

Transformational Leadership in the Digital Age: A Literature Review on the Management of Technological Change

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Abstract— The objective of this research is to ascertain the nature of transformational leadership in the digital age within the context of education, and to investigate the ways in which transformational leaders manage technological change. The research method employed is qualitative, with a literature review. The data sources employed in this research comprise journal articles from the Google Scholar database that have undergone a review process. In the initial phase of the study, the researchers gathered and examined articles pertaining to the concepts of transformational leadership, managing technological change, and innovation in the education sector within the context of the industrial era 4.0. This process entailed the selection of pertinent articles and a critical examination of preceding findings. The results demonstrate that transformational leadership in the digital age in education has a favourable and highly pertinent impact, enabling educational institutions to adapt effectively to technological change. Transformational leaders not only assist educational institutions in achieving their objectives but also foster a supportive environment and are able to assist in dealing with technological change, commencing with the alignment of the vision, thus enabling the institution to develop sustainably.

Keywords--Transformational Leadership; Digital Era; Technological Change

I. INTRODUCTION

The incorporation of technology in the field of education is of paramount importance in enhancing the quality of education through the strategic integration of technology [1]. With the advent of technological advancement, the Indonesian education system will undergo a significant transformation, enabling enhanced efficiency, transparency, and community engagement, while addressing challenges such as the digital divide in the realm of education [2].

The implementation of transformational leadership in education is intended to foster innovation, creativity, and sustained assistance for educators in integrating digital technologies into their pedagogical practices [2]. However, empirical evidence suggests that this implementation is often

inconsistent, impeding effective change and adaptation to current challenges [3].

This indicates that the improper implementation of this concept may impede the leader's endeavours to enhance academic performance within the transformational leadership style model of leadership. Furthermore, this transformational leadership must adapt to the integration of technology with the objective of overcoming the challenges inherent to human resource management in the digital era in Indonesia [4].

Hardianto [5] has indicated that there is a paucity of research on transformational leadership in education in Indonesia that is able to integrate digital technology [6]. Furthermore, the existing research is inadequate in preparing learners to meet the demands of the current digital era [7]. Sinaga [8] posits that for transformational leadership in Indonesian education, there is a need to prioritise the integration of digital technologies into the curriculum, the development of interactive learning, support for learners' holistic development, and their preparation for the challenges of the digital era.

Basically, the use of transformational leadership is thought to have benefits such as: it can create a positive work environment and skills in solving problems [9] and can emphasize adaptability, encourage high performance, inspire, and can even align strategically with organisational goals while overcoming contextual challenges [10].

This is consistent with the findings of Zeynalova [11] who demonstrated that transformational leadership in education fosters positive change, innovation, and enhanced performance among educators or students, thereby creating a conducive environment for educational institutions to flourish in the technological era.

In relation to the findings of the aforementioned researchers, it is asserted that there are some who oppose these findings. As Nsom [12] has demonstrated, impure transformational leadership can result in decreased motivation, lower employee

satisfaction and hindered productivity. This allegation is aligned with Budiman's [13] research, which indicates that imperfect transformational leadership can give rise to conflicts of interest between subordinates and leaders, impede optimal practices and negatively impact organisational effectiveness in educational institutions.

The impact of transformational leadership is diminished by information technology, which draws attention to the constraints inherent in the utilisation of technology [14]. This assertion is corroborated by the findings of Peter and Placido [15] who uncovered the adverse consequences of technologically progressive transformational leadership in crisis management, underscoring the disadvantages and obstacles associated with the deployment of technology.

It can be assumed that the support of technology in transformational leadership is not arbitrary. There are pros and cons to a study, and thus the utilisation of the transformational leadership model needs to be examined further. This research aims to find out: first, how transformational leadership is in the digital era in education; second, how the management of technological change is in transformational leadership?

