Effect of identity as a mediator: The relationship between mathematics teacher cooperation and readiness in facing the era of industrial revolution

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ABSTRACT

Background: The Industrial Revolution has significantly impacted education, making mathematics instructors crucial in preparing students for the demands of the industrial era.
Purpose: This research seeks to explore the correlation between mathematics teacher cooperation and readiness to face the era of the Industrial Revolution, with a specific focus on the mediating effect of identity.
Design/Methodology/Approach: This research utilized a quantitative research design and collected data through surveys administered to school math instructors. The surveys assess the level of cooperation among mathematics teachers, their readiness to adapt to the challenges of the Industrial Revolution era, and their individual identities as teachers. Statistical analyses, including correlation and mediation analyses, are employed to examine the relationships among the variables.
Findings: Preliminary findings indicate a positive correlation between mathematics teacher cooperation and readiness to face the Industrial Revolution era. Moreover, the mediating effect of identity suggests that a strong sense of professional identity among mathematics teachers enhances their cooperation and subsequently contributes to their readiness to adapt to the changing educational landscape.
Conclusion: This research highlights the importance of fostering a strong professional identity among mathematics teachers to foster cooperation and preparedness. It provides insights for policymakers, school administrators, and educators to develop strategies to promote collaboration and professional development in the Industrial Revolution era.
Contribution to Literature: This study enhances understanding of the relationship between mathematics teacher cooperation, identity, and readiness during the Industrial Revolution era, highlighting the importance of teacher identity formation.

Keywords: *Cooperation, Era of industrial revolution, Identity, Mathematics teacher, Mediating, Readiness.*

1. INTRODUCTION

The prompt evolution of technological advancement in the 21st century has led to the emergence of the era of the Fourth Industrial Revolution, characterized by the integration of digital, physical, and biological systems. This has significant implications for the education sector, particularly in developing countries such as Indonesia, where the education system is still largely focused on traditional teaching methods.

The fourth industrial revolution often referred to as Industry 4.0, represents a significant shift in the way technology is utilized and integrated into various aspects of society and the economy. This transformation is described as the fusion of digital technologies, such as artificial intelligence, robotics, the Internet of Things (IoT), and big data analytics, with traditional industrial processes.

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In terms of education, Industry 4.0 emphasizes the need for individuals to acquire new skills and adapt to the changing demands of the digital era. It requires a focus on lifelong learning as well as the integration of technology into educational systems to prepare individuals for the future workforce (Udvaros, Gubán, Gubán, & Sándor, 2023).

According to Tikhonova and Raitskaya (2023), gender dynamics are also impacted by Industry 4.0, as it provides opportunities for greater inclusivity and gender equality. By breaking down traditional barriers and biases, technological advancements can create a more diverse and balanced workforce.

The integration of automation, smart systems, and robotics by industry 4.0 transforms work environment. This revolution has the potential to enhance productivity, improve efficiency, and create new job opportunities. However, it also raises concerns about the displacement of certain jobs and the need for reskilling and upskilling to adapt to new roles (George & Navya, 2023).

From a mental development perspective, Industry 4.0 brings forth a range of innovations that can improve mental well-being, such as telemedicine, mobile health apps, and wearable devices that monitor and support mental health. The integration of technology into healthcare can lead to more accessible and personalized mental health services (Rekha & Yashaswini, 2022).

Prasetyo and Sutopo (2018) highlight several benefits associated with Industry 4.0. The improvement of production speed and flexibility allows businesses to respond quickly to market demands and reduce time-to-market for new products. Enhanced services to customers, enabled by technologies such as chatbots and personalized recommendations, can lead to improved customer experiences and loyalty. Additionally, the positive economic impact of Industry 4.0 can be seen in job creation, increased productivity, and overall economic growth for countries embracing these advancements.

However, Industry 4.0 also presents challenges that need to be addressed. Zhou, Liu, and Zhou (2015) identify five key challenges: knowledge, technology, economics, social, and political challenges. These challenges include issues such as ensuring access to quality education and training to bridge the skills gap, managing the ethical implications of emerging technologies, addressing concerns about job displacement and income inequality, mitigating potential social disruptions caused by technological advancements, and establishing appropriate regulations and policies to govern utilizing technology.

On this basis, algebra or math instruction is of crucial importance, as it is a fundamental subject that provides the basis for many other fields. It is essential for mathematics teachers to be prepared to face the challenges of the Industrial Revolution era and to adapt their teaching methods accordingly. One way to enhance their readiness is to promote cooperation among mathematics teachers, as this can lead to the sharing of ideas, resources, and best practices.

However, the effectiveness of mathematics teacher cooperation in promoting readiness to face the era of industrial revolution may depend on various factors, including the identities of the teachers involved. Identity is a multidimensional construct that encompasses various aspects of an individual's self-concept, including their personal characteristics, cultural and social background, and professional roles and responsibilities.

Some studies suggest that identity can play a mediating role in the relationship between cooperation and readiness. For instance, teachers with a strong sense of professional identity may be more likely to participate in cooperative activities and be better prepared to face the challenges of the industrial revolution. Similarly, teachers who identify strongly with their cultural or social background may be more effective in promoting cooperation among teachers from diverse backgrounds.

