Journal for the Education of Gifted Young Scientists, 12(4), 181-192, Dec 2024
e-ISSN: 2149- 360X
jegys.org
dergipark.org.tr/jegys

Genc Bilge (Young Wise) Publishing
gencbilgeyayincilik.com

Research Article

Preparing future-ready students: the role of transformational leadership in equipping students for the 21st-century workforce

Sravan Nemani[1]

Department of Leadership, University of the Cumberlands, US

Article Info

Received: 30 July 2024
Accepted: 5 November 2024
Available online: 30 Dec 2024

Keywords
21st-century skills
Innovation
STEM education
Transformational leadership
Workforce preparedness

2149-360X/

Abstract

This study examines the role of transformational leadership in developing essential 21st-century skills like innovation, adaptability, problem-solving, and digital literacy within educational institutions. Using a cross-sectional survey design, data was collected from educators in public and private schools. The survey assessed leadership practices, including innovation inspiration, professional development opportunities, and guidance on adapting teaching strategies. T-tests and correlation analyses were used to explore the relationships between leadership and educational outcomes. Results indicate that transformational leadership significantly enhances STEM education, with 62.67% of respondents inspired to innovate and 56.67% reporting improved confidence in STEM teaching. No statistically significant differences were found between public and private schools, suggesting these practices are universally applicable. The correlation analysis revealed a moderate positive correlation ($r = 0.495$, $p < 0.001$) between fostering adaptability and preparedness for the workforce, underscoring the critical role of leadership in equipping students with the skills needed for success in the 21st-century job market. The findings underscore the critical role of leadership in equipping students with the skills needed for the 21st-century workforce and highlight the importance of fostering lifelong learning and adaptability. Future research should explore long-term impacts and applicability across diverse educational contexts.

To cite this article:

Nemani, S. (2024). Preparing future-ready students: the role of transformational leadership in equipping students for the 21st-century workforce. *Journal for the Education of Gifted Young Scientists*, *12*(4), 181-192. DOI: http://dx.doi.org/10.17478/jegys.1552021

Introduction

The 21st-century workplace is marked by unprecedented transformations driven by rapid technological advancements, globalization, and evolving industry demands. As organizations navigate these changes, there is a growing emphasis on equipping students with the skills, knowledge, and adaptability required to thrive in an increasingly complex and dynamic job market (Turi et al., 2022; Jada & Mayayise, 2024). Despite the clear need for these competencies, research consistently highlights a significant gap between the skills employers expect and those that recent graduates possess, revealing a critical misalignment between educational outcomes and market demands (Tushar & Sooraksa, 2023). This gap underscores the necessity for educational institutions to adopt a more proactive approach in preparing students for the workforce (Li, 2022). Central to this effort is the role of transformational leadership in education, which has the potential to bridge the divide by fostering a culture of innovation, critical thinking, and technological readiness. Transformational leaders can drive meaningful changes in educational practices, ensuring that curricula are aligned with

1 PhD candidate, Department of Leadership, University of the Cumberlands, 6178 College Station Drive, Williamsburg, KY 40769, USA. E-mail: snemani8199@ucumberlands.edu ORCID: 0009-0007-9961-5708

the skills required in the modern workplace (Sliwka et al., 2023; Heenan et al., 2023; Kareem et al., 2023). By integrating technology into learning and emphasizing the development of employability skills, educational leaders can better prepare students to meet the challenges of the 21st-century workforce (Oliveira & Marques, 2024; Cassidy, 2006). This study explores the pivotal role of transformational leadership in equipping students with the competencies needed for success in today's rapidly evolving job market.

Specifically, this research aims to:

- Evaluate the influence of transformational leadership on the development of 21st-century skills such as innovation, adaptability, problem-solving, and digital literacy in STEM education
- Assess the role of school leaders in providing professional development opportunities and involving teachers in decision-making processes related to STEM education
- Analyze the consistency of perceptions regarding transformational leadership practices in STEM education across public and private schools
- Examine the correlation between leadership practices and key educational outcomes such as adaptability, problem-solving, and digital literacy
- Investigate how transformational leadership prepares students for the challenges of the 21st-century workforce by fostering a culture of lifelong learning and adaptability.

The study investigates how transformational leadership influences the development of 21st-century skills—innovation, adaptability, problem-solving, and digital literacy—in STEM education. It explores the role of school leaders in providing professional development opportunities and involving teachers in STEM-related decision-making. Additionally, the study examines whether perceptions of transformational leadership in STEM education are consistent across public and private schools. It also assesses the relationship between leadership practices and key educational outcomes, such as adaptability, problem-solving, and digital literacy. Finally, the study evaluates how transformational leadership prepares students for 21st-century workforce challenges by fostering a culture of lifelong learning and adaptability.

The study proposes several hypotheses: H1 suggests that transformational leadership significantly influences the development of 21st-century skills such as innovation, adaptability, problem-solving, and digital literacy in STEM education. H2 posits that school leaders who actively provide professional development opportunities and involve teachers in decision-making processes significantly enhance the effectiveness of STEM education. H3 asserts that perceptions of transformational leadership practices in STEM education are consistent across public and private schools, with no statistically significant differences. H4 indicates a positive correlation between transformational leadership practices and key educational outcomes, particularly adaptability and workforce preparedness, with adaptability showing a stronger correlation.