II. METHOD

A. Type of Research

This research is of the review type, comprising a literature study. As defined by Snyder [16] a literature study is a research method that aims to collate and draw conclusions from previous research, as well as analyse several conclusions from experts written in the text. The objective is to suggest new topics for future research. The methodology employed by researchers is more aligned with the literature study approach, particularly the qualitative variant thereof. This approach is utilized to ascertain the optimal means of managing transformational leadership in the context of the contemporary digital age and to identify strategies for navigating technological advancements in transformational leadership within the confines of a literature review.

B. Research Review

In this study, data were collected through a literature review in accordance with the methodology proposed by Sunardi, et al [17], This approach entailed a comprehensive examination of relevant literature, including various academic journals, to inform the research process and answer the research questions.

C. Data Analysis

A comprehensive literature search was conducted using the journal database, Google Scholar. The literature search spanned the last five years, commencing in 2019 and concluding in 2024. The data search was conducted by entering keywords pertinent to the topic. The results were then organised into a table to enhance the clarity and coherence of the topic.

III. RESULT AND DISCUSSION

In the context of the ongoing digital transformation, transformational leadership represents a crucial strategic approach for fostering innovation and adaptation in education. Transformational leadership is instrumental in driving organisational culture change, enhancing engagement, and optimising the utilisation of technology to achieve sustainable education goals. With regard to the formulation of the problem in this study, the researchers will proceed to delineate it as follows :

A. Transformational Leadership in the Digital Age of Education

In order to provide a more detailed understanding of the application of transformational leadership in the digital era based on literature studies, the following table has been constructed :

Table 1 A review of the literature on transformational leadership in the digital age

No	Author and Year	Article Title	Key Findings
1.	Intan Fajar Daratista et al., (2023)	A review of the literature on transformation leadership	Transformational leadership in education in the digital era entails the cultivation of a supportive school climate, the enhancement of teacher performance, and the promotion of the four Cs—critical competencies that are indispensable for student success.
2.	Bohari et al., (2024)	Transformational leadership's role in shaping Education 4.0 within higher education	In the context of the digital age, transformational leadership entails the fostering of innovation, the embracing of technology, and the cultivation of a culture of continuous improvement. These elements collectively facilitate the

			improvement of organisational performance The objective is to facilitate personalised learning experiences and to equip students with the skills and knowledge required to navigate future challenges.
3.	Alam et al., (2023)	Implementation of Transformational Leadership on the Performance of PAUD Teachers in the Digital Era	Transformational leadership should be implemented by encouraging innovation, fostering creativity and providing ongoing support to educators. This will enable the effective integration of digital technologies in early childhood education.
4.	Zubaidah & Putra, (2022)	A Model of Digital Leadership for School Principals in the Context of Technological Advancement	In the context of the digital era, the concept of transformational leadership entails the mastery of a range of skills, including critical thinking, emotional intelligence, and innovation. These skills are to be applied in a staged manner, with the objective of facilitating the emergence, instillation, and transformation of educational institutions.
5.	Schmitz et al., (2023)	Transformational leadership for technology integration in	Transformational leadership in education should prioritise the

		schools: Empowering teachers to use technology in a more demanding way	empowerment of teachers through the promotion of positive beliefs about technology, the enhancement of technical skills and the encouragement of effective teaching practices to facilitate the integration of digital tools in the classroom.
6.	Fedorova et al., (2021)	Leadership for Education in a Digital Age	The advent of the digital age has brought with it a need for transformational leadership in education. This requires the development of a new pedagogical culture, the enhancement of digital competence and the fostering of collaboration among stakeholders in order to facilitate adaptation to systemic change and innovation.
7.	Gruzina et al., (2020)	Leadership Ideas Shaped by Digital Insights in Higher Education	The concept of transformational leadership in the context of digital age education can be addressed by fostering interactions between the various layers of the educational system, utilising digital resources for the purpose of fostering collaboration, and promoting the implementation of generative

