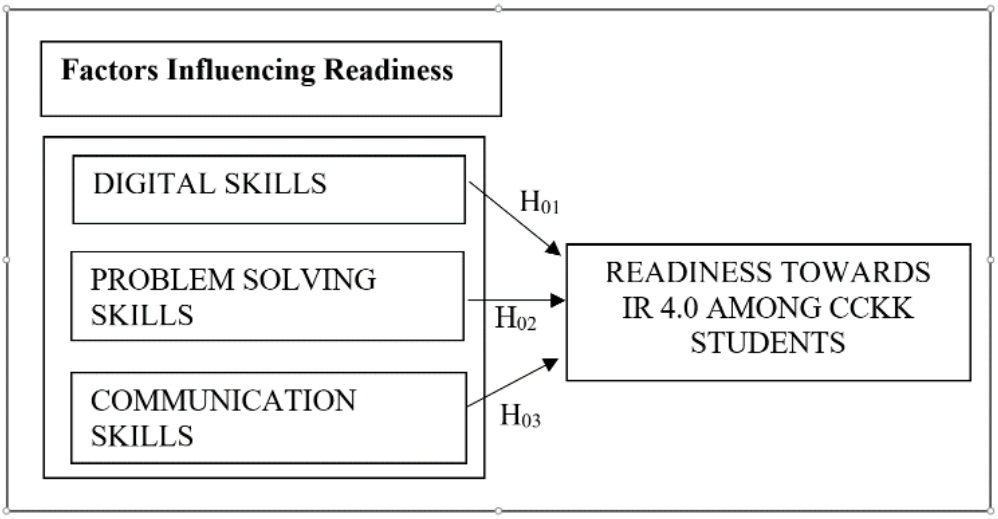


Figure1. Proposed Research Framework.

METHODOLOGY

This study employs a descriptive research design within a quantitative approach, utilizing a survey. Data were collected through questionnaire distributed via email and WhatsApp. Participants were given consent form obtained from all respondents prior to completing the survey. The study targeted 55 active full-time students from the pastry department, but only 48 respondents who sent back the questionnaires. The questionnaire, adapted from prior studies by Ahmad et al. (2019) and Khaghanizadeh et al. (2014), was structured into six sections: demographic data (Section A), IR 4.0 readiness (Section B), digital skills (Section C), problem-solving skills (Section D), and communication skills (Section E). Responses were measured on a 5-point Likert scale, ranging from 'strongly disagree' to 'strongly agree.' For data analysis, the study utilized both Pearson Correlation Analysis and regression analysis to explore relationships between variables. Pearson Correlation Analysis was applied to measure the strength and direction of associations between digital, problem-solving, and communication skills and IR 4.0 readiness. To further investigate the predictive impact of each skill set on IR 4.0 readiness, a multiple regression analysis was conducted, using the following statistical model:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon$$

where:

Y represents the IR 4.0 readiness score,
X_1, X_2, X_3 would represent the individual skill variables (digital, problem-solving, and communication skills).

β_0 is the intercept,

β_1, β_2, and β_3 would be the coefficients associated with each predictor variable, indicating the contribution of each skill to the readiness score and ϵ is the error term.

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This regression analysis allows for the estimation of the extent to which each skill independently predicts IR 4.0 readiness, providing a clearer understanding of cause-effect relationships.

RESULTS AND DISCUSSION

DEMOGRAPHIC PROFILE

The demographic profile of the 48 respondents from Community College Kuala Kangsar (CCKK) is detailed in Table 1. Notably, the majority of participants were female, making up 77.1% (N=37), while males represented 22.9% (N=11). The age range of respondents varied, with the largest group being 21 to 23 years old, representing 66.7% (N=32) of the respondents. This was followed by the 18 to 20 years age group at 22.9% (N=11), 8.3% (N=4) in the 24 to 26 years age group, and 2.1% (N=1) aged between 27 and 29 years. Ethnically, the vast majority of respondents were Malay, accounting for 93.8% (N=45), with the remaining 6.3% (N=3) being Indian. Regarding education level, 79.2% (N=38) of the respondents were diploma holders, while 20.8% (N=10) were certificate students. Additionally, the knowledge of Industrial Revolution 4.0 among the respondents was generally low, with 97.9% (N=47) indicating they only had limited knowledge, and only 2.1% (N=1) reported having substantial knowledge of the topic.

