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Research article

The readiness of IR4.0: Morality and technology integration among mathematics teachers

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Abstract: The rapid advancement of technology in the era of the Fourth Industrial Revolution presents both opportunities and challenges for education, particularly in the field of mathematics. As teachers incorporate technology into their instructional practices, it is crucial to examine the role of morality in shaping their approach and the subsequent impact on readiness to face the demands of this transformative era. This study investigates the effect of morality as a mediator between teachers' use of technology in mathematics education and readiness for the Fourth Industrial Revolution. The study adopted a quantitative research design, involving a sample of mathematics teachers from Malaysia and Indonesia. The findings found that the impact of technology use on the readiness for IR4.0 among mathematics teachers in Indonesia and Malaysia was found not statistically significant, but it significantly influences morality, suggesting that morality full mediates the relationship between technology use and readiness among mathematics teachers in Indonesia and Malaysia. This study contributes to understanding of how technology integration and moral values intersect in preparing mathematics teachers for the readiness of IR4.0. These insights can inform the development of effective strategies, policies, and interventions to equip teachers with the necessary skills and ethical frameworks to thrive in the digital age.

Keywords: morality, technology integration, mathematics teachers, Fourth Industrial Revolution, readiness

1. Introduction

The Fourth Industrial Revolution, characterized by the rapid advancement of technology and its integration into various aspects of society, has brought about significant changes in the education landscape. In this era of transformative technological advancements, it is crucial to examine the role of technology in education, particularly in mathematics instruction. However, it is equally important to consider the ethical implications and moral factors associated with the use of technology in the classroom. The advent of the Industrial Revolution has brought forth a transformative wave of technological advancements, reshaping societies and industries across the globe. In the realm of education, the integration of technology in mathematics instruction has emerged as a pivotal aspect, promising enhanced learning experiences and preparing students for the demands of the digital age. However, amidst this technological revolution, the role of morality as a mediator in teachers' use of technology in mathematics and their readiness for this era warrants careful examination. By delving into the ethical considerations, equity implications, student autonomy, data privacy, and professional development, we can unravel the complex relationship between teachers' moral perspectives and their utilization of technology in mathematics education. This exploration not only sheds light on the moral compass guiding educators but also illuminates the path towards responsible and effective technology integration, ultimately shaping the educational landscape for the era of the Industrial Revolution.

Previous studies have extensively investigated the impact of technology on educational outcomes, focusing on student achievement, engagement, and motivation [1,2]. However, limited research has explored the role of morality as a mediator between teachers' use of technology in mathematics instruction and students' readiness to face the challenges of the Industrial Revolution era [3]. Understanding the interplay between teachers' moral perspectives, the integration of technology, and students' preparedness becomes crucial in shaping effective educational practices for the future [3]. The integration of technology in mathematics instruction has the potential to enhance students' learning experiences, promote critical thinking, and develop problem-solving skills. However, the responsible use of technology requires careful consideration of ethical considerations, such as privacy, equity, data security, and digital citizenship. Teachers play a pivotal role in navigating the ethical dimensions of technology integration and guiding students towards responsible and ethical technology use [4].

Equity and access are significant moral issues that arise in the context of technology use in mathematics education. While technology has the potential to enhance learning opportunities, it can also exacerbate existing inequalities if not implemented thoughtfully. Teachers with a strong moral compass recognize the importance of equitable access to technology, considering factors such as socioeconomic disparities, availability of resources, and the potential for creating a digital divide among students. They strive to bridge these gaps and ensure that all learners have fair opportunities to engage with technology and its benefits [5].

Lastly, teachers' readiness for the era of the Industrial Revolution and their ethical use of technology in mathematics education necessitate ongoing professional development. Teachers with a moral perspective engage in reflective practices, seek training opportunities that incorporate ethical dimensions, and collaborate with colleagues to address ethical challenges related to technology use in the classroom. By continuously honing their ethical reasoning and professional growth, educators can navigate the ever-evolving landscape of technology integration with a sense of responsibility and purpose [6].

This study aims to investigate the effect of morality as a mediator between teachers' use of technology in mathematics instruction and students' readiness to face the era of the Industrial Revolution. By examining the moral perspectives of teachers and their influence on the integration of technology, this research seeks to uncover the ethical considerations inherent in the adoption and implementation of educational technologies. Furthermore, the study aims to explore how teachers' moral beliefs shape their instructional practices and ultimately readiness for the evolving demands of the modern workforce. Meanwhile, this study seeks to bridge the gap between technology integration, morality, and students' readiness for the era of the Industrial Revolution. By examining the morality dimensions of technology use in mathematics instruction, educators can ensure that the integration of technology aligns with moral considerations and fosters students' preparedness for the dynamic and technology-driven future.