Research indicates that mathematics identity plays a crucial role in shaping the knowledge, skills, habits, attitudes, beliefs, and relationships necessary for engaging with mathematics (Allen & Schnell, 2016). Moreover, an individual's mathematics identity influences their preferred level of mathematical involvement (Piatek-Jimenez, Nouhan, & Williams, 2020). Anderson (2007) defines mathematical identity as the understanding of one's relationship with mathematics, although this definition remains somewhat vague and open to interpretation. To provide greater clarity, Aguirre, Mayfield-Ingram, and Martin (2013) expanded on this definition, describing mathematical identity as the beliefs learners evolve regarding their capability to effectively engage and utilize mathematics in various aspects of their lives. Cribbs, Hazari, Sonnert, and Sadler (2015) further extended this framework by incorporating interest and recognition from others as integral components of mathematical identity. Their research revealed that students' perceptions of their mathematical abilities also influenced how they

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believed others perceived them in relation to mathematics. Similarly, their findings demonstrated a positive correlation between students' confidence in their mathematical abilities and their level of interest in the subject (Cribbs et al., 2015). Therefore, for the sake of this research, the definition of mathematics character is students' beliefs in their competence and achievements in mathematical contexts, their interest in participating in mathematical topics, and their perceptions of how others perceive them mathematically (Aguirre et al., 2013; Cribbs et al., 2015).

Therefore, this research seeks to investigate the relationship between mathematics teacher cooperation and readiness to face the era of industrial revolution in Indonesia and Malaysia, and to explore the mediating role of identity in this relationship. This study's results could have significant implications for mathematics education in Indonesia and other developing countries as they strive to prepare their teachers for the obstacles of the Fourth Industrial Revolution.

1.1. Research Questions

1. To what extent does teacher identity mediate the relationship between mathematics teacher cooperation and readiness to face the era of industrial revolution in Indonesia and Malaysia?
2. What is the nature of the relationship between mathematics teacher cooperation and readiness to face the era of industrial revolution in Indonesia and Malaysia?

1.2. Significance of Research

1. Addressing the era of the industrial revolution: The era of industrial revolution, characterized by rapid technological advancements and automation, has transformed various industries, including education. This research aims to investigate how mathematics teachers can effectively adapt to the changing educational landscape and be prepared to meet the demands of the industrial revolution.

2. Understanding the role of identity in teacher readiness: The inclusion of identity as a mediator in this study recognizes the influence of teachers' professional identities on their readiness to face the industrial revolution. Teacher identity encompasses their beliefs, values, experiences, and self-perception as professionals. By investigating how identity mediates the relationship between mathematics teacher cooperation and readiness, the research aims to provide insights into the psychological factors that shape teacher preparedness for the changing educational landscape.

3. Enhancing teacher collaboration: Collaboration among teachers has been recognized as a valuable strategy for professional development and improving instruction. Mathematics teacher cooperation, as mentioned in this study, emphasizes the importance of teachers working together to share ideas, resources, and instructional strategies. The research may explore how collaborative efforts among mathematics teachers can enhance their preparedness to address the challenges of the industrial revolution effectively.

2. LITERATURE REVIEW

The industrial revolution era has brought about significant changes in the way we live and work, and these changes have also impacted education. The need for students to develop skills that are relevant to the modern workforce has had an impact on mathematics education in particular. Mathematics teachers possess a significant role in being involved in preparing students for this era, and their cooperation and readiness are essential for achieving this goal. This literature review will explore the relationship between mathematics teacher cooperation and readiness in confronting the industrial revolution era and the role of identity as a mediator in this relationship.

2.1. Mathematics Teacher Cooperation

Cooperation among mathematics teachers has been recognized as a significant element in improving mathematics education (Bjerke, Eriksen, Rodal, Smestad, & Solomon, 2013; Fernández, 2008). Teachers who work together to plan lessons, share resources, and provide feedback to one another are more likely to improve their teaching practices and enhance student learning outcomes. Concerning the era of the industrial revolution, cooperation among mathematics teachers can also help to certify that pupils are gaining the necessary knowledge and skills that are relevant to the modern workforce. Research conducted in the discipline of teaching mathematics in Malaysia and Indonesia has established the significance of collaborative and cooperative learning approaches

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(Leong, Kaur, & Kwon, 2017). Cooperative learning is employed to cater to students of various abilities, taking into account their comprehension levels, styles of learning, and sociological backgrounds. This approach aims to foster students' academic achievement, skill development, and social harmony between pupils from diverse ethnic backgrounds (Veloo, Md-Ali, & Chairany, 2016). In addition to academic accomplishments, the cultivation of process skills and values plays a crucial role in extending social harmony between pupils in the modern multi-ethnic schools. Consequently, teachers should adopt pedagogies that facilitate students' acquisition of academic knowledge and professional skills, enabling them to tackle the obstacles they encounter in their daily lives. Building upon the findings of cooperative learning studies, Malaysian scholars have underscored the effectiveness of cooperative learning as an impactful pedagogical approach to enhance students' proficiency in mathematics and their communication abilities. This study aims to describe the importance of cooperative and collaborative learning in helping students improve their communication abilities, mathematics achievement, and the significant integration of values within the context of mathematics education in Malaysia (Hossain, Tarmizi, & Ayub, 2012). Hunter and Civil (2021) shed light on the significance of collaborative mathematical understandings and advocated for the utilization of a situative strength-based approach. This approach aims to illustrate the diverse ways in which learners from collectivist traditions engage in mathematical interactions. It also, underscores the importance of providing learners from non-dominant communities with opportunities to broaden their practices and adapt to various learning contexts.