			leadership models among all stakeholders in the field of education.
8.	Safi'i, (2023)	A Transformative Leadership Style Model for Enhancing Educational Competitiveness in the Industrial Age 4.0	Transformative leadership in education has the potential to enhance competitiveness by fostering teamwork, improving teacher professionalism and creating a supportive organisational climate. This is particularly important in the context of the technological demands of the industrial era 4.0.
9.	Sliwka et al., (2024)	Transformational leadership for deeper learning: shaping innovative school practices for enhanced learning	Transformational leadership is a key factor in fostering an improvement-oriented culture, which is essential for integrating technology and innovation. This, in turn, enhances personalised learning experiences and equips students to effectively face future challenges.
10.	Dong, (2023)	A Systematic Review of the Transforming Leadership Literature and Future Outlook	In order to effectively navigate the technological advances that are occurring in the digital age, leaders must possess innovative capabilities and a culture that is improvement-oriented. This will enable them to

			enhance the personalised learning experiences that students receive.
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Transformational leadership in the digital era has the objective of establishing a supportive school climate [22], [24]. In addition to developing this climate [18],[23] it seeks to enrich personalised learning experiences [7], foster teaching practices [6], maintain educational quality [19], and facilitate the systematic emergence, embedding and transformation of educational institutions [20].

Transformational leadership posits that the 4C competencies—critical thinking, creativity, collaboration, and communication—are vital in modern education [18]. These competencies include critical thinking and emotional intelligence [20], the development of a new pedagogical culture to support learning relevant to the needs of the times [21], and the fostering of effective interactions between layers in the educational ecosystem, thus creating a sustainable collaborative environment [22].

Transformational leadership encourages collaboration among stakeholders [21], [22], fostering effective collaboration which in turn can improve competitiveness in various aspects of education and organisations [23]. This is achieved through the application and integration of technology, which is an important focus in the world of education [7], [24], and technology [6]. Digital competence is a key enabler of systemic change and innovation [21], with improvement being the primary driver for navigating technological advances effectively [25]. This, in turn, facilitates continued innovation and a significant impact on the transformation of education, particularly in the context of students adapting to the demands of technology in the modern era [19], [20].

Transformational leadership is a concept that places emphasis on student success, with the objective of preparing them for future challenges [18], [7]. These challenges may be encountered at any stage of the educational process, from early childhood education [19] to the utilisation of digital tools in the classroom [6]. Transformational leadership also plays an important role in helping students adapt to the technological demands of the industrial era 4.0 [23]. Enhancing personalised learning experiences is therefore a top priority, as it equips students with relevant skills and optimally prepares them for the future [24], [25].

B. Management of technological change in the context of transformational leadership

The following table provides a more detailed understanding of the management of technological change in transformational leadership :

No	Penulis dan Tahun	Judul Artikel	Temuan Utama
1.	Pawar & Dhumal, (2024)	The role of technology in transforming leadership management practices	Transformational leadership is characterised by a commitment to embracing technological change. This is achieved through the encouragement of innovation, the improvement of communication and the utilisation of data analysis for the purpose of informed decision-making. Additionally, it promotes emotional intelligence and collaboration within virtual teams.
2.	Adigwe, (2024)	Transformational Leadership: A Comparative Exploration of the Leadership Prowess of Jeff Bezos and Steve Jobs	Transformational leadership is a style of leadership that drives innovation and adaptability during periods of technological change. This is achieved by emphasising inspirational motivation, individualised consideration and strategic risk-taking, which in turn increases employee engagement and organisational performance.
3.	Schmitz et	Transformational	Transformational

	al., (2023)	leadership for technology integration in schools: Empowering teachers to use technology in a more demanding way	leadership has a beneficial impact on teachers' beliefs, technical abilities and teaching skills, thereby facilitating the integration of technology in the classroom and encouraging student engagement in cognitively challenging activities.
4.	Hargitai & Bencsik, (2023)	The Role of Leadership in Digital Learning Organizations	Transformational leadership is conducive to the development of an adaptive organisational culture, encourages innovation and collaboration, effectively manages technological change by aligning the organisation's vision with emerging digital trends and motivates employees to embrace transformation..
5.	Telli, (2022)	İşletmelerin Dijital Dönüşüm Yolculuğunda Liderlik: Transformasyonel (Dönüşümcü) Liderlikten Dijital Liderliğe	Transformational leadership plays a pivotal role in facilitating technological change by inspiring and motivating employees to embrace innovation, fostering a culture of adaptation, and

