

Transformational Leadership and the Challenges of Educational Digitalization: A Systematic Literature Review (2020-2025)

Shakila Kausar¹⁾, Muhamad Arif^{2)*}, Saliha Sebgag³⁾

¹⁾ International School for Chinese Language and Culture (ISCLC), Henan University China:

shakilakausar5@outlook.com

²⁾ Institut Al Azhar Menganti Gresik, Indonesia: muhamadarif0705@gmail.com

³⁾ University Mohamed Khider of Biskra, Algeria: saliha.sebgag@univ-biskra.dz

e-mail Correspondent: muhamadarif0705@gmail.com

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Abstract

Transformational leadership has an ideal role in managing education in the digital era; the need for education to transform from various digitalization challenges should be noted for making decisions by prioritizing the vision and goals of education in the digital era. Hence, the purpose of this study is to analyze the role of transformational leadership in encouraging digital innovation in the world of education, analyze the characteristics of effective transformational leadership in supporting technology integration in the world of education, and examine the challenges faced by educational leaders in implementing digital innovation based on transformational leadership. The research method used is a systematic literature review, which analyzes articles from 2020-2025 through PRISMA analysis. The study found that a leader's role starts with channeling positive attitudes with a clear vision, driving change, motivators and inspirators, role models/examples, and becoming a foundation for building a sustainable organizational culture. So several characteristics of leaders were found, such as Idealized Influence, Inspirational Motivation, Intellectual Stimulation, Individualized Consideration, Digital Competence, and Visionary Leadership. However, in terms of implementation, several challenges are still found, ranging from digital competency gaps, lack of digital literacy, limited infrastructure, resistance to change, lack of ongoing training, and lack of understanding of AI and the theoretical implications of this study are the development of Bass and Avolio's theory on the characteristics of transformational leadership through Four P's: idealized influence, inspirational motivation, intellectual stimulation and individualized consideration, by adding one character that is in line with the challenges of education in the digital era, namely digital competence and visionary leadership with the abbreviation Four P's and DV.

Kata kunci:

Kepemimpinan Transformasional, pendidikan, digital competence, visionary leadership

Abstrak

Kepemimpinan transformasional dalam mempunyai peran ideal dalam mengelola pendidikan di era digital, kebutuhan pendidikan dalam bertransformasi dari berbagai tantangan digitalisasi seharusnya menjadi catatan untuk mengambil keputusan dengan mengedepankan visi dan tujuan pendidikan di era digital, sehingga tujuan dari penelitian ini adalah menganalisis peran kepemimpinan transformasional dalam mendorong inovasi digital di dunia pendidikan, analisis karakteristik kepemimpinan transformasional yang efektif dalam mendukung integrasi teknologi di dunia pendidikan, serta tantangan yang dihadapi oleh pemimpin pendidikan dalam mengimplementasikan inovasi digital berbasis kepemimpinan transformasional. Metode penelitian yang digunakan adalah systematic literature review dengan menganalisis artikel di rentang tahun 2020-2025, melalui PRISMA Analisis. Hasil penelitian menemukan peran pemimpin mulai dari; menyalurkan sikap positif dengan visi yang jelas, penggerak perubahan, motivator dan inspirator, teladan/contoh serta menjadi podasi dalam membangun budaya organisasi yang berkelanjutan. Sehingga ditemukan beberapa

karakteristik pemimpin, seperti: Idealized Influence, Inspirational Motivation, Intellectual Stimulation, Individualized Consideration, Digital Competence and Visionary Leadership. Meskipun, secara implementatif masih ditemukan beberapa tantangan, mulai dari kesenjangan kompetensi digital, minimnya literasi digital, keterbatasan infrastruktur, resistensi terhadap perubahan, masih minimnya pelatihan berkelanjutan dan kurangnya pemahaman terhadap AI dan implikasi teoritis dari penelitian ini adalah pengembangan teori Bass dan Avolio tentang karakteristik kepemimpinan transformasional melalui Four I's: idealized influence, inspirational motivation, intellectual stimulation and individualized consideration, dengan menambahkan satu karakter yang sejalan dengan tantangan pendidikan di era digital yaitu digital competence and visionary leadership dengan singkatan Four I's and DV.

INTRODUCTION

The advent of the digital technology era has driven all elements in the field of education to undergo gradual and continuous change (Ibrahim et al., 2024; Rahmadi, 2024). This situation is being felt by schools as formal educational institutions that encompass institutional management processes and learning activities, which must be able to adapt amid the challenges of the 21st century (Kardi et al., 2023; Mutohhari et al., 2021; Rohmah et al., 2023; Xie, 2021). Therefore, the success of schools in the digital technology era cannot be measured solely by how well digital innovations are implemented (Lakshmypriya et al., 2021); more importantly, schools must be founded on leadership that can provide direction (Purnamasari et al., 2020; Ruloff, 2025), offer inspiration (Liu, 2025; Rahmadi, 2024), and hold a vision for change (Babic, 2020; Bohari, 2024). Mulawarman et al. noted that smart and efficient school management can influence school performance in the digital era (Mulawarman, 2022), which in turn will impact the quality development and achievements of schools in the digitalization era (Maulidin et al., 2024).