Literature review

The Critical Role of Employability Skills in the 21st-Century Workplace

The 21st century has transformed the workplace environment, driven by advancements in technology, socioeconomics, and industry. These changes, accelerated by the COVID-19 pandemic, have made it imperative for organizations to adapt by fostering employees who excel in technical and professional skills, embrace emerging technologies, and demonstrate self-motivation. These qualities, broadly termed employability skills, are essential for achieving competence, confidence, and effectiveness in modern work settings. Despite their importance, research consistently shows that many graduates lack the market-driven employability skills necessary for success in today's rapidly evolving workplace, highlighting a critical gap that needs to be addressed for future workforce readiness (Lim, 2023; Llinares-Insa et al., 2018; Tushar & Sooraksa, 2023).

Aligning Educational Outcomes with Employability Skills

Tushar & Sooraksa (2023) identified a gap between employers' expectations and the skills that graduates possess. As a result, the employability skills highlighted in their study can serve as an essential resource for bridging this gap. These

skills include problem-solving, communication, teamwork, adaptability, willingness to learn, creativity and initiative, ICT skills, analytical and critical thinking, integrity, interpersonal skills, leadership, planning and organizing, self-management, responsibility, and maintaining a positive attitude and behavior. These skills are seen as critical for graduates to meet employers' expectations and succeed in a rapidly evolving job market. The study emphasizes the importance of aligning educational outcomes with these skills to better prepare students for the modern workplace (Tushar & Sooraksa, 2023).

Employers are focused on closing skill gaps through strategies like hiring skilled employees, retraining current staff, and leveraging automation. They also believe that higher educational institutions play a vital role in developing these necessary skills (Cassidy, 2006). According to Qenani et al. (2014), universities should act as hubs of culture and creativity, fostering the development of knowledge, traits, and skills vital for students' personal and professional growth. This highlights the shared responsibility between employers and educational institutions in preparing a workforce equipped for the demands of the modern workplace.

Preparing Future-Ready Graduates: The Need for Transformational Leadership

The 21st-century workplace is characterized by workforce diversity, technological advancements, and evolving management strategies (Turi et al., 2022). Technology has revolutionized work, enabling remote collaboration and global connectivity, but also presenting challenges like cybersecurity threats and the ongoing need for skill development. These changes require new management approaches that address the dynamic workplace environment (Jada & Mayayise, 2024).

Preparing students for the 21st-century workforce involves equipping them with the skills, knowledge, and character needed to thrive in a constantly changing job market. As globalization and population growth intensify, higher education must not only produce graduates but also transform educational practices to better prepare them for workplace challenges. This includes providing meaningful and authentic educational experiences that enhance human capital (Casillas et al., 2019). Leadership within higher education institutions plays a pivotal role in student success, demanding focused attention to its impact. Institutions must shift from merely developing human capital to fostering "future-ready" graduates. Current teaching philosophies may fall short in equipping students with the necessary skills for the modern workforce, highlighting the need for improved teacher training and classroom approaches. Higher education leaders must adapt to ensure that graduates are prepared to meet the demands of the 21st-century workplace (Oliveira & Marques, 2024).

Transforming Education Through Technology-Ready Leadership

Employees' technology readiness is increasingly essential in the 21st-century workplace, with many key competencies reflected in the Technology Readiness Level (TRL) model. School leadership's transformational role is vital in fostering a culture that equips students with these competencies. As technology becomes more integral to daily life, the educational sector—comprising leadership, educators, and students—faces mounting pressure to produce individuals proficient in using and adapting to advanced technology. This requires not only familiarity with current technology but also the ability to navigate continuous technological advancements.

For meaningful change in the classroom, educational organizations must undergo transformation from the top down. Leadership at all levels must be retrained in the effective integration of technology into their roles. Educational leaders must address the same pedagogical challenges as teachers and support them in this transition. Professional development should begin at the administrative level, guiding leaders to develop and implement a vision for integrating web-based instruction and technology into curricula. By doing so, educational leadership can ensure that technology is effectively utilized in teaching, training, and support services, ultimately enhancing learning outcomes and preparing students for a tech-driven future.

The Role of Human Capital Resources in Organizational Success

Human capital resources are not just the sum of individual employee characteristics but emerge from the interactions among employees' knowledge, skills, abilities, and organizational factors. These resources, including both explicit and

tacit knowledge, are critical for gaining a competitive edge. Explicit knowledge is well-documented and easily shared, while tacit knowledge, derived from experience, is more nuanced and essential for effective decision-making.

The development and utilization of human capital resources are heavily influenced by organizational context—such as structure, culture, and work design—and by human resource policies and talent management practices. Training and development initiatives play a vital role in shaping these resources, ensuring that employees can apply their knowledge effectively within the organization. By fostering an environment that promotes the interaction of these factors, organizations can enhance their human capital resources, thereby driving innovation, adaptability, and sustained competitive advantage (Noe et al., 2014; Ployhart & Moliterno, 2011).