			aligning organisational goals with technological advancements for sustainable growth.
6.	Kapucu, (2020)	Technoversal Leader: Triumphant Leader of the Technological Era	Transformational leadership is a response to the necessity of adapting to technological change. It does so by developing agility, problem-solving skills and a deep understanding of digital tools. These tools emphasise human relationships alongside technological advances.
7.	Chiş-Manolache, (2022)	the Importance of Transformational Leadership in Organisations	Transformational leaders facilitate the management of technological change by fostering innovation, encouraging the involvement of subordinates in decision-making processes, and stimulating creativity to identify effective solutions while maintaining a favourable environment for adaptation.
8.	Knezevic, (2023)	The impact of technologies on leadership styles in Southeast European countries	Transformational leadership is a style of leadership that is able to adapt to technological change. This is

			achieved by leveraging factors such as organisational readiness and leader attitude. This facilitates a proactive approach to embracing technological advances and improving performance.
9.	Hariyati et al., (2023)	Transformational Leadership in The Implementation of Sekolah Penggerak's Program	Transformational leadership plays a pivotal role in facilitating technological change in education. It does so by inspiring and motivating educators, fostering a supportive environment, and meeting individual development needs. Ultimately, this increases the adoption of innovative practices.
10.	Nasukah & Maunah, (2021)	Kepemimpinan Transformasional Dalam Tinjauan Sejarah Dan Perkembangannya Pada Bidang Pendidikan	Transformational leadership plays an instrumental role in facilitating technological change in education. It does so by fostering a shared vision and commitment, increasing organisational capacity, and promoting

			innovative teaching practices among educators and students.
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Consequently, the management of technological change in transformational leadership necessitates the alignment of organisational vision with evolving digital trends [28], Transformational leadership is predicated on the fostering of a shared vision and commitment at all levels of the organisation, ensuring the alignment of all members towards the same goal [34], This requires the utilisation of data analysis to support informed decision-making [26], and demands the capacity to take strategic risks to ensure effective adaptation and innovation in the context of dynamic change [27].

The importance of transformational leadership can be inspirational motivation to encourage sustainable change [27], inspire and motivate educators, create an environment [29], [33], motivate and strengthen the commitment of participation of all members of the organization in the transformation process, in improving effective communication [26] strengthening technical skills and teaching skills of teachers [6].

Transformational leadership promotes the development of agility, problem-solving skills, and a deep understanding of digital tools [30] and embraces technological advances [32]. It requires effective collaboration, including in virtual teams, to achieve common goals [26], [28], which focuses on improving employee engagement and organizational performance and technology integration [6], [31], which requires individualized consideration [27], and is supported by positive and proactive attitudes of leaders in the face of change [6], [32], to face change more wisely [26], in cultivating an adaptive culture and willing to adapt to dynamic technological developments [28], [29].

Managing technological change in transformational leadership requires encouraging continuous innovation [26], [27], aligning organizational goals with technological advances to achieve sustainable growth [29], maintaining a balance between technological advances and human relationships [30], stimulating creativity in finding innovative solutions while creating an adaptive environment [31], which will ultimately increase the adoption of innovative practices [33], among educators and students to promote continuous transformation in education [34], [28].

C. Interpretation of Research

Transformational leadership in the digital era in education has a positive impact, especially in improving educator professionalism and learning quality [11]. Transformational leadership also encourages innovation and builds a positive culture, which is crucial in improving the learning experience and preparing students for future challenges in the digital era. This view is in line with Gachugu [35], which states that

transformational leadership plays an important role in fostering a culture of innovation, driving digital initiatives, and improving organizational performance, especially in large organizational environments. Thus, the important role of transformational leadership in the digital era, especially in the field of education, has the following points:

1. **Enhanced Educator Professionalism and Learning**
Transformational leadership is an effective motivational tool for educators, facilitating their development into professionals in the teaching process. This has a positive impact on the quality of learning, where educators are more innovative in using new technologies and methods, thus improving students' learning experience..
2. **Promoting Innovation and Positive Culture**
Transformative leadership is a key factor in fostering an environment conducive to innovation, which is vital in the context of rapid developments in the digital age. Leaders who are able to inspire and provide clear direction can play a pivotal role in creating a positive culture in educational organisations, thereby enhancing the effectiveness of the process of adapting to technological change.
3. **The Importance of Digital Initiatives for Organisational Performance**
It is argued that transformational leadership is instrumental in fostering innovation and a key factor in the success of digital initiatives. In the context of large organisations, this type of leadership is essential for improving overall performance through the integration of technology in operations and learning.

