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Leading Digital Leadership in Schools: Future Implications towards Nation Based on The Quadruple Helix Model

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Abstract
Digital leadership is one of the leadership styles that is much discussed. The influence of digital leadership has also affected the education sector. However, the use of digital leadership in education is still limited in Malaysia. In Malaysia, leadership research mainly discusses transformational and instructional leadership styles. Therefore, this study aims to explain the use of digital leadership to improve the teaching and learning process because teachers' leadership style is important as it affects students' achievement. The concept of the Quadruple Helix Model based on innovation in digital leadership specifically in digital and technology will also be discussed in this article to enhance the teaching and learning process. The Quadruple Helix Model emphasizes the relevance of the engagement of the government, university, industry, and society in research and innovation. The results of this study are anticipated to be valuable in the expansion of already-existing information and in the development of a new method and strategy to enhance teaching and learning via digital leadership. In addition, it is anticipated that the Quadruple Helix Model will be able to generate suggestions for ways to enhance and guarantee that Malaysia's educational system ranks among the best in the world. Digital leadership will be the predicted as a dominant leadership approach used globally in the educational sector in another ten years.
Keywords: Digital Leadership, Quadruple Helix Model, School, Education, Innovation.

Introduction

A school is one example of an organization where leadership is a valuable asset. As a result, more work needs to be done to develop and keep the best leadership in the educational system. In this context, the importance of developing good leaders must be highlighted. Accordingly, the nation wants to raise a new generation of leaders in the hopes that they will shape future leaders of the quality of teachers. Leading at the teacher level should be the first step in this endeavour.

The post-pandemic era is now perceived as more receptive to a digital leadership approach that can be used in the educational system. The digital world is now very relevant in the 21st century since everyone is actively working towards Industrial Revolution 4.0 day by day. The current COVID-19 epidemic has accelerated the usage of digital technology in the field of education. Through the use of online learning tools, the norms of the digital world can be observed. In the field of education, using the Internet and digital devices is normal among both teachers and students.

Face-to-face interaction still occurs in the field of education, despite the fact that most activities now take place online. However, it is not improbable that practices or procedures will entirely switch to online again if there is a requirement depending on the current scenario. Therefore, planning can begin with individuals who are involved in the country's education in order to give an educational system access to all future prospects. For instance, teachers who drive change. Teachers must therefore prepare themselves with a variety of abilities, including digital leadership.

Digital leadership has many definitions and variables. Abbu et al (2022) measured through fifteen/dimensions of humanity from digital leadership, which is a philosophy that draws on created digital leadership. For example, honesty, humility, courage, artificial intelligence, a growth-oriented pattern of thought, transparency, data-focused storytelling, inspiring engagement, digital literacy, a positive attitude, skill learning, information sharing, participation, and a colleague's good example. A study by Hamzah et al (2021) found that the digital leadership of the head teacher is associated with teachers' ability to teach using technology. According to (Yuting et al., 2022)’s research, digital leadership, also known as leadership technology, is connected with information and communication competency or teachers' digital competence. A study by (Rawung et al., 2023) showed the digital leadership skills of kindergarten teachers have a favourable and significant relationship with the digital leadership of the kindergarten head.

Digital leadership is thus applicable at both the institutional and individual levels (Antonopoulou et al., 2020). In other words, digital leadership is important in making substantial use of technology to enhance the well-being, circumstances, and quality of life of others (Couros, 2013). Furthermore, digital leadership in education contributes to the acceptance, adoption, and application of new technologies in order to transform schools into digital-age learning environments, according to (Zhong, 2017). Digital leadership is important to establish and lead a shared vision for the institution's quality, to promote innovation, the development of professional learning environments, and the responsible use of information technology (International Society for Technology in Education, 2009; Westerman et al., 2014). This is done to create digital leaders in education who can establish direction, persuade others, start lasting change based on knowledge, and develop connections in order to foresee changes that are crucial to the future success of the school (Sheninger, 2019).