Table 1. Demographic profile

Item	Description	Frequency	Percent
Gender			
	Male	11	22.9
	Female	37	77.1
Age			
	18-20	11	22.9
	21-23	32	66.7
	24-26	4	8.3
	27-29	4	2.1
Ethnicity			
	Malay	45	93.8
	India	3	6.3
Education level			
	Diploma	38	79.2
	Certificate	10	20.8
Knowledge of Industrial Revolution 4.0	Little	47	97.9
	A lot	1	2.1

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PEARSON CORRELATION ANALYSIS

The Pearson correlation table 2 presents the relationships between Readiness towards IR 4.0 and three skills: Digital Skills, Problem-Solving Skills, and Communication Skills. The Pearson correlation coefficient between Readiness towards IR 4.0 and Digital Skills is r = 0.330 with a significance value (p-value) of 0.022, indicating a statistically significant moderate positive correlation. This findings suggests that as Digital Skills increase, Readiness towards IR 4.0 also tends to increase, with this relationship being statistically meaningful at the 5% significance level. For Readiness towards IR 4.0 and Problem-Solving Skills, the Pearson correlation coefficient is r = 0.277with a p-value of 0.057. While this suggests a positive association where higher Problem-Solving Skills correspond to increased Readiness towards IR 4.0, the relationship is not statistically significant at the 5% level (though it is close), implying that this positive correlation is weaker and may not be reliable. Lastly, Readiness towards IR 4.0 and Communication Skills have a Pearson correlation coefficient of r = 0.195 with a p-value of 0.184, indicating a weak positive correlation that is not statistically significant. This implies that there is little to no reliable association between Communication Skills and Readiness towards IR 4.0 in this sample. In summary, the data indicate that among the three skills, Digital Skills has the strongest and only statistically significant positive correlation with Readiness towards IR 4.0. Problem-Solving Skills shows a weaker, nearly significant relationship, while Communication Skills exhibits a weak, non-significant correlation with Readiness towards IR 4.0. These findings suggest that while Digital Skills may play a notable role in enhancing readiness towards IR 4.0, the impact of Problem-Solving and Communication Skills on readiness may be limited.

Table 2. Pearson correlation

		Digital Skills	Problem Solving Skills	Communication Skills
Readiness towards IR 4.0	Pearson Correlation	.330*	.277	.195
	Sig. (2-tailed)	.022	.057	.184
	N	48	48	48

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

SCATTER PLOT MATRIX

The Figure 2 displays a scatter plot matrix, which is often used to visualize pairwise relationships between multiple variables. Here, four variables are represented: Digital Skills, Problem Solving Skills, Communication Skills, and Readiness towards IR 4.0. Each cell in the matrix shows the relationship between a pair of these variables across a set of observations. The scatter plot matrix suggests various degrees of correlation between the skills. Digital Skills and Readiness towards IR 4.0 may have a positive relationship, suggesting that digital proficiency could contribute to overall readiness towards IR 4.0. Then, Problem Solving Skills and Communication Skills might also show a positive correlation, indicating that these cognitive and interpersonal skills often develop together. However, some skills, such as Problem Solving Skills and Readiness or Communication Skills and Digital Skills, might show weaker or no correlation, indicating they are relatively independent in this findings. This matrix is useful for identifying skill interdependencies, which could guide training or development programs by focusing on correlated skills. For instance, improving Communication Skills alongside Problem Solving Skills might be beneficial in educational or professional settings. The scatter plot matrix thus provides insights into how these skills interrelate, which can help inform targeted skill development strategies.