Navigating Career Challenges in Higher Education and the Transition to the Workforce

The rapid social, economic, and political changes of recent years have introduced new challenges in career construction, particularly for college students. These challenges impact students' ability to adapt to and persist in higher education and their transition to or specialization within the job market. Key vocational tasks during this period include preparing for professional roles and aligning jobs with their training.

Students must navigate increasingly complex and dynamic academic environments, manage their time effectively, and balance studies with personal life. Upon graduation, they face the challenge of finding or creating jobs that match their training and career goals while making significant career decisions in often precarious and unstable labor markets. This transition requires students to adapt and assume new professional roles in society amid these uncertainties (Savickas, 2005; Soares et al., 2021). Preparing future-ready students for the 21st-century workforce necessitates transformational leadership that aligns educational outcomes with essential employability skills and technological readiness. As the workplace evolves due to technological advancements and global connectivity, educational institutions must foster a culture that equips students with critical skills, adaptability, and innovation. By transforming educational practices and integrating technology, leaders can ensure students are well-prepared to navigate the challenges of modern careers. This holistic approach, emphasizing leadership, human capital development, and technology, is essential for bridging the gap between academic preparation and workforce demands.

Conceptual Framework

The conceptual framework of this study is centered on the relationship between transformational leadership and the development of 21st-century skills within STEM education. It is designed to explore how leadership practices influence educational outcomes and prepare students to meet the demands of the modern workforce. At the core of this framework is transformational leadership, characterized by four key components: inspirational motivation, intellectual stimulation, individualized consideration, and idealized influence. Inspirational motivation involves leaders inspiring and motivating educators to pursue innovation and creativity in their teaching practices, particularly within STEM education. Intellectual stimulation refers to leaders encouraging critical thinking and problem-solving, challenging educators to continuously improve their teaching methods and adapt to new educational demands. Individualized consideration highlights how leaders provide tailored support and professional development opportunities, addressing the unique needs of each educator to enhance their effectiveness in STEM education. Idealized influence encompasses leaders serving as role models, fostering a culture of trust, respect, and commitment to educational excellence.

The framework posits that transformational leadership directly impacts the development of essential 21st-century skills in students, including innovation, creativity, adaptability, lifelong learning, problem-solving, critical thinking, and digital literacy. Leadership-driven initiatives inspire educators to integrate new ideas and technologies into the curriculum, while an emphasis on continuous learning and adaptability helps students thrive in changing circumstances. Intellectual stimulation further develops problem-solving and critical thinking skills, and leadership support enhances digital literacy by integrating digital tools into the educational environment. This framework also explores the relationship between transformational leadership and key educational outcomes, specifically within STEM education. These outcomes include increased teacher confidence and competence, as leaders' support and guidance improve educators' ability to deliver STEM education effectively. Additionally, transformational leadership prepares students for

the demands of the modern job market by fostering essential 21st-century skills. The framework examines whether perceptions of transformational leadership are consistent across public and private schools, emphasizing the universal applicability of these practices.

Finally, the framework includes a feedback loop where the outcomes of transformational leadership inform and refine leadership practices. This continuous improvement cycle ensures that leadership strategies remain relevant and effective in addressing emerging challenges in STEM education and workforce preparation. Overall, this conceptual framework provides a comprehensive structure for understanding the critical role of transformational leadership in shaping educational practices and outcomes in the 21st century, with a particular focus on STEM education.

Significance of Study

The significance of the study lies in its exploration of the impact of transformational leadership on the development of essential 21st-century skills in STEM education, such as innovation, adaptability, problem-solving, and digital literacy. By examining how school leaders influence these outcomes through professional development and teacher involvement, the study provides valuable insights into effective leadership practices that can enhance STEM education across different types of institutions. Additionally, the study's findings on the consistency of leadership perceptions between public and private schools contribute to understanding the universal applicability of transformational leadership. Ultimately, the research helps to inform educational leaders and policymakers on strategies to better prepare students for the challenges of the 21st-century workforce, fostering a culture of lifelong learning and adaptability essential for future success.

Problem of Study

The 21st-century workforce demands a new set of skills, including innovation, adaptability, problem-solving, and digital literacy, which are essential for success in a rapidly evolving and complex job market. Despite this need, there is a significant gap between the skills employers expect and those that recent graduates, particularly in STEM (Science, Technology, Engineering, and Mathematics) education, possess. This misalignment underscores the urgent need to explore how educational leadership, specifically transformational leadership, can address this gap. Key areas of investigation include understanding how transformational leadership influences the development of 21st-century skills in STEM education, the extent to which school leaders involve teachers in decision-making processes related to STEM education, the consistency of perceptions of transformational leadership across different types of educational institutions, such as public and private schools, and the relationship

Method

Research model

This study employed a mixed-methods research design to examine the influence of transformational leadership on the development of 21st-century skills—specifically innovation, adaptability, problem-solving, and digital literacy—in STEM education. The research integrated both quantitative and qualitative components to provide a comprehensive understanding of the connections between leadership practices, teaching methods, and the enhancement of critical skills in educational settings. The quantitative component involved the use of surveys to assess the impact of transformational leadership, while the qualitative component included in-depth interviews to gain deeper insights into participants' experiences and perceptions.