2. Literature review

2.1. Technology use in mathematics education

Technology use in mathematics education has been a topic of increasing interest and research. Studies have explored how primary school mathematics teachers in South Africa and Germany utilize educational technology, finding that teachers in both countries use it as a presentation, reinforcement, supplement, and problem-solving tool, as well as to stimulate the learning environment [7]. A scoping review of the literature revealed that technology integration into mathematics education is a distinct research area, with various research topics showing different trends over time [8]. Additionally, the COVID-19 pandemic has led to the transformation of teaching and learning in higher education, including the incorporation of technology-based pedagogy in mathematics education [9]. The development of the metaverse has also introduced new possibilities for technology use in mathematics education, with the potential for innovative teaching methods and improved mathematical development [10].

Technology use in mathematics education in Indonesia and Malaysia varies. In Indonesia, efforts are being made to improve students' mathematical abilities and skills through comparative studies with Singapore, Japan, and Malaysia. While Indonesia and Malaysia initially relied on algorithms and memorization, they are now focusing on strengthening students' mathematical comprehension and problem-solving ability, with Malaysia also emphasizing the use of technology in mathematics education [11]. In Malaysia, the concept of Industry 4.0, which includes cyber-physical systems, Big Data, artificial intelligence, and the industrial Internet of Things, is being applied to increase the autonomy and effectiveness of decision-making and production processes. This has implications for teaching and learning practices in Malaysia, particularly in mathematics education [12]. Additionally, research in Indonesia has shown that performance expectancy and social influence are significant factors influencing mathematics teachers' intentions to use digital textbooks, which in turn affects their actual usage [13].

Previous research has investigated the effects of technology use in mathematics education. For instance, a study by Eseryel et al. [14] and Al-Abdullatif and Gameil [15] found that technology integration positively influenced students' engagement and problem-solving skills. Similarly, Young [16] reported that technology-enhanced mathematics instruction improved students' conceptual understanding and achievement. These studies highlight the potential benefits of technology use in mathematics education.

2.2. Morality in the context of technology use

Morality in the context of technology use is a complex and evolving topic. As technology becomes increasingly integrated into our lives, questions arise about how to morally program technology and allocate moral authority [17]. Technology's role in ethical decision-making processes is limited, as it cannot "do" ethics the way humans do. Therefore, programming alternatives such as consequentialism and deontology are considered, with deontic logic as a starting point [18]. Additionally, technology should incorporate elements of meta ethics to handle scenarios that lead to conflicts in moral programming [19]. The use of AI-generated synthetic context can be valuable in detecting and quantifying moral sentiment, as shown in studies that leverage pretrained generative language models [20]. Furthermore, the increasing presence of technological artifacts as active mediators in human action challenges conventional notions of moral responsibility distribution [21]. Overall, the intersection of morality and technology requires ongoing exploration and ethical considerations.

Morality plays a crucial role in guiding teachers' decisions regarding technology use in the classroom. Research by Xia et al. [22] emphasized the importance of ethical considerations when integrating technology, such as ensuring equitable access and addressing ethical dilemmas related to data privacy and security. Additionally, Hiep et al. [23] and Maass et al. [24] highlighted the role of social responsibility in promoting responsible technology use in mathematics education. These studies emphasize the ethical dimensions of technology integration.

2.3. Mediating role of morality

The concept of morality, which is described as temperament, character, or manners, expresses the established character structure in humans and the behaviors of individuals that occur under their own will. Although moral perceptions vary by time, society, and culture, they also exhibit mandatory and unchanging rules of behavior [25]. Applying moral principles ensures that technology and mathematical solutions are designed with a focus on benefiting humanity, considering human welfare, safety, and dignity, integrating moral values fosters a sense of accountability among researchers, developers, and users, encouraging responsible behavior and ensuring that individuals take ownership of the ethical implications of their work [26]. Believing in conspiracy theories about COVID-19 reduces adoption of health-related behaviors and policy support for public health measures. This relationship is mediated by moral identity and morality-as-cooperation, indicating that conspiracy beliefs are morally infused and should be addressed accordingly [27]. Organizational culture has a direct effect on leadership morality, which in turn has a direct influence on the internal control system [28]. The feasibility appeal is more effective in enhancing social media engagement for individuals with higher moral traits, while no significant difference between message framing emerged for individuals with lower moral traits [29]. Perceived moral acceptability and positive outcome expectations partially mediate the effects of social norms on the willingness to engage in nonmedical use of prescription drugs to enhance cognitive performance [30]. These findings highlight the importance of considering morality as a mediating factor in various contexts, including public health, organizational behavior, and consumer engagement.