Furthermore, they emphasize the role of family and whānau (extended family) in the lives of these learners. It highlights the value of embracing their prior knowledge of interactions and collaboration, which they have acquired within their homes and communities. Recognizing and incorporating this prior knowledge is seen as crucial for fostering meaningful mathematical engagement and supporting the learning journey of these students. As well, Yohannes (2017) highlighted the need for scholars to improve techniques that enhance student performance, including collaborative learning. This approach involves students and teachers working together to find understanding, solutions, and products. It promotes greater accomplishment, constructive interpersonal interactions, and psychological health, producing graduates who are collaborative, caring, introspective, analytical, and creative.

2.2. Mathematics Teacher Readiness

Mathematics teacher readiness refers to the extent to which teachers feel prepared to teach in the Industrial Revolution era. This includes having the necessary knowledge and skills to impart math knowledge in a manner that is relevant to the modern workforce, as well as being able to adapt to new technologies and teaching methods. Teachers who are more ready to face the obstacles of the industrial revolution era are more likely to be effective in preparing students for the modern workforce (As'ari, Kurniati, & Subanji, 2019).

With the growing emphasis on inclusive education, educators are now expected to possess the necessary readiness and competence to address each student's diverse needs within mainstream classrooms. They must be equipped to handle a wide range of responsibilities across different levels of education. In this study, teacher readiness refers to the abilities, dispositions, practices, and knowledge that enable teachers to effectively address the individual needs of their students (e.g., Aishah Bua and Bahari (2011)). Teacher efficacy beliefs and quality are two critical factors that have a profound influence on both the readiness of the teacher and the achievement of the student (Bolyard & Moyer-Packenham, 2008; Feng & Sass, 2013; Holzberger, Philipp, & Kunter, 2013; Tara, 2012).

Extensive research has highlighted the significance of teacher quality for educational outcomes. Studies have shown that teachers who possess strong content knowledge, pedagogical skills, and effective classroom management strategies tend to have a positive effect on students' learning. These findings underscore the importance of ongoing professional development and continuous improvement for teachers to improve their instructional practices and meet the diverse needs of their students.

Teacher efficacy beliefs play a vital part in forming instructional practices and student outcomes. Teachers with high levels of efficacy believe in their ability to positively influence student learning and overcome challenges. Such beliefs can lead to increased motivation, engagement, and persistence in both teachers and students. Conversely, low teacher efficacy may hinder instructional effectiveness and limit student achievement.

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Understanding the significance of teacher quality and fostering teacher efficacy beliefs are vital for creating a supportive and effective learning environment. Investing in professional development opportunities, promoting collaboration among teachers, and providing resources and support could aid in the development of high-quality teachers and enhance their efficacy beliefs. Ultimately, these factors can positively impact student achievement and promote educational success (Brown & McNamara, 2011). Becoming a mathematics teacher involves not only acquiring the necessary knowledge and skills but also developing a sense of identity and identification with the role. Identity refers to how individuals perceive themselves in relation to a particular social group or role, while identification refers to the process of aligning oneself with the values, beliefs, and behaviors associated with that group or role (Brown & McNamara, 2011).

For someone aspiring to become a mathematics teacher, developing a strong identity as a mathematics educator is crucial. This involves seeing oneself as a knowledgeable and competent practitioner of mathematics, as well as recognizing the value and importance of teaching mathematics to others. This identity can be shaped through personal experiences, educational background, and interactions with other mathematics teachers and students (Brown & McNamara, 2011).

Identification, on the other hand, involves adopting the characteristics and practices of effective mathematics teachers. This can include aligning oneself with the professional standards and expectations of the teaching profession, as well as adopting teaching strategies and approaches that are supported by research and best practices. Identification also involves developing a sense of belonging to the mathematics teaching community and engaging in ongoing professional development to improve one's teaching skills (Brown & McNamara, 2011).

2.3. Identity as a Mediator

Indeed, identity has been recognized as a significant factor in mediating the relationship between teacher collaboration and student learning outcomes (Teeters, Shedro, Alvarez, McKimmy, & Dimidjian, 2021). Within the particular context of teaching mathematics, identities of teachers as mathematics educators can play a role in mediating the link between collaboration and readiness. Teachers who strongly identify as mathematics teachers may be more inclined to engage in cooperative activities with their peers and may feel more prepared to address the challenges posed by the era of the industrial revolution.

Additionally, Shah (2020) emphasizes the importance of mathematical identity formation for learners who struggle with learning within the realm of curricular studies. In a study on transformative design, Shah employs a survey-style method to gather quantitative information on the formation of students' mathematical identities. The study analyzes various factors such as confidence, motivation, anxiety, and career interest, establishing significant correlations among these variables. The findings contribute to the existing scholarship on forming a mathematical identity for learners with educational obstacles and have implications for tertiary education and professions in mathematics. Positive development of mathematical identity is crucial for fostering access and equity for students with learning disorders (Shah, 2020).