The reason for the digital leadership in education needs to be investigated because there is currently little research on the subject, particularly after the pandemic. Additionally, the issues with digital leadership will also be recognised, which will aid in decision-making and problem-solving through the use of digital leadership. We need to know about the growth of digital leadership by reviewing knowledge development because the pertinent components

of the implementation of digital leadership in schools can be improved using the variables that have been identified as supporting the success of digital leadership in education. The Ministry of Education really needs this information to prepare some interventions and programs to enhance digital leadership in schools. This concept paper provides an interesting and exciting opportunity to advance our knowledge of digital leadership based on findings from the current research papers related to digital leadership in schools. Therefore, this explanation makes a major contribution to research on the body of knowledge of digital leadership by expanding the discussions by focusing on intervention in digital leadership in schools using the Quadruple Helix Model.

This context offered a significant chance to increase understanding of digital leadership in light of the consequences of the Quadruple Helix implications. The study offers some important insights into a focus group of Quadruple Helix Model of innovation, focusing on the four main aspects namely government, universities, industry and civil society by giving sort of awareness on how to empower the students' development strength on digital leadership. This review has a high need in leadership theoretical development for a reason that systematic literature review can arrange the trends of digital leadership effectively. This will help others to pinpoint the components, areas of strength, and areas of weakness in the use of digital leadership.

Concepts of Digital Leadership

Malaysia and other nations across the world are putting more emphasis on digital leadership in the sphere of education lately. At least six studies on digital leadership have been carried out in Malaysia. One study by Yusof et al (2019), for instance, identified two aspects of digital leadership practise: communication and school climate. There would be at least four studies on digital leadership completed in 2021. One of them is to determine the level of teachers' digital teaching practises, the level of principals' digital leadership, and the components of principals' digital leadership that predict teachers' digital teaching levels by Hamzah et al (2021). The study's findings indicate that teachers' digital teaching practises and their level of digital leadership are both at a high level, with only digital citizenship serving as a significant predictor of teachers' digital teaching.

Next, a study by Omar and Ismail (2021) investigated how teachers' self-efficacy with information and communication technology (ICT) and principals' technological leadership relate to one another. The outcome demonstrates that there was no discernible variation in teachers' self-efficacy in using ICT based on their gender or age. In addition, there was a modest impact of principle technology leadership on teachers' self-efficacy and a moderately positive relationship between principal technology leadership and teacher self-efficacy. In 2021, a different study sought to investigate digital leadership among high-performing school principals, particularly from a public relations standpoint (Saraih et al., 2021). According to the research, social media has replaced traditional public relations channels among the best Malaysian school principals. The results also imply that third parties, like pupils, parents, and alumni, can improve school administrators' public relations strategies by using their social media platforms.

In Malaysia, two additional studies are being conducted on digital leadership. The goal of Ismail et al (2021)'s research is to examine the connection between teachers' self-efficacy and principals' leadership in technology. The results indicate that there was no discernible

difference in the improvement of self-efficacy amongst teachers of either gender. The association between technological leadership and teachers' self-efficacy, however, was minimal. Excellence in professional practise and digital citizenship are two aspects of technology leadership that enhance teachers' self-efficacy in using ICT. In another study, Saraih et al (2022) discovered that social media has replaced face-to-face interaction as the primary means of communication among the best Malaysian school principals. Research has also indicated a potential link between it and productivity and job performance.

At least one study carried out abroad in 2022, while three conducted there in 2021. The impact of digital leadership among school principals on teachers' use of technology during the COVID-19 pandemic in Kuwait was covered in a paper by (AlAjmi, 2022). The study found that teachers' adoption of technology during the COVID-19 epidemic was positively impacted by digital leadership among school principals. A study conducted in 2021 examined how digital leadership was applied to communication and teacher professional development in Indonesia (Rusnati & Gaffar, 2021). The findings showed that good communication gave stakeholders the necessary information in a timely manner. For instance, the more available socialisation of school programs (parent-teacher conferences, flyers, and viral content) through various social media and electronic gadgets. Principals also took the initiative to support teachers in their professional development and encouraged them through various workshops and training sessions to improve their teaching and leadership abilities.