Several studies have examined the mediating effect of morality in the relationship between technology use and student outcomes. For instance, a study by McPherson et al. [31] found that teachers' ethical considerations mediated the relationship between technology use and students' academic achievement in mathematics. Similarly, Panisoara, et al. [32] reported that teachers' ethical

decision-making mediated the relationship between technology use and students' motivation. These studies highlight the important role of teachers' moral considerations in shaping the impact of technology use on student outcomes. According to Sarbini [33] students who are able to apply ethical and moral education in this technological age will be able to control technology as a learning medium. On the other hand, students who do not have sufficient ethical and moral education will be controlled by technology. moral engagement with professional and ethical basis associated with the instructional strategy and application in virtual interaction, reference model demonstrates how the human with all the potency they behave can become a significant contribution to the society at large to enhance the abilities to improve their capacities to operate the technological tools wisely and appropriately [34].

Morality plays a mediating role between teachers' use of technology in mathematics and their readiness. Teachers' Technological Pedagogical Knowledge (TPK) level may not align with their readiness in implementing online learning [35]. Mathematics teachers' readiness towards Education 4.0 is uncertain, indicating a lack of preparedness and knowledge about Education 4.0 [36]. The implementation of online mathematics learning in Indonesia faces obstacles such as limited technology skills among teachers and reliance on traditional resources [37]. Filipino secondary school teachers show readiness in Mathematics flipped classroom, and there is a significant relationship between teachers' profile and their readiness in this context [38]. Mathematics teachers' pedagogy with technology, including tools like GeoGebra, has a positive impact on students' performance in mathematics [39].

2.4. Readiness for the era of the industrial revolution

The readiness for the era of the Industrial Revolution 4.0 is a crucial aspect that needs to be addressed. Several studies have examined the preparedness of different groups, including students, graduates, and the church, for this new era. Colleges play a vital role in preparing teacher candidates for the Industrial Revolution 4.0 by enhancing education quality and relevance [40]. Vocational High School (SMK) graduates need to possess work readiness skills such as technology adoption, communication, collaboration, adaptability, and critical thinking to face global job competition [41]. Universities and lecturers also need to be ready to face the demands of work in this era [42]. The church, as a community, needs to improve its resources and technological capabilities to avoid becoming obsolete in the future [43]. Overall, the readiness for the Industrial Revolution 4.0 requires individuals and institutions to adapt to technological advancements and develop the necessary skills to thrive in this new era [44].

Readiness for the era of the Industrial Revolution encompasses the knowledge, skills, and attitudes necessary for adapting to and thriving in a technologically advanced society. Although limited studies specifically focus on readiness in mathematics education, research by Maryanti et al. [45] discussed the importance of developing computational thinking skills and digital literacy to prepare students for the demands of the Fourth Industrial Revolution. These findings underscore the relevance of technology integration in fostering students' readiness [3,45].

3. Methodology

3.1. Research design

A survey was carried out to evaluate the readiness of mathematics teachers in confronting the

challenges posed by the industrial revolution. The survey methodology, as outlined by Creswell and Creswell [46], employed a quantitative research approach utilizing questionnaires to gather information from a selected sample. Through an analysis of the sample's characteristics, the study findings can be applied to a larger population. To capture data for this specific study, questionnaires were administered to the mathematics teachers was selected from Malaysia and Indonesia. The study samples for each country were determined using a simple random sampling technique, guaranteeing the inclusion of an appropriate number of teachers from both nations.

3.2. Participant

The study encompassed a total of 231 mathematics teachers from Indonesia and 384 mathematics teachers from Malaysia. The participants were selected randomly, ensuring an equal chance for each teacher to be included. In Indonesia, the sample consisted of 59 male teachers, accounting for 25.5% of the total, while 172 female teachers comprised 74.5% of the sample. In terms of teaching experience, 26 participants (11.3%) had less than 5 years of experience, 65 (28.1%) had 5 to 10 years of experience, 97 (42.0%) had 11 to 15 years of experience, 19 (8.2%) had 16 to 20 years of experience, and 24 (10.4%) had more than 20 years of experience. Primary schools had 65 teachers (28.1%), middle schools had 71 (30.7%), and senior high schools had 95 (41.1%) teachers. In Malaysia, the sample included 88 male teachers, representing 22.9% of the total, and 296 female teachers, comprising 77.1% of the sample. In terms of teaching experience, 27 participants (7.0%) had less than 5 years of experience, 66 (17.2%) had 5 to 10 years of experience, 104 (27.1%) had 11 to 15 years of experience, 85 (22.1%) had 16 to 20 years of experience, and 102 (26.6%) had more than 20 years of experience. Primary schools had 260 teachers (67.7%), middle schools had 41 (10.7%), and senior high schools had 83 (21.6%) teachers. These demographic details provide an overview of the study sample composition in both Indonesia and Malaysia. They offer insights into the gender distribution, teaching experience, and representation across different types of schools among mathematics teachers in each country.