Participants and Sampling

The study included 150 participants, comprising 115 university students enrolled in STEM courses and 35 professors teaching STEM subjects. These participants were selected using a stratified random sampling technique to ensure diversity in experience levels and educational backgrounds. Additionally, purposive sampling was employed for qualitative interviews with school district officers, capturing a diverse range of perspectives on the influence of leadership on STEM education. This approach allowed the study to gather a representative sample across different educational contexts and ensured a broad range of opinions.

Data Collection Tools

Data collection involved two primary tools: a 37-item questionnaire rated on a 5-point Likert scale, based on Peck & Shu (2009), and a set of demographic questions regarding participants' employment. The questionnaire was designed to assess perceptions of transformational leadership's role in fostering innovation, adaptability, problem-solving, and digital literacy in STEM education, with a particular focus on its impact on teaching practices and student preparedness for the workforce. Additionally, qualitative data were collected through in-depth interviews with selected school district officers, providing richer context and deeper understanding of the quantitative findings.

Data Analysis

The data were analyzed using a combination of descriptive statistics, t-tests, and correlation analysis. Descriptive statistics provided an overview of perceptions related to leadership's role in innovation, professional development, decision-making, confidence in STEM implementation, and fostering lifelong learning. The t-tests were conducted to compare perceptions between public and private schools, revealing no significant differences and indicating consistent views of leadership practices across institutions. Correlation analysis was employed to examine the relationships between leadership practices and key educational outcomes, showing a strong correlation between adaptability and workforce preparedness, with weaker correlations for problem-solving and digital literacy.

Procedure

The survey was distributed online using Amazon Mechanical Turk (MTurk). Of the 190 questionnaires distributed, 150 were completed and returned, yielding a response rate of 78.95%. The qualitative interviews were conducted following the survey to complement and deepen the understanding of the quantitative data. This combined approach allowed for a holistic examination of the impact of transformational leadership on the development of 21st-century skills in STEM education, aligning with Creswell's (2014) mixed-methods methodology. The data organization and analysis were performed using the Statistical Package for the Social Sciences (SPSS). After data cleaning and weighting, the mean and standard deviation were calculated to provide a descriptive overview of the collected data.

Results

The Role of Transformational Leadership in Enhancing 21st-Century Skills

The Table 1 indicates several key insights regarding the role of leadership in advancing STEM education. Leadership inspiration for innovation in STEM was evident, with 62.67% of respondents agreeing that their school leaders inspire them to be more innovative and creative in implementing STEM education in their classrooms. Opportunities for professional development were also significant, as 37.33% of respondents reported that their school leaders frequently provide opportunities and resources related to STEM education. When it comes to involvement in decision-making, 53.33% of respondents agreed that their school leaders actively involve teachers in decision-making processes concerning STEM education implementation. Leadership's impact on building confidence in implementing STEM education was notable, with 56.67% of respondents expressing confidence due to the support and guidance provided by their leaders. Additionally, 60.00% of respondents found leadership guidance to be effective in helping them adapt their teaching strategies for STEM education.

Moreover, 51.33% of respondents agreed that transformational leadership effectively prepares students for the challenges of the 21st-century workforce through STEM education. Similarly, 51.33% of respondents agreed that leadership fosters a culture of lifelong learning and adaptability among students, which is essential for their success in the modern workforce.

Table 1. Percentage distribution of variables related to STEM education and leadership

Variables	%
Leadership Inspiration for Innovation in STEM	62.67
Opportunities for Professional Development	37.33
Involvement in Decision-Making	53.33
Confidence in Implementing STEM Education	56.67
Leadership Guidance on Adapting Teaching Strategies	60.00
Preparation for the 21st Century Workforce	51.33
Fostering Lifelong Learning and Adaptability	51.33

Consistent Perceptions of Transformational Leadership in STEM Education Across Public and Private Schools

As stated in the table 2, the t-test results comparing responses between public and private schools indicate that none of the differences in the average responses for the key questions are statistically significant at the 5% level. This means that the observed differences in perceptions of transformational leadership in STEM education between public and private schools are not statistically significant, suggesting that these differences could be due to chance. These results suggest that the overall perceptions of transformational leadership in advancing STEM education are relatively consistent between public and private educational institutions.

Table 2. Consistent leadership perceptions in STEM education across school Types

Statements	t	*p*
Innovation and creativity inspired by leadership	-0.0214	0.9830
Teacher involvement in STEM decision-making by leadership	0.0878	0.9302
Confidence in STEM implementation with leadership support	-1.0114	0.3139
Impact of leadership on adapting STEM teaching strategies	-0.5097	0.6112
Motivation from transformational leadership to integrate STEM	-0.0428	0.9660
Effectiveness of leadership in fostering a supportive STEM environment	-1.1013	0.2737
Transformational leadership prepares students for 21st-century workforce challenges through STEM	0.2326	0.8164
Leadership fosters lifelong learning and adaptability through STEM education	0.2039	0.8388

The Influence of Leadership on Adaptability, Problem-Solving, and Digital Literacy

The correlation analysis reveals that leadership practices have a significant impact on key variables like adaptability and preparedness for the 21st-century workforce (Table 3). A moderate positive correlation (0.495) exists between fostering adaptability and workforce preparedness, with a strong significance. A weaker yet positive correlation (0.291) is found between fostering adaptability and adapting teaching strategies. The correlation between workforce preparedness and adapting teaching strategies is the weakest (0.159), with a p-value slightly above the 5% significance level. These findings suggest that leadership significantly influences adaptability and preparedness, with a somewhat weaker effect on problem-solving and digital literacy (Table 3).