The study's goals in Thailand were to examine the elements of digital leadership and create a digital leadership model (Suksai et al., 2021). The findings indicate that vision leadership, the use of digital technology in management, the support and management of digital technology in education, the use of digital technology in measurement and evaluation, and the use of digital technology ethically are all elements of digital leadership. While this is going on, the model for developing digital leadership consists of: (1) Context - policy is a guideline for implementation, principle is a guideline for development, and objective of indicating changing behaviours; and (2) Guideline for Digital Technology Development - input consists of organisational culture, technology, and administrative structure, as well as digital technology development processes like design thinking.

The perceptions and experiences of teachers regarding their school principal's digital leadership roles and technology capabilities during the COVID-19 epidemic are then examined in a study conducted in Turkey (Karakose et al., 2021). The use of digital technology, support for the digital transformation, support for technology-based professional development, support for a culture of digital learning, and digital leadership skills are the five primary themes identified based on the perceptions and experiences of the participants. The study's findings showed that teachers thought school principals' use of digital technology during the COVID-19 pandemic was appropriate. Additionally, it was shown that principals of schools promote technology-based professional development in schools and digital transformation. Additionally, it was shown that school principals play a role in creating a culture of digital learning in schools within the parameters of the research. According to the study's findings, technology utilisation, managerial abilities, and individual capabilities are the three areas that best describe school administrators' digital leadership abilities.

Future Implications of The Country: Digital Leadership Innovation Expectations in The National Education Context Based on The Quadruple Helix Model

This subtopic explains the quadruple helix model of innovation, focusing on the four main aspects, namely government, universities, industry and civil society. (Carayannis & Campbell, 2006) first introduced the Quadruple Helix Model in their book and later, it was combined in their article (Carayannis & Campbell, 2009). It has incorporated public or civil society as another helix to the Triple Helix Model proposed by (Etzkowitz & Leydesdorff, 1995). The Quadruple Helix Model describes the knowledge society and knowledge democracy (Campbell, 2019). To be more explicit, it demonstrates how knowledge flows into all areas of society and the innovation ecosystem in a modern knowledge society and economy, in addition to university, industry, and government (Cai & Lattu, 2022). Given the growing public awareness of socially responsible innovation, as well as the role of civil society in the development of science and technology in government policy, people tend to view the Quadruple Helix Model as timelier and more appropriate to address new features of society (De Oliveira & Carayannis, 2017; Miller et al., 2018). Therefore, this model can be used to the education sector by incorporating innovation that is built on digital and technology and making improvements to the country's educational system.

The role that the government plays in digital and technological innovation can enhance digital leadership. According to Abdul Musid et al (2022)'s study, infrastructure and finances are one of the obstacles to the adoption of digital leadership. Therefore, the government should provide low-income children with access to a complete infrastructure, including computers, tablets, and Internet resources. This is crucial to ensure that children participate in lessons and learning activities and lower the likelihood that they will drop out of school. Government funding may encourage the implementation of more workshops and courses for school administrators. This is due to the fact that most administrators lack understanding and expertise in digital leadership, according to Abdul Musid et al (2022)'s research.

The university can contribute to digital and technological innovation in digital leadership. Digital and technology-savvy academics can plan training for teachers and administrators. This is due to how quickly digital and technological development is occurring. Teachers and administrators must thus keep up with the latest innovations. A shortage of study in the area of digital leadership was also discovered in Abdul Musid et al (2022)'s investigation. If the university undertakes further research, various demographic-based digital and technological requirements can be discovered, and interventions can be put into place. Based on the collected empirical data, any digital and technology difficulties in digital leadership can therefore be properly addressed. Additionally, the university might create an instrument to assess digital leadership that concentrates on knowledge and abilities like leveraging digital technologies. This recommendation is a follow-up to Abdul Musid et al (2022)'s study's conclusions, which indicated that measurement and assessment are among the problems with digital leadership.

The industry can be involved in deploying digital innovation and technology to help promote digital leadership even if the education sector under discussion is governed by the government. As an industry, it has benefits in terms of financial resources and professional services. The phrase "corporate social responsibility" is now often used to describe how corporations and industry support organisations like schools. As a result, the industry can

provide funding or equipment to complete the technology facilities in schools. Programs and activities that are beneficial to students, teachers, and school administrators can be implemented with the assistance of expert services offered by companies with a digital or technological focus.