Nababan et al. stated that leadership holds the most crucial role in steering the organizational machinery in schools (Nababan et al., 2021), especially as the challenges of the digital 4.0 era require schools to improve human resources (Elistiowati et al., 2021) related to digital-based technological, communication, and information knowledge, including artificial intelligence (Fullan et al., 2024; Wang, 2021). Thohir et al. align with this, asserting that one key leadership trait is openness to the dynamics of change in science and information technology (Thohri, 2022). Juharyanto et al. revealed that leadership models with strong spiritual characteristics can be a determining factor in school success, particularly in rural areas (Juharyanto et al., 2021). These findings can be integrated with the digital leadership model by strengthening school human resources through training (Ridho et al., 2024), utilizing technology, and integrating (Cvetković et al., 2023) school management models based on both spiritual and digital values (Yusubov et al., 2021).

A similar sentiment was expressed by Bush, Pahome and Saditu, who emphasized that leadership in schools is a key factor for success, as it influences interaction patterns among members in building a shared vision (Bush & and Glover, 2014; Pahome & Suditu, 2017), as well as shaping the values and responding to the challenges of the digital era. Various leadership models have been identified, each with its strengths and weaknesses. Sarros et al. proposed that the transactional leadership model is suitable for school implementation (Sarros & Santora, 2001), as leaders serve as role models, coaches, and primary strategists (Bass et al., 1996), particularly in developing schools during the digital era (Putra et al., 2020). However, one noted drawback is the failure of such leaders to effectively motivate and challenge human resources (Ahmad, 2025). This aligns with Purwanto's observation that the implementation of leadership models depends on the condition of human resources in the school (Purwanto, 2020); for example, democratic (Moyle,

2014), authoritarian, and charismatic (Hofmann, 2023; Queen, 2023) models have been shown to significantly influence teacher performance.

Furthermore, numerous studies on the challenges of digitalization in schools have leaned heavily on the transformational leadership model (Hadi et al., 2024; Ibrahim et al., 2024). Ruloff and Schmitz et al. provided data showing that transformational leadership is a suitable choice for schools aiming to develop in the digital era (Ruloff & Petko, 2025; Schmitz et al., 2023), as it positions teachers as key players in classroom learning, such as in the development of the World Wide Web, digital applications, and presentation tools (Sliwka et al., 2023; Todd & O, 1999). One of the key successes of transformational leadership in schools is its approach to decision-making that emphasizes collective agreement, starting from the vision and goals that influence school survival in the digital age (Eitan & Gazit, 2024; Sangthong & Wangthanomsak, 2023). Moreover, teachers also tend to be more actively involved in professional development in communication and digital technology (Eitan & Gazit, 2024).

Based on this data, it is evident that transformational leadership models have a higher probability of success in managing schools in the digital technology era (Hadi et al., 2024; Ruloff & Petko, 2025; Sangthong & Wangthanomsak, 2023; Schmitz et al., 2023), and thus, they can serve as a reference for developing schools as innovative (Armila & Sopianingsih, 2022), adaptive, and technology-savvy institutions (Matsunaga, 2024), in line with institutional goals (Rivera, 2025). Reviewing the above findings, it appears that current research still predominantly consists of field-based studies with varying challenges and opportunities. Therefore, there remains a gap that calls for in-depth research using a different methodology, namely a systematic literature review—a process of deep, systematic, and analytical examination. This study will address the following three research questions: What is the role of transformational leadership in driving digital innovation in education?, What are the characteristics of effective transformational leadership in supporting technology integration in education? And What challenges are faced by educational leaders in implementing digital innovation based on transformational leadership?

RESEARCH METHOD

The research method employed in this study is a systematic literature review, which involves several stages including the collection, evaluation, and analysis of data relevant to the theme and the following three research questions: (1) What is the role of transformational leadership in promoting digital innovation in education? (2) What are the characteristics of effective transformational leadership in supporting technology integration in education? and (3) What challenges do educational leaders face in implementing digital innovation through transformational leadership? Data collection was conducted using the "Publish or Perish 8" application with the following keywords: ("transformational leadership" OR "innovative leadership") AND ("digital innovation" OR "technology integration" OR "digital transformation") AND ("schools" OR "educational institutions" OR "school leadership"). The targeted databases included Google Scholar, Scopus, and Web of Science (WOS). The analysis process utilized the PRISMA framework, which ensures that the search, selection, and reporting stages are carried out systematically, transparently, and replicably through the use of the PRISMA flow diagram.