Technological change in transformational leadership is initiated by aligning the organisation's vision with evolving digital trends. This necessitates the utilisation of data analysis to inform decision-making processes, the prioritisation of inspirational motivation, the enhancement of effective communication and effective collaboration, and the individual consideration of the needs and potential of each member of the organisation. Subsequently, the promotion of emotional intelligence is required to facilitate more prudent responses to change. Therefore, the management of technological change in transformational leadership necessitates the encouragement of innovation.

According to Alainati et.all [36], transformational leadership plays an important role in driving innovation and empowering stakeholders, so managing technological change in education needs to be done effectively to improve the overall development and success of the institution. In addition, transformational leadership helps members overcome the challenges of digitization by creating a supportive environment and addressing individual concerns regarding new technologies [37]. According to Dr. Demian, with the ability to drive innovation and inspire change, the entire educational ecosystem

can meet the challenges and opportunities that exist amidst the rapid advancement of Industry 4.0 [38].

Accordingly, the findings of this study indicate that transformational leadership is a significant factor in the management of technological change. The following points illustrate this assertion:

1. Vision Alignment with Digital Trends

Transformational leadership is a process that ensures the organisation's vision is aligned with the latest technological developments. This requires the utilisation of data analytics to support an informed decision-making process.

2. Inspirational Motivation, Effective Communication and Collaboration

Transformational leadership employs inspirational motivation to encourage organisational members to embrace change. Furthermore, enhanced communication and effective collaboration are crucial to facilitate the involvement of all parties in the technology change process.

3. Individualised Consideration and Emotional Intelligence

It is incumbent upon leaders to gain an understanding of the needs and potential of each member of the organisation through a personal approach and to promote emotional intelligence. This enables individuals to adapt wisely to technological change and to reduce resistance.

4. Innovation Drive to Deal with Change

Transformational leadership is a process that encourages innovation in order to facilitate the smooth and sustainable adaptation to change. Innovation and the empowerment of stakeholders are essential for success in managing change in the education environment.

5. Overcoming the challenges of using Technology

Transformational leadership is a key factor in providing solutions to the challenges of digitisation. It does this by creating a supportive environment that helps individuals to overcome concerns and fears about new technologies.

6. Technology Integration in the Industry 4 Era.

Transformational leadership is a key factor in driving innovation and inspiring change across the entire education ecosystem, enabling it to meet the challenges and seize the opportunities presented by the advent of Industry 4.0..

It can be concluded from the analysis of the two problem formulations that transformational leadership in the digital era is a highly relevant concept for educational institutions, as it enables them to adapt effectively to technological change. Transformational leaders not only assist educational institutions in achieving their goals but also create a supportive environment and are able to help deal with technological changes, starting with aligning the vision, so that the institution can develop sustainably.

IV. CONCLUSION

1. Transformational leadership in the digital age has a beneficial effect on educational institutions, particularly in terms of fostering innovation, establishing a positive environment and culture, enhancing the professionalism of educators and improving the quality of learning. Furthermore, it prepares students to navigate the digital era, especially in larger institutions..
2. The management of technological change in transformational leadership is contingent upon the alignment of the organisation's vision with evolving digital trends. This necessitates the utilisation of data analysis to inform decision-making processes, the prioritisation of inspirational motivation, the enhancement of effective communication and collaboration, and the individual consideration of the needs and potential of each member within an institution. Subsequently, the development of emotional intelligence is essential to equip individuals with the capacity to navigate technological changes and challenges with greater discernment.

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