2.4. The Relationship between Mathematics Teacher Cooperation and Readiness

The relationship between mathematics instructor cooperation and readiness to confront the Industrial Revolution era is multifaceted. On one hand, mathematics teacher cooperation facilitates the exchange of innovative pedagogical approaches, content knowledge, and technological integration strategies. Through collaboration, teachers can collectively develop a repertoire of effective teaching practices that align with the demands of the Fourth Industrial Revolution (Mokher & Jacobson, 2021). This cooperation can enhance teachers' readiness by equipping them with the necessary skills and resources to adapt to new educational paradigms. Collaboration and readiness are interconnected concepts within the realm of mathematics education. The act of working collaboratively and cooperatively among teachers has a positive impact on their level of preparedness and ability to deliver effective instruction (Mokher & Jacobson, 2021). Through collaboration, teachers can establish a supportive and inclusive learning environment that fosters teacher readiness. This collaborative environment facilitates the evolution of pedagogical knowledge and skills, enabling teachers to enhance their instructional practices. One notable example of the benefits of collaboration is evident when teachers collaborate to plan and design a comprehensive mathematics curriculum. By pooling their diverse expertise and knowledge, they can create a curriculum that is both rigorous and accessible to all students. This collaborative effort ensures that the

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curriculum caters to the varied needs and abilities of students, promoting their readiness to engage with the subject matter.

Furthermore, collaboration among mathematics teachers plays a vital role in staying abreast of current research and best practices in the field. By engaging in collaborative professional learning communities, teachers can continuously update their knowledge and refine their instructional approaches. This active collaboration enables teachers to adapt their teaching methods based on emerging research and innovative practices, leading to improved instructional outcomes (Slavíčková & Novotná, 2022). In summary, collaboration among mathematics teachers is closely linked to their readiness to effectively teach in the classroom. Collaborative practices facilitate the establishment of a supportive educational environment, enhance pedagogical knowledge and skills, and foster continuous professional development. By leveraging collaboration, mathematics teachers can enhance their readiness to face the challenges and opportunities of mathematics education in the modern era.

3. METHODOLOGY

3.1. Research Design

A quantitative research design was used in this study to investigate the relationship between mathematics teacher cooperation and readiness to face the Industrial Revolution era, with a particular focus on the mediating role of identity. To assess the readiness of mathematics teachers to face the Industrial Revolution, a survey was conducted. According to Creswell (2012), a survey design is commonly used in quantitative research, involving the administration of questionnaires to a study sample to identify characteristics within the population and enable generalization of findings. In this study, questionnaires were utilized to gather information from the entire population of teachers in Malaysia and Indonesia. Simple random sampling was employed to determine the number of study samples from each country.

3.2. Sampling

The sample will consist of mathematics teachers who are currently teaching in secondary schools. The study encompassed a sample of 231 mathematics teachers from Indonesia and 384 mathematics teachers from Malaysia, chosen using a simple random sampling approach. In Indonesia, the sample consisted of 59 (25.5%) male teachers and 172 (74.5%) female teachers. Regarding teaching experience, 26 (11.3%) teachers had less than 5 years of experience, 65 (28.1%) had 5 to 10 years, 97 (42.0%) had 11 to 15 years, 19 (8.2%) had 16 to 20 years, and 24 (10.4%) had more than 20 years of experience. Furthermore, the distribution based on the type of school was as follows: 65 (28.1%) teachers from primary schools, 71 (30.7%) from middle schools, and 95 (41.1%) from senior high schools.

In Malaysia, the sample comprised 88 (22.9%) male teachers and 296 (77.1%) female teachers. In terms of teaching experience, 27 (7.0%) teachers had less than 5 years of experience, 66 (17.2%) had 5 to 10 years, 104 (27.1%) had 11 to 15 years, 85 (22.1%) had 16 to 20 years, and 102 (26.6%) had more than 20 years of experience. Additionally, the breakdown based on the type of school was as follows: 260 (67.7%) teachers from primary schools, 41 (10.7%) from middle schools, and 83 (21.6%) from senior high schools.

3.3. Data Collection

The study utilized adapted instruments to measure readiness for the era of the Industrial Revolution, mathematics teacher cooperation, and ethics. These instruments were designed to be used with a 5-point Likert scale, where 1 indicates "strongly disagree" and 5 indicates "strongly agree." The readiness for the era of the Industrial Revolution instrument measured the extent to which teachers were prepared to face the challenges of the era, including their knowledge and attitude towards the era of intelligence. It encompassed aspects such as knowledge of the era of intelligence and attitudes towards it. The cooperation aspect focused on teachers' willingness to collaborate, exchange ideas, participate in activities, and support their colleagues. It aimed to measure the level of collaboration among mathematics teachers. The identity aspect of the instrument explored teachers' sense of responsibility in carrying out their professional duties. It aimed to assess their dedication and commitment to their role as educators. In order to guarantee the validity and reliability of the research instruments, experts in relevant fields reviewed the content and language. A pilot study involving 150 mathematics teachers was carried out to examine the instruments' reliability. Exploratory factor analysis (EFA) was employed to examine the validity of the

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items and constructs. Additionally, confirmatory factor analysis (CFA) was conducted using a sample of 150 teachers to confirm the compatibility of the items with the proposed model.