Inclusion and Exclusion Criteria

During the process of searching, collecting, and analyzing articles, the researcher applied five inclusion and exclusion criteria: First, only articles published within the last five years (2020–2025) were included, as older publications were considered less relevant to current conditions.

Second, only peer-reviewed journal articles were selected, thereby excluding book chapters, conference papers, proceedings, and undergraduate theses. Third, only articles written in English were considered, and publications in other languages were excluded. Fourth, the search was conducted using the Publish or Perish application with predetermined keywords: ("transformational leadership" OR "innovative leadership") AND ("digital innovation" OR "technology integration" OR "digital transformation") AND ("schools" OR "educational institutions" OR "school leadership"). Fifth, the selected databases Google Scholar, Scopus, and WOS were chosen for their global reputations and integration with the Publish or Perish application, ensuring that the data collection process was valid and measurable.

Screening and Publication Results

The data filtering process resulting from publications using the publish or perish 8 application on April 8, 2025, shows the following data:

Tabel 1: search result data using publish or perish

No	Keywords	Year	Databased	Count
1	("transformational leadership" OR	2020-2025	Google Scholar	225
2	"innovative leadership") AND ("digital		Scopus	13
3	innovation" OR "technology integration"		WOS	8
	OR "digital transformation") AND			
	("schools" OR "educational institutions"			
	OR "school leadership")			
Count				264

Based on the article search process with the keywords above, 264 papers were found, and the researcher conducted an in-depth analysis process so that 46 articles were obtained that were in accordance with the researcher's questions. After that, the researcher collected it in the ZOTERO application and imported data in the form of RIS. The researcher entered the RIS results into the vos viewers application to get a visualization of the findings from the collected articles, as in the image below:

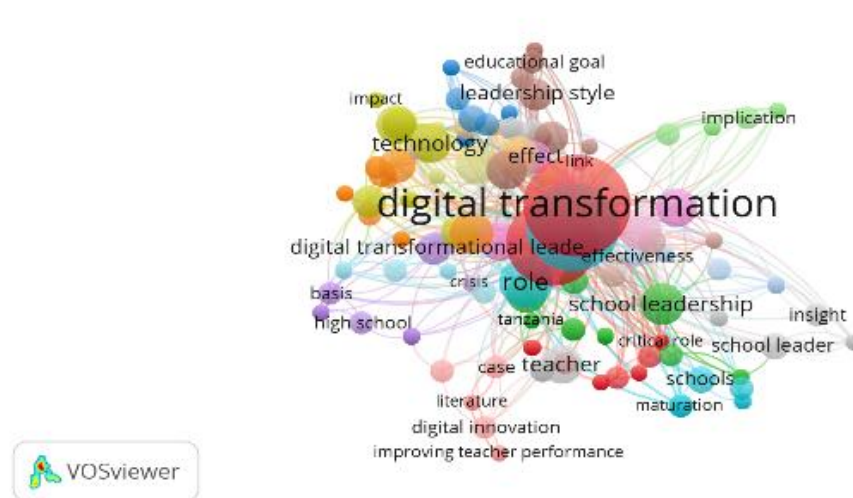


Figure 1: Distribution of research results related to transformational leadership in education in the digital era

In the picture above, it shows that there is a very close and direct relationship between transformational leadership and digital transformation, both of which have the same data and are widely studied because of their novelty. In addition, digital transformation leadership is also related to schools starting from elementary, middle and high school levels. And there is an indirect relationship with digital innovation, technology and improving teacher performance.

PRISMA Analysis

PRISMA analysis in the research is used as an in-depth analysis based on the research data collection process in three global databases: Google Scholar, Scopus and WOS, in detail the PRISM analysis is as follows:

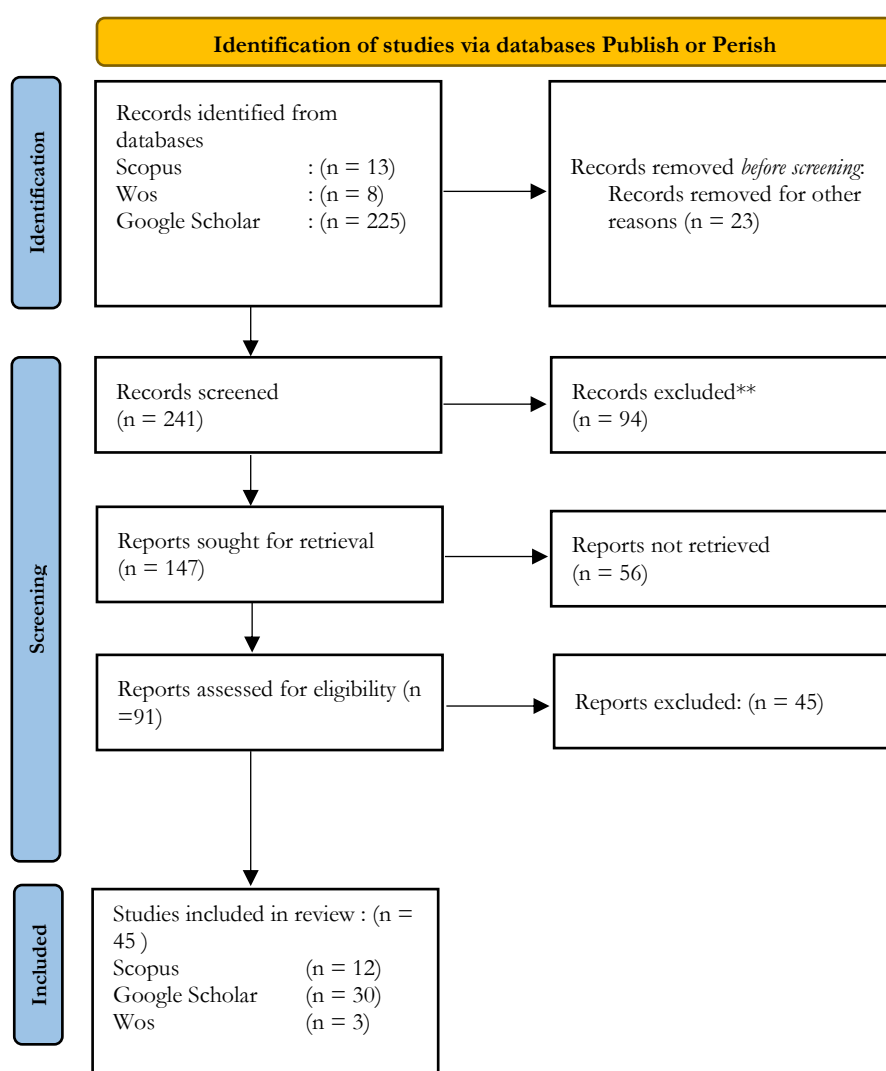


Figure 2. PRISMA analysis in the research

Based on the data from the prism analysis results, it shows 46 articles with full papers and in accordance with the research questions, in detail the articles from the analysis are 30 Google Scholar, 12 Scopus and 3 indexed papers in WOS. so that in the next stage the researcher will present the sub-chapter of the research results.

RESULTS AND DISCUSSION

RESULTS

Based on the PRISMA analysis process, the researcher classified the findings according to the three research questions: (1) What is the role of transformational leadership in promoting digital innovation in education? (2) What are the characteristics of effective transformational leadership in supporting technology integration in education? and (3) What challenges are faced by educational leaders in implementing digital innovation through transformational leadership? The detailed findings are presented in the following subsections.

The Role of Transformational Leadership in Promoting Digital Innovation in Educational Settings

The transformational leadership model plays a strategic role as a driver of change in educational environments, including schools and higher education institutions (Karimi, 2024; Mydin et al., 2025). Bohari et al. highlight that the central role of transformational leadership is to create an educational environment that is flexible, relevant, and forward-thinking, in alignment with the challenges and goals of education in the era of digital technology 4.0 (Bohari, 2024; Purwanto, Purba, Sijabat, et al., 2021). A similar view is expressed by Krein and Laursen et al., who state that transformational leadership serves as a source of motivation and inspiration for teachers. In the digitalization era of education, leaders must provide exemplary conduct for teachers and school staff in cultivating a digital culture (Krein, 2024; Laursen & Weiss, 2025; Ridwansyah et al., 2023).

According to Yuan et al., the presence of transformational leaders in the digital age, particularly in primary and secondary schools, should also influence teachers' life satisfaction by engaging them in digital education development and facilitating opportunities for professional growth that contribute to their overall fulfillment (Yuan & Wang, 2025). The positive impact of transformational leadership in building organizational culture in the digital era is evident and must be consistently and sustainably maintained (Primahendra et al., 2024; Ridwansyah et al., 2023; Yusuf et al., 2023). Moreover, transformational leaders serve as innovative figures who influence teachers' interest in developing professional competencies in the digital era ultimately giving rise to the next generation of transformational leaders capable of addressing future educational challenges (Magesa & Jonathan, 2022; Purwanto, Purba, Sijabat, et al., 2021; Yan & Yuet, 2025).