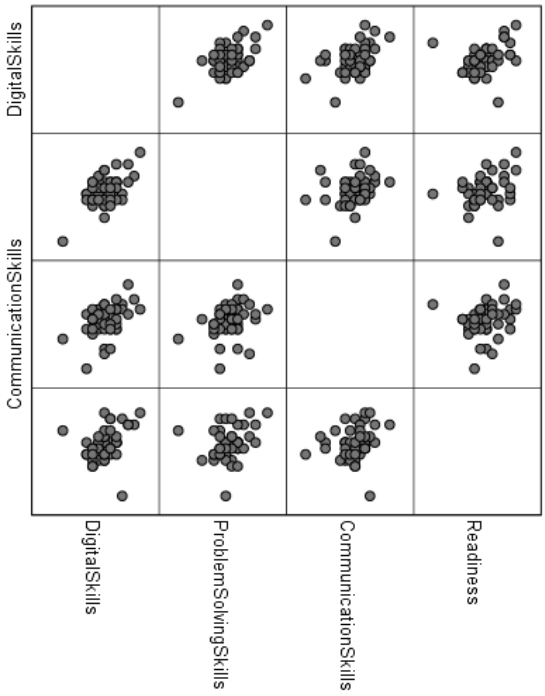


Figure 2. Scatter plot matrix displaying pairwise relationships between four skill variables: Digital skills, problem solving skills, communication skills, and readiness towards IR 4.0.

MULTIPLE REGRESSION ANALYSIS

The multiple regression analysis explores the relationships between Readiness towards IR 4.0 (the dependent variable) and three independent variables: Digital Skills, Problem-Solving Skills, and Communication Skills. The model summary shows a correlation coefficient (R) of 0.352, indicating a weak positive relationship between the predictors and Readiness towards IR 4.0. The R Square value of 0.124 suggests that only 12.4% of the variance in Readiness towards IR 4.0 can be explained by these three skills combined, with the Adjusted R Square even lower at 0.064, meaning that after accounting for the model's complexity, only about 6.4% of the variance in Readiness towards IR 4.0 is explained. The ANOVA table indicates an *F*-value of 2.074 with a *p*-value of 0.117, which is above the significance threshold of 0.05. This implies that the model, as a whole, does not significantly predict Readiness towards IR 4.0. In other words, the combined impact of Digital Skills, Problem-Solving Skills, and Communication Skills on Readiness towards IR 4.0 is not statistically significant. The coefficients table provides insight into each predictor's individual relationship with Readiness towards IR 4.0. Digital Skills has a positive but non-significant coefficient of 0.222 (p = 0.202), suggesting a small positive influence on Readiness towards IR 4.0 that lacks statistical significance. Problem-Solving Skills also shows a positive but weak association, with a coefficient of 0.116 (p = 0.451), while Communication Skills has the weakest association, with a coefficient of 0.048 (p = 0.729). None of these predictors are significant individually, as all p-values exceed 0.05. In summary, the analysis reveals that Digital Skills, Problem-Solving Skills, and Communication Skills collectively do not significantly predict Readiness, and each skill individually has a weak, non-significant association with Readiness towards IR 4.0. This suggests that other factors not included in this model may better explain variations in Readiness. The multiple regression equation for this model with the specific predictors is:

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Readiness (Y) = 2.506 + 0.222 (Digital Skills) + 0.116 (Problem-Solving Skills) + 0.048 (Communication Skills) + ϵ

Table 3. Multiple linear regression model for digital skills, problem solving skills and communication skills

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.352[a]	.124	.064	.423

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.115	3	.372	2.074	.117[b]
	Residual	7.883	44	.179		
	Total	8.998	47			

a. Dependent Variable: Readiness towards IR 4.0
b. Predictors: (Constant), Digital Skills, Problem Solving Skills, Communication Skills

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.506	.609		4.115	.000
	Digital Skills	.222	.172	.234	1.296	.202
	Problem Solving Skills	.116	.152	.130	.761	.451
	Communication Skills	.048	.137	.055	.348	.729

a. Dependent Variables: Readiness towards IR 4.0

This study explores the relationships between readiness towards IR 4.0 and various skills, specifically digital skills, problem-solving skills, and communication skills, to understand which competencies most significantly impact readiness. Digital skills showed a statistically significant correlation with readiness, suggesting their importance in equipping individuals to meet the demands of modern environments.

The significant positive correlation between digital skills and readiness towards IR 4.0 aligns with findings from other studies that emphasize the importance of digital competence in preparing individuals for Industry 4.0 and technology-driven workplaces. Research highlights that professionals with robust digital skills demonstrate higher readiness, particularly when they engage with training that enhances both hard and soft digital skills (Yahya et al., 2021). Additionally, professionals in fields that require a high level of information and communication technology skills

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often show better performance in digital tasks and readiness to adapt to evolving workplace demands (Lee & Meng, 2021).