3.3. Instrument

The study employed customized assessment tools developed by the author to evaluate the preparedness of mathematics teachers in adapting to the industrial revolution, with a specific focus on their utilization of technology in mathematics and their moral understanding. Participants' responses were measured on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The assessment encompassed three main aspects: the technology use based on teaching and learning, teachers' readiness of IR4.0 and morality. However, each aspect had 5 items (see Appendix A). Readiness for the industrial revolution era involved assessing teachers' knowledge and attitude towards this era as a whole. It encompassed understanding the concepts and requirements of the industrial revolution era, as well as the necessary attitudes and mindset to address its challenges. Technological readiness examined teachers' knowledge, skills, and attitudes towards technology. It evaluated their familiarity with technological tools and their ability to effectively incorporate technology into their teaching practices.

The study also considered teachers' sense of Morality and responsibility in fulfilling their professional duties. This aspect focused on their commitment to their role and their dedication to

carrying out their responsibilities. However, the morality was measured using survey as developed by the author and its followed Likert scale to find out if the morality mediating the effect between mathematics teachers' readiness and technology use in industrial revolution era (IR 4.0). The use of technology and information is currently important for teachers in an effort to prepare themselves to face various educational challenges. The development of information and technology in the era of industrial revolution 4.0 is increasingly rapid and has become an important part of the world of education.

To ensure the validity and reliability of the research instruments, experts in the content and language areas were consulted. A pilot study involving 150 mathematics teachers was conducted to assess the reliability of the instruments. Exploratory factor analysis (EFA) was utilized to examine the validity of the items and constructs developed. Additionally, a confirmatory factor analysis (CFA) test was performed with a separate sample of 150 teachers to further confirm the compatibility of the items with the proposed model. These rigorous methods were employed to ensure the validity and reliability of the research instruments, providing a solid foundation for assessing the readiness of mathematics teachers in the era of the industrial revolution. The outcomes of the exploratory factor analysis (EFA) reveal a Kaiser-Meyer-Olkin (KMO) score of 0.884 and a significance level lower than 0.001. Communalities values span from 0.552 to 0.866, all exceeding the 0.5 threshold. Eigenvalues for technology, morality, and readiness are 7.265, 1.761, and 1.300, respectively, all surpassing the value of 1. Additionally, the cumulative variance is reported as 68.8%, satisfying the minimum requirement of 60%.

Table 1. Rotated component matrix.

	Component			Eigen value	Variance
	Technology	Morality	Readiness		
F1			.683	1.300	8.7%
F2			.594		
F3			.694		
F4			.734		
F5			.735		
C1		.819		1.761	11.7%
C2		.752			
C3		.719			
C4		.813			
C5		.696			
B1	.807			7.265	48.4%
B2	.801				
B3	.809				
B4	.886				
B5	.834				

The results obtained from the Confirmation Factor Analysis indicate loading factors for each variable that range from 0.63 to 0.92. The Chi-square/degrees of freedom (df) ratio is documented as 2.691, with the Goodness-of-fit Index (GFI) at 0.852, the Comparative Fit Index (CFI) at 0.922, and

the Root Mean Squared Error of Approximation (RMSEA) at 0.070. The relationships among variables exhibit variations ranging from 0.48 to 0.66. In summary, these findings collectively suggest that the constructed model exhibits a high level of quality [45,47,48].

Table 2. Confirmation Factor Analysis (CFA).

Factor	Item	Loading Factor	Cronbach alpha	CR	AVE
Readiness	F1	0.65	0.827	0.831	0.501
	F2	0.63			
	F3	0.75			
	F4	0.68			
	F5	0.80			
Morality	C1	0.80	0.938	0.939	0.755
	C2	0.88			
	C3	0.89			
	C4	0.88			
	C5	0.80			
Technology	B1	0.92	0.948	0.949	0.790
	B2	0.92			
	B3	0.90			
	B4	0.87			
	B5	0.83			

The internal validity of each variable, assessed through Cronbach's alpha values, falls within the range of 0.827 to 0.948, all of which exceed the required threshold of $\geqslant$ 0.70. Similarly, Composite Reliability (CR) values span from 0.831 to 0.949, also surpassing the $\geqslant$ 0.70 criterion. Additionally, Average Variance Extracted (AVE) values range from 0.501 to 0.790, meeting the established $\geqslant$ 0.50 criterion [44]. In summary, the validation factor analysis adheres to the predetermined criteria, indicating that the tested instrument is suitable for application in real research scenarios.