Table 3. Influence of leadership on adaptability, problem-solving, and digital literacy

Variables	r	*p*
Culture of lifelong learning and adaptability to change vs Student preparation for 21st-century workforce	0.4951	4.33
Culture of lifelong learning and adaptability to change vs ability to adapt teaching strategies	0.2907	0.00
Student preparation for 21st-century workforce vs ability to adapt teaching strategies	0.1595	0.05

Discussion

The relationships between transformational leadership practices and key educational outcomes, specifically problem-solving, adaptability, and digital literacy, in various types of educational institutions was investigated in the present study. The descriptive statistics provide a clear indication of the significant role that leadership plays in advancing STEM education. The data highlights several key areas where effective leadership positively influences educational outcomes,

particularly in fostering innovation, professional development, decision-making involvement, confidence in teaching, and overall preparedness for future challenges.

Leadership Inspiration for Innovation in STEM

With 62.67% of respondents agreeing that their school leaders inspire them to be more innovative and creative in implementing STEM education, it is evident that leadership plays a crucial role in encouraging educators to embrace and promote innovative practices within their classrooms. This high level of agreement underscores the importance of visionary leadership that motivates teachers to explore new teaching methods and integrate creative approaches into their curriculum. Leaders who prioritize innovation are likely to create a dynamic and engaging learning environment that benefits both teachers and students (Candrasari et al., 2023).

Opportunities for Professional Development

The fact that 37.33% of respondents reported frequent opportunities for professional development indicates that while a significant portion of educators recognize the efforts of their leaders in this area, there is still room for improvement. Professional development is essential for equipping teachers with the latest tools, resources, and knowledge necessary to effectively teach STEM subjects (Huang et al., 2022; Hasim et al., 2022). Leadership that actively supports continuous learning and provides access to development resources can help teachers stay current with educational trends and best practices, ultimately enhancing their teaching effectiveness (Germuth, 2018; Hurley et al., 2023).

Involvement in Decision-Making

With 53.33% of respondents agreeing that their leaders involve them in decision-making processes related to STEM education, the data suggests that participatory leadership is fairly common. Involvement in decision-making can empower teachers, giving them a sense of ownership and responsibility for the educational strategies implemented in their schools. Leaders who involve teachers in such decisions are likely to foster a collaborative environment where teachers feel valued and motivated to contribute to the success of STEM initiatives (Park et al., 2020; Nezhad & Stolz, 2024).

Confidence in Implementing STEM Education

The finding that 56.67% of respondents feel confident in implementing STEM education due to leadership support indicates that effective leadership directly contributes to teacher confidence. Confidence is fundamental for the successful delivery of STEM education, as it affects how teachers approach their subjects, manage their classrooms, and engage with students. Leaders who provide clear guidance, resources, and encouragement can significantly boost teachers' confidence, leading to more effective teaching and better student outcomes (McTigue et al., 2024).

Leadership Guidance on Adapting Teaching Strategies

The fact that 60.00% of respondents found leadership guidance effective in helping them adapt their teaching strategies highlights the importance of adaptive leadership in a rapidly changing educational landscape. As educational needs evolve, particularly in STEM fields, teachers must continually adjust their methods to meet new challenges. Leaders who offer strong guidance in this area enable teachers to remain flexible and responsive, ensuring that their teaching remains relevant and effective (Friesen & Brown, 2020).

Preparation for the 21st Century Workforce

The agreement from 51.33% of respondents that transformational leadership prepares students for the challenges of the 21st-century workforce underscores the critical role of leadership in aligning education with future workforce demands. In a world where STEM skills are increasingly vital, leaders who focus on preparing students for these demands help ensure that their education is not only academically rigorous but also practically applicable in real-world scenarios (Whorton et al., 2017; Tushar & Sooraksa, 2023).

Fostering Lifelong Learning and Adaptability

Similarly, the agreement from 51.33% of respondents that leadership fosters a culture of lifelong learning and adaptability is significant. In today's fast-paced and ever-changing world, the ability to adapt and continue learning throughout one's life is essential. Leaders who instill these values in their students and staff contribute to a culture that

values growth, resilience, and continuous improvement, which are key to long-term success in any field, particularly in STEM (Feraco et al., 2023).