Armila et al. add that transformational leadership drives the development of a strong organizational culture and optimal work ethic (Armila & Sopianingsih, 2022). The role of intellectual stimulation in encouraging innovation (Antonopoulou et al., 2025), fostering discussion, and promoting digital transformation (Hamzaha et al., 2024; Krein, 2024) in schools is proof of effective leadership in managing educational institutions that can respond to digital-era demands. Another crucial role of transformational leadership in the digital age is serving as an influential role model (a change agent), as leaders must exemplify effective and sustainable digital practices in the teaching process (Lagura & Paglinawan, 2024). In line with this, Masry-Herzallah et al. emphasize that the key to successful transformational leadership in education lies in fostering a positive attitude supported by a clear vision within the organization (Masry-Herzallah et al., 2025; Mollazehi et al., 2022). Leaders must be communicative, supportive of change, develop individual and group technical skills, enhance digital pedagogical abilities, and provide access to

technological development for human resources (Primahendra et al., 2024; Ridwansyah et al., 2023). These findings are clearly summarized in Table 2.

Table 2. The role of transformational leadership in the world of education in the digital era

No	Role	Description	References
1	Channeling a Positive Attitude and Clear Vision	Cultivate a positive attitude and support the organization's vision.	Masry-Herzallah et al. (2025); Mollazehi et al. (2022)
2	Driver of change	Transformational leadership as a driver of change in education in the digital era. Creating a flexible educational environment in line with technological challenges.	Karimi (2024); Mydin et al. (2025) Bohari (2024); Purwanto et al. (2021)
3	Teacher Motivation and Inspiration in Professional Development in the Digital Era	Leaders as motivators and inspirations for teachers to develop a digital climate. Developing teacher professionalism in the digital era. Encouraging innovation and digital transformation in schools.	Krein (2024); Laursen & Weiss (2025); Magesa & Jonathan (2022); Purwanto et al. (2021); Antonopoulou et al. (2025)
4	Be a role model/example	Be a role model for teachers and lead digital change.	Yuan & Wang (2025), Hamzaha et al. (2024); Krein (2024)
5	Organizational Culture and Sustainability	Building a positive and sustainable organizational culture.	Primahendra et al. (2024); Ridwansyah et al. (2023)

Based on Table 2, five key roles of transformational leaders in education during the digital era were identified. These include fostering a positive attitude within the educational environment, acting as agents of change, and serving as motivators and sources of inspiration for teachers roles that are essential in navigating ongoing changes in the educational landscape. The advent of the digital era presents unique challenges for education to remain relevant, making the implementation of a sustainable organizational culture rooted in a positive vision a crucial strategy for addressing these challenges

Characteristics of Transformational Leadership that Effectively Support Technology Integration in Education

Leaders in the digital era play a crucial role across various sectors of education. They serve as an integral link in the process of knowledge and skills transfer within learning environments (Alhejaili, 2022; Cvetković et al., 2023). In light of this, the classification of effective transformational leadership characteristics can serve as a model for consistent and sustainable management in educational institutions (Amin et al., 2024; Baharuddin et al., 2025). Several characteristics of transformational leadership have been identified by Krein and Laursen et al., including the role of the leader as both an inspiration and motivator. A leader not only provides instruction but also builds confidence among human resources (Krein, 2024; Laursen & Weiss, 2025; Ridwansyah et al., 2023), enlivens a future-oriented vision for education in the digital age (Mustari & Nurhayati, 2024; Nukliri et al., 2025), and motivates through exemplary behavior and optimism (Cvetković et al., 2023; Primahendra et al., 2024), for instance, school principals actively

organizing and participating in digital-based training alongside teachers (Antonopoulou et al., 2025; Ming & Mansor, 2024; Okunlola, 2024; Schmitz et al., 2023; Sobirin et al., 2024; Yan & Yuet, 2025).

An essential characteristic of transformational leadership in the digital era is intellectual stimulation, where leaders encourage their subordinates to foster a critical, innovative, and creative organizational culture (Primahendra et al., 2024; Ridwansyah et al., 2023; Yuan & Wang, 2025; Yusuf et al., 2023). This leadership style promotes teachers' professional development to effectively address the challenges of digital education (Magesa & Jonathan, 2022; Mustari & Nurhayati, 2024; Norman et al., 2025; Purwanto, Purba, Sijabat, et al., 2021). Moreover, leaders must value experimentation and new ideas (Karousiou, 2025; Masry-Herzallah et al., 2025) by consistently involving teachers in decision-making and guiding the direction of digital transformation. Orunbon et al. also emphasize that educational leaders in the digital era should demonstrate a strong organizational commitment to inspiring teachers to enhance their innovation and creativity in teaching (Orunbon et al., 2023; Rahmadi, 2024; Ruloff & Petko, 2025).