3.4. Data analysis

This study utilized AMOS software and employs structural equation modeling (SEM) analysis to investigate the model of teacher readiness in confronting the industrial revolution. The primary objective of the SEM analysis is to examine the direct effects of Teachers' Use of Technology in Mathematics and Readiness on teachers' preparedness to face the challenges of the industrial revolution. The analysis investigates how Teachers' Use of Technology in Mathematics and Readiness directly influence teachers' readiness in adapting to the industrial revolution. Technology readiness refers to the level of knowledge, skills, and attitudes that teachers possess regarding the incorporation of technology in their teaching practices. Teachers' Use of Technology in Mathematics, on the other hand, examines the extent to which teachers engage in collaborative activities, share ideas, and support one another in their professional endeavors.

Furthermore, the study explores the mediating role of morality in the relationship between

Teachers' Use of Technology in Mathematics and their readiness to face the industrial revolution. Morality, in this context, pertains to the ethical responsibilities and obligations that teachers have towards their students, parents, colleagues, and society at large. The analysis examines how morality mediate the connection between Use of Technology in Mathematics and Readiness and their readiness to confront the challenges presented by the industrial revolution. By utilizing SEM analysis with the AMOS software, this study aims to provide a comprehensive understanding of the factors influencing teacher readiness in the era of the industrial revolution. It allows for the examination of both direct effects and the mediating role of morality, shedding light on the intricate relationships among Teachers' Use of Technology in Mathematics and Readiness, and overall preparedness to address the challenges and opportunities brought about by the industrial revolution. Do not add a full stop at the end of the table title.

4. Result

4.1. The effect of morality as a contribution mediator between teachers' use of technology in Indonesia mathematics and readiness in facing the era of the industrial revolution