Table 1 presents the outcomes of the exploratory factor analysis (EFA), which reveal a Kaiser-Meyer-Olkin (KMO) score of 0.913 and a significance level lower than 0.001. Community values span from 0.502 to 0.853, all surpassing the 0.5 threshold. Eigenvalues for identity, cooperation, and readiness stand at 7.763, 1.814, and 1.165, respectively, all is exceeding the value of 1. Additionally, the cumulative variance is documented as 71.7%, satisfying the minimum criterion of 60%.

Table 1. Rotated component matrix.

Items	Component			Eigen value	Variance
	Identity	Cooperation	Readiness		
F1			0.714	1.165	7.8%
F2			0.675		
F3			0.644		
F4			0.691		
F5			0.739		
A1		0.768		1.814	12.1%
A2		0.758			
A3		0.742			
A4		0.832			
A5		0.738			
E1	0.767			7.763	51.8%
E2	0.809				
E3	0.855				
E4	0.831				
E5	0.850				

The results of the Confirmation Factor Analysis indicate loading factors for each variable that vary from 0.63 to 0.92. The Chi-square/degrees of freedom (df) ratio stands at 1.850, with the Goodness-of-fit Index (GFI) at 0.875, Comparative Fit Index (CFI) at 0.958, and Root Mean Squared Error of Approximation (RMSEA) at 0.076. The relationships among variables range from 0.48 to 0.77. Taken together, these findings suggest that the constructed model exhibits a high level of quality (Awang, 2012; Kline, 2005).

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	0.69			
	F5	0.80			
Cooperation	A1	0.90	0.926	0.931	0.731
	A2	0.69			
	A3	0.91			
	A4	0.91			
	A5	0.84			
Identity	E1	0.83	0.940	0.94	0.759
	E2	0.70			
	E3	0.81			
	E4	0.71			
	E5	0.77			

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Table 2 presents the internal validity of each variable, which as determined by Cronbach's alpha values, falls within the range of 0.827 to 0.940, all of which satisfy the required threshold of ≥ 0.70. Similarly, Composite Reliability (CR) values span from 0.831 to 0.940, also exceeding the ≥ 0.70 criterion. Moreover, Average Variance Extracted (AVE) values range from 0.501 to 0.759, meeting the established criterion of ≥ 0.50 (Awang, 2012). In summary, the validation factor analysis adheres to the predefined criteria, indicating that the tested instrument is suitable for application in real research scenarios.

3.4. Data Analysis

Structural equation modeling (SEM) with a software package, such as AMOS will be utilized for examining the data. SEM will allow us to test the hypothesized model, which posits that identity mediates the relationship between mathematics teacher cooperation and readiness to confront the industrial revolution era. The model will be evaluated using goodness-of-fit indices such as the chi-squared test, the Tucker-Lewis Index (TLI), the comparative fit index (CFI), and the root means square error of approximation (RMSEA).