Although the correlation between problem-solving skills and readiness towards IR 4.0 in this study was not statistically significant, other research indicates that problem-solving remains a vital component of workplace competence. Problem-solving skills enhance readiness by enabling workers to tackle complex tasks and adapt to diverse work settings. For instance, a study among nursing students demonstrated that problem-solving skills are predictive of their ability to handle real-life professional challenges, even if this relationship varies depending on attitudes toward communication (Zyoud et al., 2022). Furthermore, problem-solving within digital environments has been shown to be essential, particularly as workplaces increasingly demand solutions to complex, technology-related issues (Doo et al., 2021).

The weak, non-significant correlation between communication skills and readiness towards IR 4.0 observed in this study could reflect a more nuanced role of communication skills. While foundational for effective collaboration, communication skills might not directly translate to readiness without being coupled with other technical competencies. Research supports this notion, suggesting that communication skills may enhance problem-solving abilities indirectly by fostering collaborative environments where knowledge-sharing is encouraged (Fernández et al., 2021). In dynamic environments, where tasks often require multidisciplinary input, communication skills can act as facilitators but might not directly influence readiness on their own (Esteve-Mon et al., 2020).

On the other hand, the findings of this study suggest that Digital Skills, Problem-Solving Skills, and Communication Skills collectively have a limited impact on students' readiness for Industry 4.0. The regression model explains only 12.4% of the variance in readiness towards IR 4.0, which is not statistically significant, indicating that other factors beyond these skills likely contribute more substantially to students' preparedness. This aligns with recent research suggesting that while these skills are essential, they alone may not fully equip students for the challenges of a rapidly evolving technological landscape (Lee & Meng, 2021; Rahmat et al., 2019).

The limited impact of Digital Skills, Problem-Solving Skills, and Communication Skills on students' readiness for Industry 4.0 in this study could indeed be influenced by the background of the respondents, as they are from a community college. Community college students may have fewer opportunities for exposure to advanced Industry 4.0 concepts and technologies compared to students from universities with more specialized programs focused on industrial or technological training. Additionally, community colleges often emphasize foundational skills and practical knowledge tailored to immediate workforce entry, which may not fully cover the complex skill sets required for Industry 4.0 readiness, such as advanced digital literacy, adaptability to automation, and cognitive flexibility. Without targeted curriculum components that specifically address Industry 4.0 technologies, such as data analytics, automation, and artificial intelligence, students may lack familiarity with these advanced competencies, thereby limiting their readiness. This lack of specialized training may partly explain the limited variance in readiness explained by the regression model, indicating the need for more focused Industry 4.0-related education within community college curricula.

Digital skills are foundational for Industry 4.0 readiness, yet research suggests that they need to be complemented by adaptive and cognitive skills for higher adaptability within the industry. Digital competencies, such as cognitive analytics and technology literacy, are essential but require

integration with other core skills to fully equip individuals for Industry 4.0's demands (Lee & Meng, 2021; Rahmat et al., 2019). Although problem-solving skills remain critical, studies indicate they are most effective when combined with other abilities like critical thinking and creativity, supporting the need for multifaceted skill sets in addressing complex, interdisciplinary challenges in modern industrial roles (Doo et al., 2021; Nisa et al., 2021). Communication skills alone may not have a significant impact on Industry 4.0 readiness without the support of technical and adaptive skills. While effective communication is essential in collaborative environments, its true value is realized when integrated with digital and problem-solving skills to meet the requirements of Industry 4.0 (Chaka, 2020; Putri, 2019). The Industry 4.0 landscape also underscores the importance of broader skills such as adaptability, resilience, and continuous learning as key factors for readiness, indicating that additional competencies like emotional intelligence and lifelong learning are crucial for success in this evolving industrial context (Halili et al., 2022; Kipper et al., 2021).