Universal Perceptions of Transformational Leadership in STEM Education across School Types

The t-test analysis shows no statistically significant differences in perceptions of transformational leadership in STEM education between public and private schools, suggesting that observed differences are likely due to random variation. This finding indicates that transformational leadership practices are perceived consistently across both institution types, underscoring the universal applicability and value of effective leadership strategies in STEM education. Educational leaders can confidently implement these strategies across different institutions without significant modifications (An et al., 2018). The results challenge assumptions about inherent differences between public and private schools, emphasizing the importance of considering individual school cultures. Further research could explore other factors influencing leadership perceptions and examine the impact of school-specific characteristics on these perceptions (Veletić et al., 2023).

Influence of Leadership on Adaptability, Problem-Solving, and Digital Literacy

The correlation analysis, as presented in Table 3, underscores the significant role of leadership practices in shaping key educational outcomes such as adaptability, problem-solving, and digital literacy. The analysis reveals a moderate positive correlation between fostering adaptability and preparedness for the 21st-century workforce, with a correlation coefficient of 0.495. This finding highlights the strong influence of leadership on these critical skills, suggesting that when leaders emphasize adaptability, it significantly enhances students' readiness for the challenges of the modern workforce (Chughtai et al., 2023; Tagscherer & Carbon, 2023; Matsunaga, 2024). Leadership positively influences problem-solving, though the correlation is weaker, indicating that promoting adaptability supports teachers in improving instructional methods (Schott et al., 2020). The weakest correlation, between workforce preparedness and adapting teaching strategies, suggests a modest link between leadership and digital literacy. These findings imply that while leadership significantly impacts adaptability, additional strategies may be needed to enhance problem-solving and digital literacy skills (Huang et al., 2022).

Conclusion

This study underscores the pivotal role of transformational leadership in enhancing STEM education and equipping students with essential 21st-century skills such as innovation, adaptability, problem-solving, and digital literacy. The findings reveal that leadership practices, including fostering a culture of lifelong learning and providing professional development opportunities, significantly impact educational outcomes. Moreover, the consistency of these effects across public and private schools highlights the universal applicability of transformational leadership in education. By aligning leadership strategies with the demands of the modern workforce, educational institutions can better prepare students for future challenges.

The study's limitations include a specific sample size, which may restrict the generalizability of the findings to other educational institutions, especially those in different regions or with varying resources. Reliance on self-reported data introduces potential biases, affecting the reliability of the results. The cross-sectional design captures data at one point in time, limiting the ability to assess changes over time or establish causal relationships. Additionally, the focus on STEM education may not fully apply to other disciplines, and the lack of longitudinal data restricts the examination of long-term effects of transformational leadership on student outcomes and teacher development.

Recommendations

For Researchers

Future research should explore the long-term impacts of transformational leadership on educational outcomes by conducting longitudinal studies. Such studies would provide insights into how leadership practices influence the development of 21st-century skills and teacher effectiveness over time. Expanding the research to include non-STEM disciplines could help determine whether the positive effects of transformational leadership observed in STEM

education are also applicable in other fields. Additionally, comparative studies across different educational contexts, such as rural versus urban schools or institutions in diverse cultural settings, would offer a broader understanding of the universality of transformational leadership practices. Researchers should also consider employing mixed-methods approaches, combining quantitative data with qualitative insights to capture the nuances of how leadership influences educational practices. Finally, investigating the role of digital tools in enhancing transformational leadership could provide valuable information on integrating technology into leadership strategies to foster innovation and adaptability in education.

For Practitioners

Educational leaders are encouraged to adopt transformational leadership practices to enhance the development of 21st-century skills in students. This includes inspiring innovation in teaching practices, involving educators in decision-making processes, and providing continuous professional development opportunities. Leaders should focus on fostering a culture of lifelong learning and adaptability, ensuring that both teachers and students are equipped to meet the challenges of the modern workforce. Policymakers should consider developing frameworks that support the implementation of transformational leadership across educational institutions, recognizing its potential to standardize effective leadership practices across public and private schools. Additionally, it is recommended that educational institutions invest in professional development programs that train leaders in transformational leadership techniques, emphasizing the importance of creating dynamic and responsive learning environments that prepare students for future success.

Acknowledgements

I extend my deepest gratitude to the Julia Morgan School for Girls for their support and to my colleagues who provided insightful feedback and encouragement throughout the research process. Special thanks to my academic advisors at the University of the Cumberland for their guidance and expertise.

Biodata of the Authors

Sravan Kumar Nemani, born in Hyderabad, India, is a seasoned educational leader and innovative curriculum developer. Sravan has dedicated over seven years to teaching in various educational settings, including charter schools and private institutions. His expertise spans STEAM and Digital Arts education, where he has significantly integrated cutting-edge technologies such as AI, IoT, and Robotics into student learning experiences. Currently, Sravan is a Ph.D. candidate in Academic Leadership at the University of the Cumberland, focusing his research on the integration of technology in education to enhance learning outcomes. He is working as Innovation teacher at the Julia Morgan School for Girls, where he contributes to curriculum development and educational technology initiatives.