The role of community is represented by the model's fourth helix. We should be willing to embrace reforms that are carried out in the field of national education as members of society. Parents of school-age children should support the efforts made by the school to promote digital and technological use. The use of social media to share information, activities, and school achievement is the most straightforward example to put into reality. Parents should actively participate in using social media to voice their opinions in a responsible manner. Parents must be more accepting of the new effort if the school chooses to utilise social media channels to make announcements rather than handing out hardcopy letters. Therefore, the attitude of community members is crucial to the successful innovation made at the school level.

Table 1
Innovation and implication based on the Quadruple Helix Model

Aspect	Innovation	Future Implication
Government	▪ Provide low-income children with access to a complete infrastructure, including computers, tablets, and Internet resources	▪ Children participate in lessons and learning activities and lower the likelihood that they will drop out of school
	▪ Funding	▪ The implementation of more workshops and courses for school administrators
University	▪ Training for teachers and administrators	▪ Teachers and administrators may keep up with the latest innovations
	▪ Undertakes further research	▪ Various demographic-based digital and technological requirements can be discovered, and interventions can be put into place
	▪ Create an instrument to assess digital leadership	▪ Any digital and technology difficulties in digital leadership can therefore be properly addressed
Industry	▪ Financial resources	▪ Complete the technology facilities in schools
	▪ Expert services	▪ Programs and activities that are beneficial to students, teachers, and school administrators can be implemented
Civil Society	▪ Support from parents	▪ The usage of social media to voice their opinions in a responsible manner

Figure 1 shows the Quadruple Helix Model. Through the use of digital and technological innovations, creative digital leadership in education may be produced. The Internet of Things (IoT) is one topic that is frequently brought up in the realm of technology and digital medium. The IoT is a contemporary paradigm that has upgraded traditional ways of existence to high-tech ones to improve our quality of life (Kumar et al., 2019). IoT uses internet-connected smart devices to offer creative solutions to a range of problems and difficulties faced by various business, governments and public/ private industries throughout the world (Sfar et al., 2017), including those affecting the education sector. For instance, when pedagogical or subject-specific reference materials are widely accessible online, teachers can enhance the effectiveness of the teaching and learning process. With the aid of technology, there are many different ways to teach students.

The next breakthrough that can be related to digital technology and contribute to digital leadership is artificial intelligence. According to a study by (Chen et al., 2020), artificial intelligence has been widely accepted and employed in education, especially by educational institutions, in a variety of ways. In the beginning, artificial intelligence was represented by computers and computer-related technologies. It then evolved into web-based and online intelligent education systems, and finally, with the use of embedded computer systems and other technologies, humanoid robots and web-based chatbots were used to perform the duties and functions of teachers either alone or in collaboration with teachers. Therefore, artificial intelligence can help teachers save a lot of time and effort while also improving the quality of their instruction.