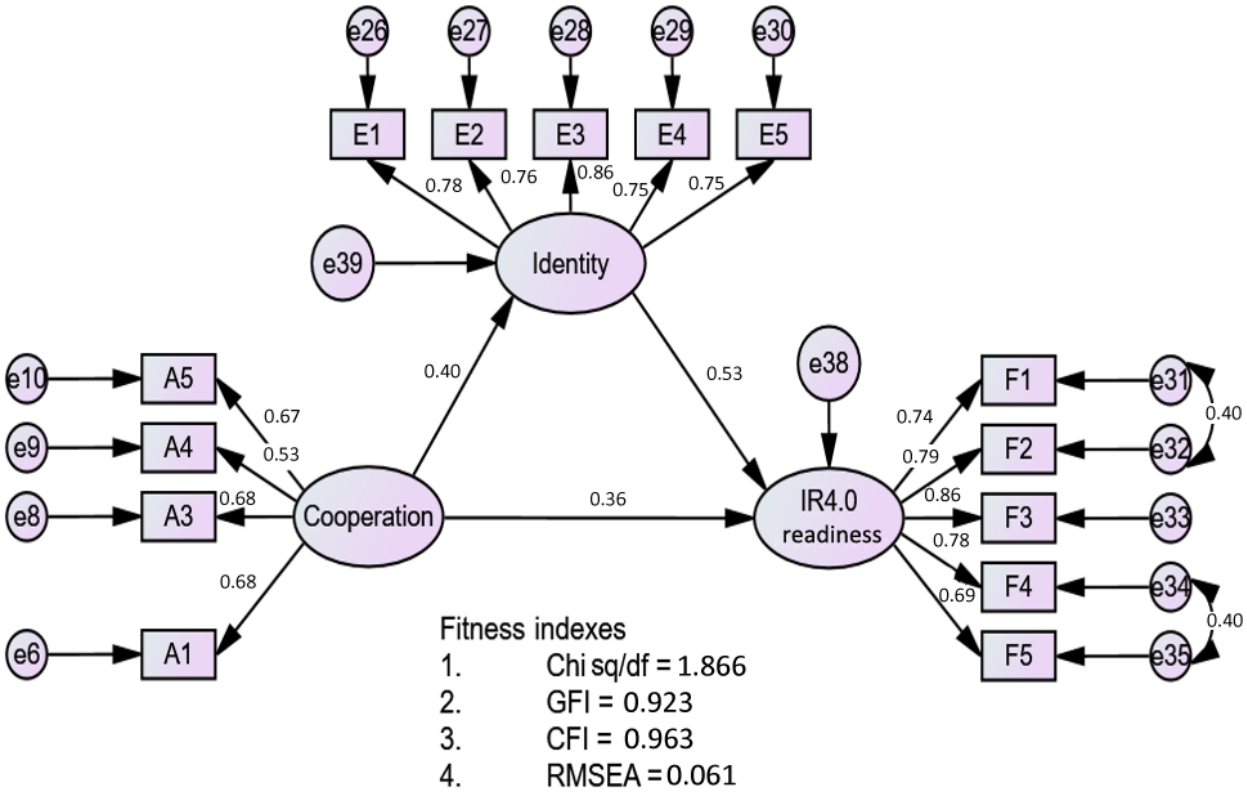

Figure 1. The mediator effect of identity in the contribution between cooperation and ir4.0 readiness of mathematics teachers in Indonesia.

4. FINDINGS

4.1. The Effect of Identity as a Mediator of Contribution between Mathematics Teacher Cooperation in Indonesia and Readiness in Facing the Era of Industrial Revolution

The findings of the study indicate significant direct effects of cooperation on both IR4.0 readiness and identity among mathematics teachers in Indonesia. The direct effect of cooperation on IR4.0 readiness suggests that increased collaboration among teachers positively influences their preparedness regarding the obstacles posed by the Industrial Revolution 4.0 ($\beta = 0.36$, $p < 0.001$). This implies that when teachers engage in cooperative activities, it enhances their readiness to adjust to the modifications created by IR4.0.

Similarly, the direct effect of cooperation on identity highlights that collaborative efforts also contribute to shaping teachers' professional identities ($\beta = 0.40$, $p < 0.001$). Through cooperation, teachers develop perception of shared

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intent, belonging, and collective efficacy, which in turn strengthens their professional identities as mathematics educators.

Furthermore, the study reveals that identity function plays a significant mediating role in the relation between cooperation and IR4.0 readiness (β = 0.21, p < 0.001). This implies that the influence of cooperation on readiness is partially explained by the mediation of teachers' identities. A strong professional identity enhances the positive impact of cooperation on readiness, indicating that teachers with a strong sense of professional identity are more likely to actively participate in cooperative activities and be better prepared to face the challenges of IR4.0.

Figure 1 illustrates that the analysis of the indirect effect demonstrates good model fit, as evidenced by the Chi Square/df value of 1.866, GFI of 0.923, CFI of 0.963, and RMSEA of 0.061. These fit indices show that the proposed model fits the data well, which supports the idea that identity, plays a part in the link between Indonesian math teachers' cooperation and readiness. In summary, the study highlights the significance of cooperation in promoting readiness for IR4.0 among mathematics teachers. It emphasizes the direct effects of cooperation on both IR4.0 readiness and identity, as well as the mediating role of identity in the relationship between cooperation and readiness. These results have consequences for educational policymakers and school administrators, emphasizing the importance of fostering a collaborative culture and supporting the growth of robust, qualified identities across math instructors to enhance their preparedness for the challenges of IR4.0.