Affiliation: University of the Cumberlands, Julia Morgan School for Girls

E-mail: snemani8199@ucumberlands.edu // snemani@juliamorganschool.org

ORCID: 0009-0007-9961-5708

Phone: (+1)510-857-5079

References

An, S., Meier, K. J., Bøllingtoft, A., & Andersen, L. B. (2018). Employee Perceived effect of leadership Training: Comparing public and private organizations. International Public Management Journal, 22(1), 2–28. https://doi.org/10.1080/10967494.2018.1497739

Candrasari, R., Yorman, Mayasari, N., Yulia, R., & Lake, F. (2023). Visionary Leadership in Education Management: Leading toward optimal achievement in the era of Independent Learning. Indonesian Journal of Education (INJOE), 3(3), 451–467. https://www.researchgate.net/publication/374081212_VISIONARY_LEADERSHIP_IN_EDUCATION_MANAGEMENT_LEADING_TOWARD_OPTIMAL_ACHIEVEMENT_IN_THE_ERA_OF_INDEPENDENT_LEARNING#fullTextFileContent

Casillas, A., Kyllonen, P. C., & Way, J. D. (2019). Preparing students for the future of work. In Routledge eBooks (pp. 35–52). https://doi.org/10.4324/9781351210485-3

Cassidy, S. (2006). Developing employability skills: peer assessment in higher education. Education + Training, 48(7), 508–517. https://doi.org/10.1108/00400910610705890

Chughtai, M. S., Syed, F., Naseer, S., & Chinchilla, N. (2023). Role of adaptive leadership in learning organizations to boost organizational innovations with change self-efficacy. Current Psychology. https://doi.org/10.1007/s12144-023-04669-z

Creswell, J. W. (2014). Research Design: Qualitative, Quantitative and Mixed Methods Approaches (4th ed.). Thousand Oaks, CA: Sage.

Deshwal, V., & Ali, M. A. (2020). A systematic review of various leadership theories. Shanlax International Journal of Commerce/Shanlax International Journal of Commerce, 8(1), 38–43. https://doi.org/10.34293/commerce.v8i1.916.

Dorenkamp, I., & Ruhle, S. (2018). Work–Life conflict, professional commitment, and job satisfaction among academics. The Journal of Higher Education, 90(1), 56–84. https://doi.org/10.1080/00221546.2018.1484644

Feraco, T., Sella, E., Meneghetti, C., & Cona, G. (2023). Adapt, explore, or keep going? The role of adaptability, curiosity, and perseverance in a network of Study-Related Factors and scholastic success. Journal of Intelligence, 11(2), 34. https://doi.org/10.3390/jintelligence11020034

Friesen, S., & Brown, B. (2020). Teacher leaders: developing collective responsibility through design-based professional learning. Teaching Education, 33(3), 254–271. https://doi.org/10.1080/10476210.2020.1856805

Germuth, A. A. (2018). Professional Development that Changes Teaching and Improves Learning. Journal of Interdisciplinary Teacher Leadership, 1(3), 77–90. https://doi.org/10.46767/kfp.2016-0025

Hasim, S. M., Rosli, R., Halim, L., Capraro, M. M., & Capraro, R. M. (2022). STEM professional development activities and their impact on teacher knowledge and instructional practices. Mathematics, 10(7), 1109. https://doi.org/10.3390/math10071109

Heenan, I. W., De Paor, D., Lafferty, N., & McNamara, P. M. (2023). The Impact of Transformational School Leadership on School Staff and School Culture in Primary Schools—A Systematic Review of International literature. Societies, 13(6), 133. https://doi.org/10.3390/soc13060133

Huang, B., Jong, M. S., Tu, Y., Hwang, G., Chai, C. S., & Jiang, M. Y. (2022). Trends and exemplary practices of STEM teacher professional development programs in K-12 contexts: A systematic review of empirical studies. Computers & Education, 189, 104577. https://doi.org/10.1016/j.compedu.2022.104577

Huang, Z., Sindakis, S., Aggarwal, S., & Thomas, L. (2022b). The role of leadership in collective creativity and innovation: Examining academic research and development environments. Frontiers in Psychology, 13. https://doi.org/10.3389/fpsyg.2022.1060412

Hurley, M., Butler, D., & McLoughlin, E. (2023). STEM Teacher Professional Learning Through Immersive STEM Learning Placements in Industry: a Systematic Literature Review. Journal for STEM Education Research, 7(1), 122–152. https://doi.org/10.1007/s41979-023-00089-7

Jada, I., & Mayayise, T. O. (2024). The impact of artificial intelligence on organisational cyber security: An outcome of a systematic literature review. Data and Information Management, 8(2), 100063. https://doi.org/10.1016/j.dim.2023.100063

Kareem, J., Patrick, H. A., Prabakaran, N., B, V., Tantia, V., M, P. K. M. P., & Mukherjee, U. (2023). Transformational educational leaders inspire school educators' commitment. Frontiers in Education, 8. https://doi.org/10.3389/feduc.2023.1171513

Li, L. (2022). Reskilling and upskilling the future-ready workforce for industry 4.0 and beyond. Information Systems Frontiers. https://doi.org/10.1007/s10796-022-10308-y

Lim, W. M. (2023). The workforce revolution: Reimagining work, workers, and workplaces for the future. Global Business and Organizational Excellence, 42(4), 5–10. https://doi.org/10.1002/joe.22218