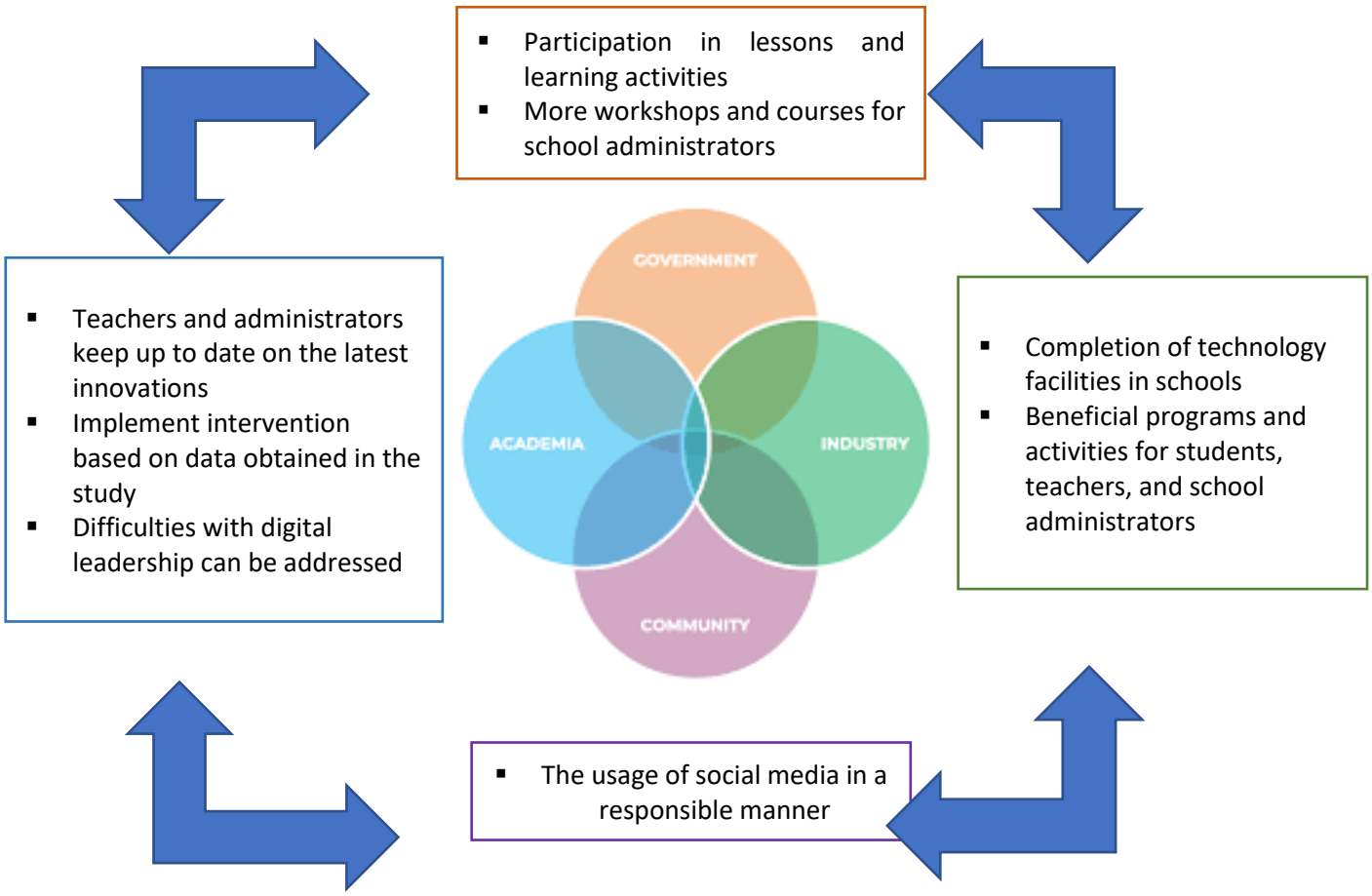

Figure 1. The Quadruple Helix Model for Digital Leadership Future Implication

Conclusion

In the area of education, this study demonstrated that digital innovation and technology may enhance digital leadership. The Quadruple Helix Model's method for fostering innovation will incorporate the government sector, university, industry, and civil society. However, there are barriers in the form of infrastructure and funding, a dearth of research on digital leadership, issues with measurement and assessment, industry support, and parental attitudes. As a result, this challenge can be overcome with adequate funding and well-developed infrastructure, additional research and the use of digital leadership tools, support from the sector in the form of funding or professional services, as well as positive parental attitudes and effort renewals. The implications that will be felt include the ability to implement, revise,

and improve the education policy related to digital and technology, the quality of teachers' teaching, students' participation in learning sessions with more fun, and parents who are less capable of supporting their children's educational needs will feel less burdened. As a result, all stakeholders, including the government, universities, industries, and civil society, must play their respective responsibilities more actively. Future research might examine how prepared the government sector, universities, industry, and civil society are to promote digital innovation and technology in the field of education. This essay outlines current flaws and recommends technological and digital advances that might be used to enhance digital leadership.

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