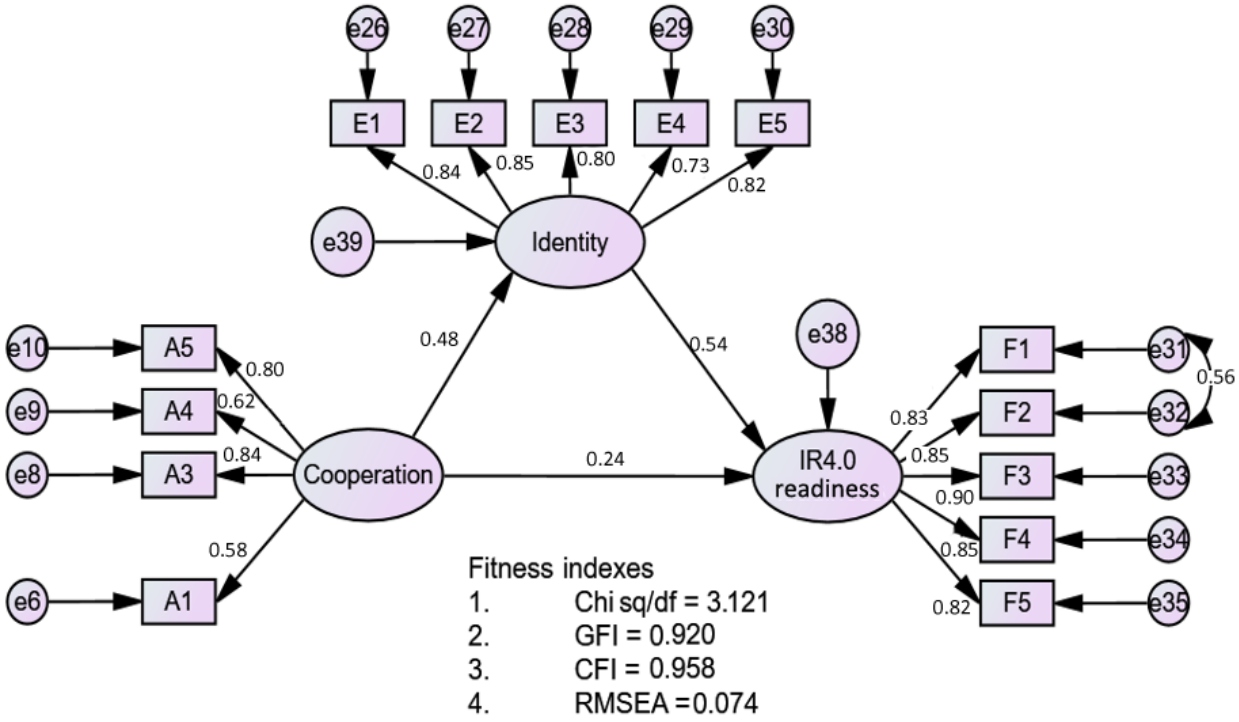

Figure 2. The mediator effect of identity in the contribution between cooperation and ir4.0 readiness of mathematics teachers in Malaysia.

4.2. The Effect of Identity as a Mediator of the Contribution between Mathematics Teacher Cooperation in Malaysia and Readiness in Facing the Era of Industrial Revolution

The study findings demonstrate significant direct impacts of cooperation on both IR4.0 readiness and identity among mathematics teachers in Malaysia. The direct effect of cooperation on IR4.0 readiness indicates that increased collaboration among teachers positively influences their preparedness to face the challenges of the industrial revolution (β = 0.24, p < 0.001). This suggests that when teachers engage in cooperative activities, they are more likely to create the talents and knowledge necessary to adjust to the alterations brought about by IR4.0. Additionally, the direct effect of cooperation on identity highlights that collaborative efforts also contribute to shaping teachers' professional identities (β = 0.48, p < 0.001). Through cooperation, teachers may gain a sense of

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belonging, shared purpose, and collective efficacy, which in turn strengthens their professional identities as mathematics educators.

Furthermore, the study reveals that identity plays a significant mediating role in the relationship between cooperation and IR4.0 readiness ($\beta = 0.26$, $p < 0.001$). This suggests that the mediation of teachers' identities is partially responsible for the influence of cooperation on readiness. A strong professional identity enhances the positive impact of cooperation on readiness, suggesting that teachers who have a strong sense of professional identity are more likely to actively participate in cooperative activities and be better prepared to face the challenges of IR4.0.

As Figure 2 illustrates, the findings also indicate good model fit for the indirect effect, as evidenced by the Chi Square/df value of 3.121, GFI of 0.920, CFI of 0.958, and RMSEA of 0.074. With these fit indices, we can see that the suggested model fits the data well, which supports the idea that identity, plays a part in the link between cooperation and IR4.0 readiness among Malaysian math teachers. Overall, the study highlights the importance of cooperation in promoting readiness for IR4.0 among mathematics teachers. It emphasizes the direct effects of cooperation on both IR4.0 readiness and identity, as well as the mediating role of identity in the relationship between cooperation and readiness. These results have consequences for educational policymakers and school administrators, emphasizing the significance of fostering a collaborative culture and supporting the advancement of robust, experienced identities across math instructors to enhance their preparedness for the challenges of IR4.0.

5. DISCUSSION

The Industrial Revolution has transformed the global economy and society, with technology playing a central role in driving progress and innovation. As the age of the Fourth Industrial Revolution approaches, it is essential to prepare future generations to fulfill the requirements of an increasingly technological and interconnected universe. Mathematics education plays a crucial role in equipping students with the necessary talents and knowledge to thrive in this new era. Therefore, it is crucial to examine factors that can enhance mathematics teachers' readiness to effectively prepare students for the challenges of the Industrial Revolution. This study is intended to investigate the impact of identity as a mediator in the relationship between mathematics teacher cooperation and readiness to face the Industrial Revolution era. The findings shed light on the significance of teachers' sense of identity in shaping their readiness for the challenges brought about by the Industrial Revolution. Furthermore, the results add to the body of current knowledge by providing insights into the mediating role of identity in the relationship between teacher cooperation and readiness. The first key finding of the study demonstrated an important favorable correlation between mathematics teacher cooperation and readiness to confront the Industrial Revolution era. This finding aligns with previous research that emphasizes the importance of collaborative practices among teachers in adapting to transformative educational contexts (Johnson & Johnson, 2019; Langset, Jacobsen, & Haugsbakken, 2018). The cooperative interactions among mathematics teachers enable them to share ideas, engage in joint activities, and provide support to one another, thus enhancing their overall readiness to face the challenges of the Industrial Revolution era. The study's second major finding demonstrated that identity serves as a mediator in the relationship between mathematics teacher cooperation and readiness. It was found that teachers' sense of identity, including their responsibility and commitment to their professional roles, significantly mediated the relationship between teacher cooperation and readiness. These findings align with earlier studies that highlight the influence of identity on teachers' professional practices and attitudes (Beijaard, Meijer, & Verloop, 2004; Day & Gu, 2014). The results indicate that when teachers participate in cooperative practices and develop a strong professional identity, they are better prepared to face the demands of the Industrial Revolution era. According to Heffernan, Peterson, Kaplan, and Newton (2020), the scholars discuss identity in education research, particularly in classrooms teaching mathematics, and dissect the diverse viewpoints on identity in order to aid scholars, educators, and readers in comprehending the various viewpoints on identity, recognize that identity could be impacted, and discover the methods that academics and researchers have studied identity interventions in mathematics classrooms thus far and continue to do so. Mathematics teachers have a responsibility to recognize and address the systems that can privilege certain individuals while oppressing others, such as those based on race, socioeconomic class, and gender. Furthermore, studies have found a connection between religious identities and ideologies that support the marginalization of individuals on the basis of gender, sexual orientation, race, and socioeconomic status (Johnson, 2016). Therefore, teacher educators must gain insight

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into how teachers comprehend sociocultural, sociopolitical, and cultural conditions in order to inspire inclusive learning environments. Specifically, recognizing the ways in which instructors navigate their identities and whether they embrace or resist new ideas is a vital step in identifying the nature of educational opportunities' and promoting equitable education for all students.