Another key characteristic of educational leaders in the digital age, as noted by Vavouras et al., is digital competence and visionary leadership (Vavouras et al., 2024). Leaders must be able to design, select, and implement strategic plans aligned with long-term visions to respond to the challenges of digital transformation in education (Karakose et al., 2023; Karimi, 2024). Lagura et al. support this by stating that transformational leaders should be capable of building a digital ecosystem that emphasizes collaboration among teachers, parents, students, and the broader community (Lagura & Paglinawan, 2024). Malla et al. also point out that in the Philippines, leaders are expected to keep pace with technological innovations in teaching and learning processes (Maala & Lagos, 2022).

Kafa et al. highlight findings from Cyprus showing that the rise of artificial intelligence (AI) poses greater challenges for leaders (Kafa, 2025; Karakose & Tülübas, 2024; Karousiou, 2025), thus requiring leaders to consistently improve communication (Lagura & Paglinawan, 2024), collaboration, and administrative efficiency. Similarly, in Switzerland, transformational leadership is characterized by competence in digital application and visionary planning, which has significant impacts ranging from infrastructure to digitally skilled teachers capable of applying technology both inside and outside the classroom (Orunbon et al., 2023; Schmitz et al., 2023). Norman et al. further strengthen the evidence that transformational leadership when exhibiting these characteristics can create adaptive, efficient, innovative, modern, and inclusive learning environments. For example, principals implementing personalized digital training for teachers in response to challenges posed by digitalization and artificial intelligence is a clear application of individualized consideration, a critical aspect of meeting educational challenges in the digital era (Norman et al., 2025; Nukliri et al., 2025; Orunbon et al., 2023). Based on the data above, these leadership characteristics can be classified as follows:

Table 3. Characteristics of Transformational Leadership in the Digital Era

No	Leadership Characteristics	Description	References
1	Idealized Influence	Leaders are role models, provide examples and behave ethically. Bringing to life the vision of the future of education in the digital age and motivating through	Cvetković et al., 2023; Primahendra et al. (2024); Antonopoulou et al. (2025)

		optimism. bringing to life the vision of the future of education in the digital age	
2	Inspirational Motivation	Leaders are able to build and convey an inspiring vision, as well as build self-confidence among teachers and staff. Leaders as inspiration and motivation, so leaders do not only give instructions, but build self-confidence in human resources.	Krein (2024); Laursen & Weiss (2025); Ridwansyah et al. (2023); Mustari & Nurhayati (2024); Nukliri et al. (2025)
3	Intellectual Stimulation	Leaders encourage an innovative, creative, and critical organizational culture. Value experiments and new ideas and involve teachers in decision making.	Primahendra et al. (2024); Ridwansyah et al. (2023); Yuan & Wang (2025); Magesa & Jonathan (2022); Karousiou (2025); Masry-Herzallah et al. (2025)
4	Individualized Consideration	Leaders provide digital training based on individual teacher needs, so as to create an adaptive, efficient, innovative, modern and inclusive learning environment.	Norman et al., (2025); Nukliri et al., (2025); Orunbon et al., (2023)
5	Digital Competence and Visionary Leadership	Leaders must have digital competence and visionary leadership, develop and implement strategic plans to face the challenges of digital transformation.	Vavouras et al. (2024); Karakose et al. (2023); Karimi (2024); Lagura & Paglinawan (2024); Kafa (2025); Schmitz et al. (2023b); Norman et al. (2025)

The data in Table 3 shows that there are five prominent characteristics commonly found in transformational leadership within the field of education in the digital era. These can serve as key references for leading education amidst various challenges of the digital age. The five transformational leadership traits: Idealized Influence, Inspirational Motivation, Intellectual Stimulation, Individualized Consideration, and Digital Competence and Visionary Leadership can be adopted as essential qualities for future educational leaders.

Challenges Faced by School Leaders in Implementing Digital Innovation Based on Transformational Leadership

The implementation of transformational leadership in educational institutions does not always proceed effectively and efficiently. This is evident from several research findings that highlight the challenges faced by leaders when implementing educational innovations in the digital era (Orunbon et al., 2023). One of the key challenges is the digital competence gap, where many school principals or teachers still lack optimal digital skills due to limited digital literacy (Amin et al., 2024; Antonopoulou et al., 2025; Cvetković et al., 2023; Duman, 2021; Karakose & Tülübas, 2024). Similarly, Karousiou pointed out that one of the biggest obstacles to digital-based educational leadership is the insufficient development of digital literacy skills (Amin et al., 2024;

Karousiou, 2025; Masry-Herzallah et al., 2025), which negatively impacts both institutions and classroom learning.