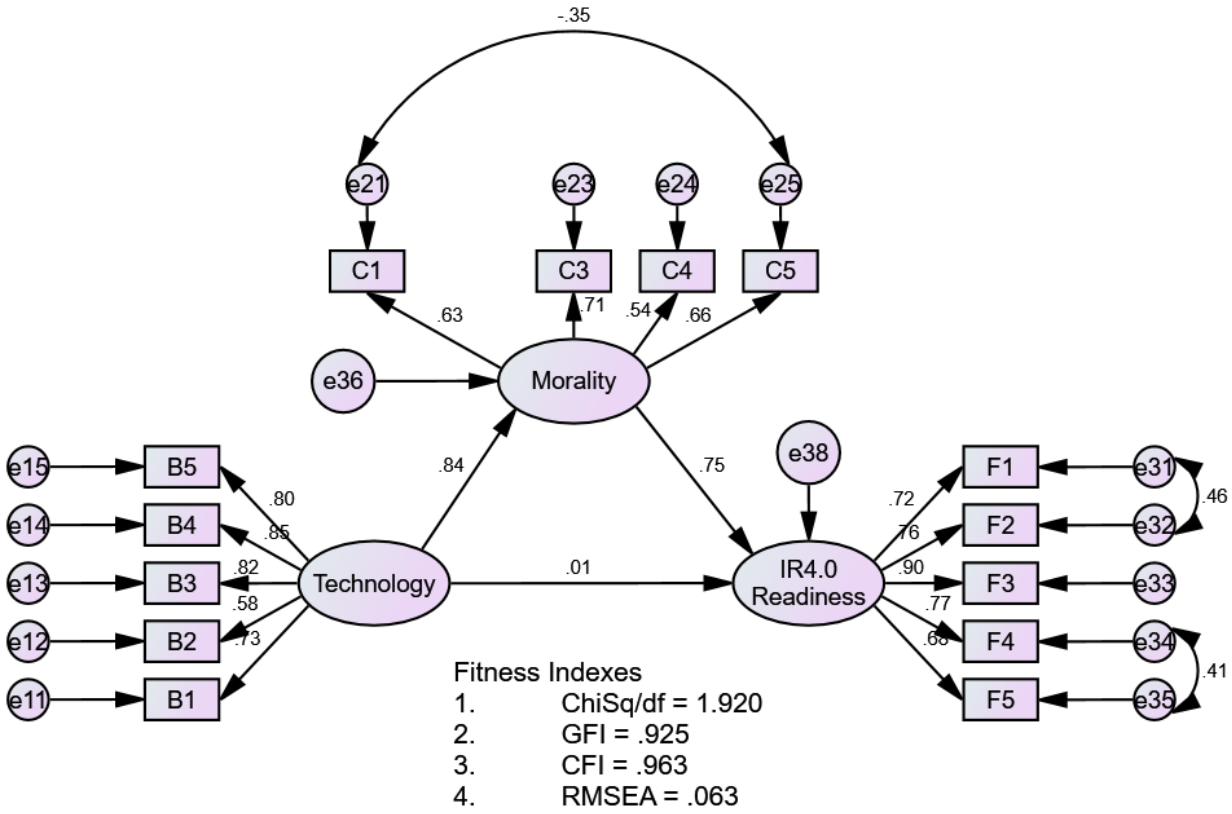

Figure 1. Moral mediator effect in the contribution between technology and IR4.0 readiness of mathematics teachers in Indonesia.

The impact of technology use on the readiness for IR4.0 among mathematics teachers in Indonesia was found to be statistically insignificant ($\beta = 0.01$, $p > 0.05$). Conversely, technology use was found to have a significant effect on moral ($\beta = 0.88$, $p < 0.001$). Moral was identified as a significant mediator in the relationship between technology use and IR4.0 readiness among

mathematics teachers in Indonesia (β = 0.63, p < 0.001). This suggests that moral fully mediates the relationship between technology use and IR4.0 readiness. The statistical analysis also revealed a good model fit, as evidenced by the values of Chi Square/df = 1.920, GFI = 0.925, CFI = 0.963, and RMSEA = 0.063, supporting the indirect effect of technology use on IR4.0 readiness mediated by moral.

4.2. The effect of morality as a mediator of the contribution between teachers' use of technology in mathematics in Malaysia and readiness in facing the era of the industrial revolution

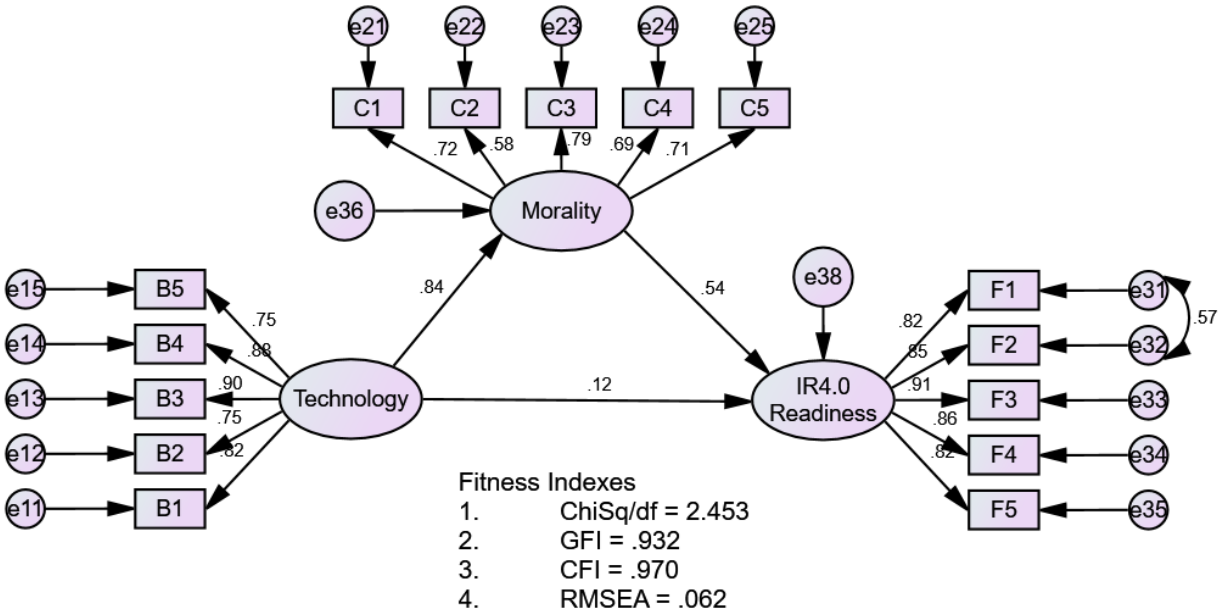

Figure 2. Moral mediator effects in the contribution between technology and IR4.0 readiness of mathematics teachers in Malaysia.