6. IMPLICATIONS

1. Educational Policy and Practice: The findings of this research can inform educational policies and practices in the context of mathematics education and teacher professional development. By understanding the relationship between mathematics teacher cooperation, readiness, and identity, policymakers and educational leaders can design strategies and interventions to enhance collaboration among teachers, support their professional growth, and ensure their readiness to meet the challenges of the industrial revolution.
2. Teacher Professional Development: The research can contribute to the field of teacher professional development by shedding light on the role of identity in shaping teachers' readiness and the impact of cooperation on their preparedness. The findings can guide the design and implementation of professional development programs that emphasize collaboration among mathematics teachers and address the development of professional identities to effectively navigate the era of industrial revolution.
3. Curriculum Design and Implementation: Understanding the relationship between mathematics teacher cooperation, readiness, and identity can have implications for curriculum design and implementation. The research can highlight the importance of incorporating collaborative strategies and opportunities for teachers to develop their professional identities within the mathematics curriculum. This can help ensure that mathematics education aligns with the needs of the industrial revolution and equips students with the necessary skills and competencies.
4. Student Learning Outcomes: Collaboration among mathematics teachers and their readiness to face the industrial revolution can ultimately impact student learning outcomes. By examining the relationship between mathematics teacher cooperation, readiness, and identity, the research can provide insights into effective instructional practices that support student success in mathematics education during the era of the industrial revolution.
5. Cross-Cultural Perspectives: If the research includes a comparative analysis between different countries or contexts, such as Indonesia and Malaysia, it can offer valuable insights into the cultural and contextual factors that influence the relationship between mathematics teacher cooperation, readiness, and identity. This can contribute to a deeper understanding of how cultural and educational contexts shape the dynamics of collaboration and preparedness in different regions, allowing for more targeted and context-specific interventions.

7. RECOMMENDATIONS FOR FUTURE RESEARCH

1. Conduct longitudinal studies to examine the relationship between mathematics teacher cooperation, readiness, and identity over an extended period.
2. Utilize a mixed-methods approach to gain a comprehensive understanding of the relationship between mathematics teacher cooperation, readiness, and identity.
3. Expand the scope of research by conducting comparative studies across different educational systems, cultures, or countries.
4. Design and implement intervention studies to investigate the effectiveness of specific strategies or programs aimed at enhancing mathematics teacher cooperation, readiness, and identity.
5. Explore the integration of collaboration and identity development components within teacher preparation programs.
6. Investigate different models of teacher collaboration and their impact on mathematics teacher readiness and identity.
7. Focus on examining the specific processes and experiences that shape mathematics teachers' professional identities.
8. Explore the relationship between mathematics teacher cooperation, readiness, and identity and student learning outcomes.

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9. Investigate the role of technology in facilitating teacher cooperation, readiness, and identity development.

8. CONCLUSION

This research examined the impact of identity as a mediator in the relationship between mathematics teacher cooperation and readiness to confront the Industrial Revolution era. The findings demonstrated a strong favorable correlation between teacher cooperation and readiness, highlighting the importance of collaborative practices among mathematics teachers. The study also demonstrated that identity plays a mediating role in this relationship, emphasizing the significance of teachers' professional identity in shaping their readiness for the challenges of the Industrial Revolution era. The findings of this research hold significant implication for professional development and mathematics teacher education. To prepare teachers effectively for the demands of the Industrial Revolution era, it is crucial to promote and support cooperative practices among mathematics teachers. Programs for teacher education ought to give educators opportunities to engage in collaborative activities, share ideas, and support one another. These collaborative practices can enhance teachers' readiness by fostering a sense of collective responsibility and a shared commitment to addressing the challenges of the era. Furthermore, cultivating a strong professional identity among mathematics teachers is essential. Teacher education programs should emphasize the development of a sense of identity that encompasses a deep commitment to their professional roles and responsibilities. This can be achieved through reflective practices, mentorship programs, and opportunities for teachers to actively engage in professional learning communities. By fostering a strong professional identity, teachers can feel empowered and motivated to adapt to the changing educational landscape of the Industrial Revolution era.

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INSTITUTIONAL REVIEW BOARD STATEMENT

The Ethical Committee of the University of Malaya, Malaysia has granted approval for this study on 27 July 2021 (Ref. No. UM. TNC2/UMREC_1449).

TRANSPARENCY

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

The idea, data analysis, collecting data and findings, H.Z.; writing, finding recourses and literature review, N.M.; literature review, conceptual framework, S.S.A.R.; literature review, conceptual framework, U.K.M.S. All authors have read and agreed to the published version of the manuscript.

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