CONCLUSION

The findings of this study indicate that Digital Skills, Problem-Solving Skills, and Communication Skills have a limited impact on students' readiness for Industry 4.0. While Digital Skills show a statistically significant, moderate positive correlation with readiness, they alone do not fully predict preparedness, as evidenced by the regression model explaining only 12.4% of the variance. Problem-Solving Skills and Communication Skills also display positive associations with readiness but lack statistical significance, highlighting their relatively minor influence in this context. The limited impact of these skills may be attributed to the community college background of the respondents, where foundational skills are emphasized over advanced competencies required for Industry 4.0, such as data analytics, cognitive flexibility, and adaptability to automation. This gap suggests the need for specialized training in Industry 4.0 technologies within community college curricula to bridge the skills needed for the modern industrial landscape.

This study provides critical insights that can help curriculum developers, educators, and policymakers adapt pastry programs for IR 4.0 readiness by integrating advanced digital competencies alongside traditional culinary skills. The findings underscore that while foundational skills like problem-solving and communication are essential, they are not enough to prepare pastry students for the demands of a technology-driven industry. For instance, curriculum developers could incorporate modules on digital baking technologies, such as automation in pastry production, 3D food printing, and data analytics for quality control and efficiency. Educators can further enhance learning by implementing hands-on projects that use these technologies, enabling students to experience the applications of IR 4.0 within the pastry field. Policymakers could support these initiatives by funding the acquisition of digital equipment and fostering industry partnerships to provide students with real-world exposure to advanced pastry technologies. By embedding these targeted skills within pastry programs, educational institutions can ensure graduates are well-equipped for the evolving demands of the culinary sector in the era of Industry 4.0.

IMPLICATIONS

These findings carry significant weight for educational institutions, especially in the area of curriculum and teaching strategies. The moderate correlation of digital skills to readiness for IR 4.0 means that community college should center their programs around digital literacy with technology infusion at the core. This should help equip students with required skills for their survivability in an increasingly digital world rapidly being automated. As such, problem-solving and

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communication skills are important, but the fact that they have weaker correlations implies that those should be integrated into a wider context of digital learning in order to effectively prepare students for the future.

THEORETICAL IMPLICATIONS

The findings of this study contribute to educational theories on skill development and readiness for technological shifts, specifically within the framework of Industry 4.0 (IR 4.0). The significant relationship between digital skills and IR 4.0 readiness supports theories that emphasize the importance of technical competencies in preparing students for modern, technology-driven workplaces. This aligns with broader educational theories that advocate for skill-based learning, where digital literacy becomes foundational in equipping students to adapt to rapidly evolving technological environments. By grounding this study in these theoretical perspectives, it highlights the need for curriculum designs that prioritize digital skills while integrating problem-solving and communication skills as complementary competencies. This holistic approach to curriculum development is essential for fostering well-rounded graduates capable of thriving in the complexities of IR 4.0.

PRACTICAL IMPLICATIONS

On a practical level, these findings underscore the importance of aligning educational curricula with industry demands, particularly by fostering partnerships between educational institutions and industries. Collaborating with industries can help ensure that curriculum content remains relevant and responsive to the specific skills needed in IR 4.0 environments. For instance, partnerships could facilitate real-world training opportunities, such as internships or collaborative projects, allowing students to apply digital, problem-solving, and communication skills in practical settings. Furthermore, the emphasis on digital skills as a critical component of IR 4.0 readiness suggests that institutions should prioritize investments in digital infrastructure and training resources, enabling students to develop hands-on technical competencies. While problem-solving and communication skills are also valuable, integrating these skills within a broader digital literacy framework could provide a more comprehensive preparation for IR 4.0 challenges.

FUTURE RESEARCH

In this regard, future studies will also home in on the items within digital skills that are predictive of readiness for IR 4.0. For example, it can be tested whether a certain kind of digital skills, such as coding, data analytics, or digital content creation, have the greatest impact. Longitudinal studies might also provide insights into how the development of these digital skills over time is related to career success in IR 4.0 environments. This is furthered by research on how digital skills, among other critical competencies, interlink with creativity and critical thinking so that together these skills can prepare the students for Industry 4.0.

In order to enhance the generalizability of the findings, future research should consider using a larger sample size. A more extensive and diverse sample would provide a broader perspective on IR 4.0 readiness among students and strengthen the study's conclusions. Expanding the sample across various institutions, disciplines, or geographic regions could reveal additional insights into how different factors influence IR 4.0 preparedness, enabling more robust recommendations for curriculum development and policy implementation.

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CONFLICT OF INTEREST

The author declares there is no conflict of interest.

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