Another challenge is the limited infrastructure, which presents a technical barrier and hinders the optimal development of digital innovation in education (Baharuddin et al., 2025; Nukliri et al., 2025). Bohari and Mollazehi et al. note that digital infrastructure is a primary resource for formulating the best strategies to address the challenges of digital education (Bohari, 2024; Mollazehi et al., 2022) helping foster a culture of digitalization in education. In addition, resistance to change is also a key challenge. Alhejaili et al. highlight that a weakness of transformational leadership can be an overreliance on the leader's self-efficacy in adapting to digital change and accepting it based on the evolving needs of digital education (Alhejaili, 2022; Lagura & Paglinawan, 2024; Mydin et al., 2025).

Furthermore, a lack of continuous training for leaders and teachers is another hurdle in facing digital education challenges (Maala & Lagos, 2022; Ming & Mansor, 2024). Vavouras et al. emphasize that training must be conducted actively and effectively, especially those related to digitalization in education (Vavouras et al., 2024), enabling leaders to shape a strong digital leadership vision and an optimal organizational culture. Kafa and Mustari et al. add that a current challenge for transformational leadership is the lack of understanding among some leaders and teachers regarding Artificial Intelligence (AI) (Kafa, 2025; Mustari & Nurhayati, 2024), which leads to delays in decision-making or even rejection of adoption (Hou et al., 2024; Karakose & Tülübas, 2024) The detailed findings of these challenges are presented in.

Table 4. which outlines the distribution and description of transformational leadership challenges.

No	Challenge	Deskription	References
1	Digital Competency Gap	Principals and teachers are not yet optimal in digital skills due to low digital literacy.	Amin et al., 2024; Antonopoulou et al., 2025; Cvetković et al., 2023; Duman, 2021; Karakose & Tülübas, 2024
2	Lack of Digital Literacy	The development of digital literacy skills in management and learning is still low.	Amin et al., 2024b; Karousiou, 2025b; Masry-Herzallah et al., 2025b
3	Infrastructure Limitations	Inadequate digital facilities and infrastructure, thus limiting the implementation of educational digitalization programs.	Baharuddin et al., 2025b; Nukliri et al., 2025a; Mollazehi et al., 2022b; Bohari, 2024
4	Resistance to Change	Some leaders are not ready for change or rely too much on self-efficacy and are not flexible to the needs of digitalization.	Alhejaili, 2022b; Lagura & Paglinawan, 2024b; Mydin et al., 2025b
5	Lack of Ongoing Training	Lack of regular and continuous training for teachers and leaders in facing digital challenges, especially in the context of technological transformation.	Maala & Lagos, 2022; Ming & Mansor, 2024; Vavouras et al., 2024

6	Lack of Understanding of AI	Some leaders or teachers do not yet understand the functions and benefits of AI, so they are slow in making decisions and reject the adoption of AI technology in schools.	Kafa, 2025b; Mustari & Nurhayati, 2024b; Hou et al., 2024; Karakose & Tülübas, 2024b
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From the table 4 above, it shows that there are six main obstacles for educational leaders in implementing digital innovation based on transformational leadership, starting from: digital competency gap, lack of digital literacy, limited infrastructure, resistance to change, lack of continuous training, lack of understanding of artificial intelligence. Based on these data, transformational leaders must be able to choose an integrated strategy to improve the initial foundation of leaders and teachers, namely by building a vision of digitalization in the world of education that is inspiring, innovative and inclusive.

DISCUSSION

Transformational leadership in educational institutions plays an ideal role in driving organizational change and building trust in human resources (Boga & and Ensari, 2009). It begins by promoting positive and ideal attitudes (Cho et al., 2011), thereby instilling confidence and respect (Birasnav, 2014). As a result, transformational leaders can act as drivers of change, aligned with the goals of education in the digital era (Alhejaili, 2022; Ibrahim et al., 2024; Okunlola, 2024), with three key elements identified by Fernet et al., (2015): change agent, change operator, and organizational culture embryo (Haq et al., 2022; Lasrado & Kassem, 2020), ideally implemented by considering both endogenous and exogenous factors eksogen (Nguyen et al., 2019; Shvindina, 2017). Additionally, the role of transformational leadership involves providing motivation to foster the development of digital technology innovations (Bunjak et al., 2022). Muliati et al. also explained that motivational support from leaders in advancing education in the digital age can have a simultaneous and positive impact on human resources specifically, teachers in developing their professional competencies (Bellibaş et al., 2021), which in turn positively affects the classroom learning process (Hilton et al., 2021; Muliati et al., 2022).