The impact of technology on the readiness of IR4.0 is found to be statistically insignificant (β = 0.12, p > 0.05). However, there is a significant direct effect of technology on morality (β = 0.84, p < 0.001). Among mathematics teachers in Malaysia, moral plays a significant mediating role in the relationship between technology use and IR4.0 readiness (β = 0.46, p < 0.001). This suggests that moral acts as a mediator between technology use and IR4.0 readiness. The findings also indicate a good model fit, as evidenced by the values of Chi Square/df = 2.453, GFI = 0.932, CFI = 0.970, and RMSEA = 0.062, which support the indirect effect.

5. Discussion

The first key finding of this study is that the direct impact of technology use on IR4.0 readiness among mathematics teachers was not significant. This suggests that simply increasing the use of technology in classrooms may not directly translate into improved readiness for the Fourth Industrial Revolution. This finding aligns with previous research highlighting the complex and multifaceted nature of technology integration in education. It suggests that a more nuanced approach is needed to

leverage technology effectively for enhancing IR4.0 readiness. However, the study did reveal a significant effect of technology use on teachers' moral. This finding underscores the importance of considering teachers' emotional well-being and motivation in the context of technology integration. It suggests that when teachers perceive technology as valuable and supportive, it can positively influence their moral levels. This finding resonates with previous research emphasizing the role of teacher attitudes and beliefs in technology adoption and implementation [26]. Furthermore, the study identified moral as a significant mediator in the relationship between technology use and IR4.0 readiness. This indicates that moral plays a crucial role in explaining how technology use influences teachers' preparedness for the Fourth Industrial Revolution. Higher moral levels were associated with a greater impact of technology use on IR4.0 readiness, suggesting that positive moral acts as a catalyst for teachers to effectively leverage technology in their instructional practices [34].

The full mediation effect observed in this study implies that the influence of technology use on IR4.0 readiness is entirely explained by teachers' moral levels. This highlights the importance of fostering a supportive and positive work environment that nurtures teachers' moral. Strategies such as professional development programs, mentoring, and collaborative networks can help cultivate positive moral among teachers, enabling them to embrace technology and enhance their readiness for the Fourth Industrial Revolution. Verbeek [49] analyses of technological mediation, which have been elaborated and philosophy of technology, have major implications for the ethics of engineering design. The insight that technologies inevitably play a mediating role in the actions of users makes the work of designers an inherently moral activity. The overall results indicate that teachers are still not fully prepared and lack knowledge about Education 4.0 [35]. In terms of integrating technology in education, there is a gap between teachers' self-assessment of their Technological Pedagogical Knowledge (TPK) and their actual readiness in organizing online learning [36]. In Indonesia, mathematics teachers' ability to use technology during online learning is still limited, with most teachers relying on WhatsApp and Google Meet or Zoom for online teaching [37]. Filipino secondary school teachers were found to be ready in implementing Mathematics flipped classroom, and there was a significant relationship between teachers' profile and their readiness in this approach [38]. The idea that mathematics is an essential part of the core curriculum is relatively new, but studying mathematics and ethics together can expand cognitive capacities and promote mathematical literacy [50].

The findings of this study provide important insights into the relationship between technology use, moral, and the readiness for IR4.0 among mathematics teachers in Indonesia. These results have implications for educational policymakers, administrators, and practitioners seeking to enhance teachers' preparedness for the Fourth Industrial Revolution. While this study offers valuable insights. Firstly, the findings are based on a specific context of mathematics teachers in Indonesia, limiting the generalizability of the results. Future research should explore the relationship between technology use, moral, and IR4.0 readiness in diverse educational settings and with different subject areas. Moreover, this study focused on the mediating role of moral, but there may be other factors at play. Future research could consider additional variables, such as teacher beliefs, self-efficacy, or organizational support, to provide a more comprehensive understanding of the complex dynamics influencing teachers' readiness for the Fourth Industrial Revolution. Teachers' readiness towards Education 4.0 and their attitude towards the use of technology in teaching mathematics were investigated in several studies