Llinares-Insa, L. I., González-Navarro, P., Zacarés-González, J. J., & Córdoba-Iñesta, A. I. (2018). Employability Appraisal Scale (EAS): development and validation in a Spanish sample. Frontiers in Psychology, 9. https://doi.org/10.3389/fpsyg.2018.01437

Matsunaga, M. (2024). The role of digital literacy in leadership. In Future of business and finance (pp. 139–188). https://doi.org/10.1007/978-981-99-8409-1_4

McTigue, E. M., Jensen, M. T., Gourvennec, A. F., & Solheim, O. J. (2024). The role of school leader support on teacher's engagement during intervention implementation. International Journal of Leadership in Education, 1–19. https://doi.org/10.1080/13603124.2024.2358038

Nezhad, P. M., & Stolz, S. A. (2024). Unveiling teachers' professional agency and decision-making in professional learning: the illusion of choice. Professional Development in Education, 1–21. https://doi.org/10.1080/19415257.2024.2349058

Noe, R. A., Clarke, A. D., & Klein, H. J. (2014). Learning in the Twenty-First-Century workplace. Annual Review of Organizational Psychology and Organizational Behavior, 1(1), 245–275. https://doi.org/10.1146/annurev-orgpsych-031413-091321

Oliveira, Í. M., & Marques, C. (2024). The role of career adaptability and academic engagement in college student's life satisfaction. International Journal of Environmental Research and Public Health, 21(5), 596. https://doi.org/10.3390/ijerph21050596

Park, J., Cooc, N., & Lee, K. (2020). Relationships between teacher influence in managerial and instruction-related decision-making, job satisfaction, and professional commitment: A multivariate multilevel model. Educational Management Administration & Leadership, 51(1), 116–137. https://doi.org/10.1177/1741143220971287

Peck, J., & Shu, S. B. (2009). The effect of mere touch on perceived ownership. ˝the œJournal of Consumer Research/Journal of Consumer Research, 1:36(3), 434–47. https://doi.org/10.1086/598614

Ployhart, R. E., & Moliterno, T. P. (2011). Emergence of the human capital resource: A multilevel model. The Academy of Management Review, 36(1), 127–150. https://doi.org/10.5465/AMR.2011.55662569

Qenani, E., MacDougall, N., & Sexton, C. (2014). An empirical study of self-perceived employability: Improving the prospects for student employment success in an uncertain environment. Active Learning in Higher Education, 15(3), 199–213. https://doi.org/10.1177/1469787414544875

Savickas, M. L. (2005). Career development and counseling: Putting theory and research to work. In: Brown S.D., Lent R.W., editors. Career Development and Counseling: Putting Theory and Research to Work. 2nd ed. Wiley.

Schott, C., Van Roekel, H., & Tummers, L. G. (2020). Teacher leadership: A systematic review, methodological quality assessment and conceptual framework. Educational Research Review, 31, 100352. https://doi.org/10.1016/j.edurev.2020.100352

Sliwka, A., Klopsch, B., Beigel, J., & Tung, L. (2023). Transformational leadership for deeper learning: shaping innovative school practices for enhanced learning. Journal of Educational Administration, 62(1), 103–121. https://doi.org/10.1108/jea-03-2023-0049

Soares, J., Taveira, M. D. C., De Oliveira, M. C., Oliveira, Í. M., & Melo-Silva, L. L. (2021). Factors influencing adaptation from university to employment in Portugal and Brazil. International Journal for Educational and Vocational Guidance, 21(3), 507–529. https://doi.org/10.1007/s10775-020-09450-3

Tagscherer, F., & Carbon, C. (2023). Leadership for successful digitalization: A literature review on companies' internal and external aspects of digitalization. Sustainable Technology and Entrepreneurship, 2(2), 100039. https://doi.org/10.1016/j.stae.2023.100039

Turi, J. A., Khastoori, S., Sorooshian, S., & Campbell, N. (2022). Diversity impact on organizational performance: Moderating and mediating role of diversity beliefs and leadership expertise. PLoS ONE, 17(7), e0270813. https://doi.org/10.1371/journal.pone.0270813

Tushar, H., & Sooraksa, N. (2023). Global employability skills in the 21st century workplace: A semi-systematic literature review. Heliyon, 9(11), e21023. https://doi.org/10.1016/j.heliyon.2023.e21023

Tushar, H., & Sooraksa, N. (2023). Global employability skills in the 21st century workplace: A semi-systematic literature review. Heliyon, 9(11), e21023. https://doi.org/10.1016/j.heliyon.2023.e21023

Veletić, J., Price, H. E., & Olsen, R. V. (2023). Teachers' and principals' perceptions of school climate: the role of principals' leadership style in organizational quality. Educational Assessment Evaluation and Accountability, 35(4), 525–555. https://doi.org/10.1007/s11092-023-09413-6

Whorton, R., Casillas, A., Oswald, F. L., & Shaw, A. (2017). Critical skills for the 21st century workforce. In Oxford University Press eBooks. https://doi.org/10.1093/acprof:oso/9780199373222.003.0003