The presence of an ideal role within transformational leadership forms a distinctive identity that becomes a character trait. This aligns with Bass and Avolio's view, which identifies four essential components of transformational leadership, known as the Four I's: Idealized Influence, Inspirational Motivation, Intellectual Stimulation, and Individualized Consideration (Bass & Avolio, 1994), This is further supported by Tucker and Krishnan, who emphasized that leaders should exert positive influence, provide new direction (Purwanto, Purba, Bernarto, et al., 2021), and develop a sustainable vision to meet the demands of education in the digital age (Krishnan, 2004; Tucker & Russell, 2004). Furthermore, leadership in digital-era education still requires inspiration and intrinsic motivation (Ballesteros et al., 2023; Chance, 2022) to realize a shared vision by building the confidence of teachers and staff, thereby encouraging a culture of innovation, creativity, and critical thinking in educational institutions (Musyoki et al., 2021). Examples of this include involving teachers in digital-based education training, on-service training, and actively enhancing competencies to implement technology-based learning (Sholeh, 2021).

One key distinction from Bass and Avolio's Four I's (Bass et al., 1996; Bass & Avolio, 1994), is the urgent need for transformational leaders to possess Digital Competence and Visionary Leadership (Dalkie & Botha, 2024; Raftoulis, 2021; Rasdiana et al., 2024). This involves having digital skills and a strategic vision (Abdullah & Kadir, 2023) to design and implement plans to

address the challenges of digital transformation in education. The differences between Bass and Avolio's Four I's characteristics and the findings of the current analysis are shown in the table below.

Table 5: Differences between Bass and Avolio's Four I's and DV Transformational leadership in education in the digital era

No	Four I's Bass dan Avolio (1994) Transformational Leadership	Four I's and DV Transformational Leadership in Education in the Digital Era
1	Idealized Influence	Idealized Influence
2	Inspirational Motivation	Inspirational Motivation
3	Intellectual Stimulation	Intellectual Stimulation
4	Individualized Consideration	Individualized Consideration
5	-	Digital Competence and Visionary Leadership

The table above shows that the characteristics proposed by Bass and Avolio remain highly relevant and applicable to transformational leadership in the field of education in the digital era. However, there is one additional characteristic that must be embraced to build a robust educational ecosystem amidst the challenges of digitalization Digital Competence and Visionary Leadership. This includes the urgency of having strategies and a vision that align with the demands of the times (Gilli et al., 2023; Schiuma et al., 2021). The rapid and uncertain changes of the digital era make this characteristic more essential and urgent, serving as a foundational pillar for leading educational transformation in the face of digitalization (Şişu, 2023).

Although its implementation faces several challenges, one of the main issues is the digital competence gap. Howell et al. highlighted that many schoolteachers still struggle with self-development and the use of digital tools in the teaching and learning process (Duncan-Howell, 2012; Zhu et al., 2024). Furthermore, the lack of digital literacy (Esmaceli et al., 2024), is a concern. Ediyanto and Matsunaga emphasized that resilient organizational leaders must be able to recognize and cultivate digital skills within themselves and encourage their subordinates to follow suit effectively (Ediyanto et al., 2025; Matsunaga, 2024). Thus, teachers with strong digital literacy competencies can serve as role models and motivate their peers, fostering a culture of digital literacy enhancement within educational institutions (Rawal, 2024).

Another significant challenge facing transformational leadership in education during the digital era is limited infrastructure. Marjan Vermeulen et al. pointed out that this limitation is a reality that must be addressed, such as by preparing a learning environment that supports digital infrastructure needs (Vermeulen et al., 2017). Likewise, Hasanah and Yusoff recommended that schools promote a culture of continuous learning, enabling educational institutions to remain relevant amidst digitalization challenges (Hasanah & Yusoff, 2024). Another finding is the resistance to change within education in the digital age. Berger and Thomas noted that skepticism often arises from fear that new digital technologies might be monopolized by "missionaries" (Berger & Thomas, 2011). Resistance is also driven by limited infrastructure and inadequate internet networks (Al Hyari, 2023). which in turn leads to a lack of continuous training and poor understanding of artificial intelligence (Bawack et al., 2021; Daneshjou et al., 2021).

CONCLUSION

In summary, transformational leadership is the best choice for leading educational organizations in the digital era. Leaders play several key roles, including conveying a positive attitude with a clear vision, being agents of change, serving as motivators and inspirers, acting as role models, and laying the foundation for building a sustainable organizational culture. As a result, several core leadership characteristics have been identified, such as idealized influence, inspirational motivation, intellectual stimulation, individualized consideration, digital competence, and visionary leadership. However, several challenges remain in practice, including the digital competence gap, low levels of digital literacy, limited infrastructure, resistance to change, lack of ongoing training, and insufficient understanding of artificial intelligence (AI).

Based on the above conclusions, this study presents a theoretical implication an extension of Bass and Avolio's theory on transformational leadership characteristics known as the Four I's: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration by adding one more characteristic that aligns with the challenges of education in the digital era: digital competence and visionary leadership, summarized as Four I's and DV. However, this study has limitations, as it has not yet provided concrete strategies to address the real-world challenges in digital-era education. Therefore, future research should explore practical solutions to these challenges using real-world, field-based approaches.

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