6. Conclusions

In conclusion, this study examined the relationship between technology use, moral, and the readiness for IR4.0 among mathematics teachers in Indonesia. The results indicated that while the direct impact of technology use on IR4.0 readiness was not significant, technology use did have a significant effect on teachers' moral. Furthermore, moral was found to fully mediate the relationship between technology use and IR4.0 readiness, indicating that the influence of technology use on teachers' preparedness for the Fourth Industrial Revolution was entirely explained by their moral levels. These findings highlight the importance of considering teachers' moral as a crucial factor in shaping their readiness for IR4.0. It suggests that enhancing teachers' moral, such as through professional development programs or support systems, can positively impact their preparedness for the challenges and opportunities brought about by the Fourth Industrial Revolution. These insights have practical implications for education policymakers and administrators. By recognizing the significant role of moral in mediating the impact of technology use on IR4.0 readiness, efforts can be directed towards fostering a supportive and conducive environment that promotes positive moral among teachers. This can involve providing adequate resources, training, and support systems to enhance teachers' moral and, subsequently, their readiness for the Fourth Industrial Revolution. Further research could explore additional factors that may influence the relationship between technology use, moral, and IR4.0 readiness. Understanding these complex dynamics will contribute to the development of effective strategies and interventions to prepare teachers for the demands of the Fourth Industrial Revolution. Overall, this study sheds light on the interplay between technology use, moral, and readiness for IR4.0 among mathematics teachers in Indonesia, emphasizing the importance of considering teachers' moral as a crucial factor in shaping their preparedness for the future.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

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Conflict of interest

The authors state that they have no personal relationship(s) that might have inappropriately influenced them in writing the current paper.

Ethics declaration

Research ethics approval was obtained by the Institutional Review Board On behalf of the University of Malaya Research Ethics Committee.

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Appendix A

Questionnaire
The Readiness Model of Mathematics Teachers in Indonesia and Malaysia in Facing Industrial Revolution 4.0.

Part A: Teacher's Background
Instructions: Please mark [/] next to the answer that matches your situation and fill in the blanks in the space provided.

1. Email : _____

2. Gender

☐ Male ☐ Female

3. Teaching experience

☐ 0-5 years

☐ 6-10 years

☐ 11-20 years

☐ More than 20 years

4. Education level

☐ Degree

☐ Master

☐ Ph.D

☐ Other

5. Employment sector

☐ Government

☐ Private

6. Type of Instition

☐ Elementary School

☐ Junior Highschool

☐ Senior Highschool

Part B: Teachers Readiness

GUIDELINES: In this section are the items provided related to your readiness for industrial revolution 4.0.

Please indicate your honest and sincere level of agreement with the statements below by circling any number based on the given scale; from a scale of 1 to 5; A score of 1 indicates a level of agreement that strongly disagrees, while a score of 5 indicates a level of agreement that strongly agrees. Please mark [/] on the answer options that have been provided.

1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Slightly Agree (SA), 4 = Agree (A) and 5 = Strongly Agree (SA)

No	Readiness	SD	D	SA	A	SA
1	Confident to implement teaching and learning based on industrial revolution 4.0	1	2	3	4	5
2	The courses and training provided by the ministry related to industrial revolution 4.0 are sufficient	1	2	3	4	5
3	Willing to attend any course related to industrial revolution 4.0 outside the polytechnic	1	2	3	4	5
4	Willing to pay his own expenses to attend courses related to industrial revolution 4.0	1	2	3	4	5
5	Confident that the concept of industrial revolution 4.0 such as the automation of the "internet of things and big data analytics" provides many benefits to the career development of teachers and students.	1	2	3	4	5

Part C: Moral

Please indicate your honest and sincere level of agreement with the statements below by circling any number based on the given scale; from a scale of 1 to 5; A score of 1 indicates a level of agreement that strongly disagrees, while a score of 5 indicates a level of agreement that strongly agrees. Please mark [/] on the answer options that have been provided.

1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Slightly Agree (SA), 4 = Agree (A) and 5 = Strongly Agree (SA)

No	Moral	SD	D	SA	A	SA
1	Telling the truth	1	2	3	4	5
2	Prohibiting students from copying during the exam	1	2	3	4	5
3	Active involvement in school activities	1	2	3	4	5
4	Forgive students who make mistakes	1	2	3	4	5
5	Always take the time to help students	1	2	3	4	5

Part D: Technology Use

Please indicate your honest and sincere level of agreement with the statements below by circling any number based on the given scale; from a scale of 1 to 5; A score of 1 indicates a level of agreement that strongly disagrees, while a score of 5 indicates a level of agreement that strongly agrees. Please mark [/] on the answer options that have been provided.

1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Slightly Agree (SA), 4 = Agree (A) and 5 = Strongly Agree (SA)

No	Technology use	SD	D	SA	A	SA
1	The use of technology helps to plan the teaching process in the classroom	1	2	3	4	5
2	The use of technology helps integrate the curriculum and the teaching and learning process	1	2	3	4	5
3	The use of technology in the teaching-learning process makes students more motivated	1	2	3	4	5
4	By using technology, students can apply real life in the teaching and learning process	1	2	3	4	5
5	Consider technology as a valuable tool in student learning in the classroom	1	2	3	4	5