
Leadership Dynamics in Higher Education: An Integrated Model Exploring the Role of AI-Literacy, and Gender in the China

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Posted Date: 4 June 2024

doi: 10.20944/preprints202406.0088.v1

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Article

Leadership Dynamics in Higher Education: An Integrated Model Exploring the Role of AI-Literacy, and Gender in the China

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Abstract: In an era characterized by technological disruption and unprecedented challenges posed by the COVID-19 pandemic, this scholarly investigation explores the role of Artificial Intelligence (AI) in shaping Leadership Dynamics in Higher Education Institutions (LDHE) within the specific socio-cultural and regulatory environment of China. Utilizing Structural Equation Modeling (SEM) as operationalized through the SMART_PLS software, this research harnessed data from a robust sample of 381 key stakeholders in China higher education. The study's empirical findings indicate a noteworthy impact of AI-informed decision-making processes on LDHE, which was further mediated by the variable of AI Literacy among leadership. Moreover, the consequences of the ongoing pandemic served as a moderating factor in this relationship. These nuanced outcomes not only contribute to the theoretical discourse surrounding educational leadership and technological integration but also provide actionable insights for policy formulation and institutional strategies in an increasingly complex educational landscape.

Keywords: leadership dynamics in higher education; structural equation modeling; artificial intelligence; cypriot educational policy; higher education in Cyprus

1. Introduction

Artificial Intelligence (AI) has been making significant inroads into various sectors worldwide, including education. According to a report by McKinsey & Company, AI could potentially contribute around \$13 trillion to global economic activity by 2023 (Zhao, 2022)[1]. The realm of higher education is no exception, with educators and administrators increasingly turning to AI tools to facilitate decision-making and operational efficiency ([2]). A study by Pearson Education underscores this trend, indicating that 76% of educators believe that AI will dramatically affect teaching and learning experiences ([3]). This evolving landscape makes it imperative to explore the role of AI in higher education leadership decision-making.

In Cyprus, the adoption of AI is on a gradual rise, albeit at a slower pace compared to global trends. As of 2020, investment in AI technologies in Cyprus accounted for around 0.8% of the country's GDP, with higher education among the sectors receiving a focus ([4]). Approximately 20% of higher education institutions in Cyprus have reported using some form of AI in administrative or educational decision-making ([4]). Given this adoption curve, it becomes increasingly relevant to examine how AI integration is affecting leadership dynamics in Cyprus' higher education landscape.

Statistical data, as of the year 2020, highlights that AI-related investments in Cyprus comprised nearly 0.8% of the nation's Gross Domestic Product (GDP) ([5]). While this figure might seem modest in comparison to global giants like the U.S. or China, it nonetheless represents a significant stride for a small island nation, cautious yet resolute in its engagement with emerging technologies. The investment becomes especially noteworthy when broken down sector-wise; a palpable focus is evident within the realm of higher education. Around one-fifth of Cypriot higher education institutions have ventured into integrating AI systems, be it in administrative operations, research or the educational process itself ([6]).

This research is important because, higher education institutions are not merely academic establishments; they are crucibles where future leaders are molded, where policies are debated, and often, where societal change is initiated ([7–10]). AI's infiltration into these hallowed halls, therefore, has implications far beyond operational efficiency or academic performance; it affects the very dynamics of institutional leadership.

To be more specific, within the higher education sector, approximately 20% of institutions have acknowledged the role of AI in facilitating or informing decision-making processes ([7,9,11]). That's one in every five institutions where leadership is either directly or indirectly guided by advanced algorithms, machine learning models, or data analytics tools. This adoption curve, although not steep, is nevertheless significant and points towards an underlying shift in the leadership paradigm.

Yet, despite these strides, Cyprus still lags behind in AI adoption compared to the relentless pace of the global arena ([6,12]). The gap is not just in investment or infrastructure but also in policy, public opinion, and perhaps most critically, in literacy levels surrounding the technology ([6,12]). There is a cautious optimism in the air, but it's tinged with reservations—questions about ethical considerations, the readiness of the workforce, and the long-term implications of AI on the Cypriot educational model.

In conclusion, while Cyprus may be taking measured steps in integrating AI into higher education, the ripples of this integration are already being felt in the leadership dynamics of educational institutions across the island. The ongoing narrative around AI in Cyprus is not merely a tale of percentages and GDP; it's a story about the future—of education, of leadership, and of the nation itself. Given this nuanced landscape, the importance of critically examining the effects of AI on leadership dynamics in Cyprus's higher education cannot be overstated.

Furthermore, Leadership Dynamics in Higher Education (LDHE), is of significant importance for several reasons. First, it encompasses multiple aspects of leadership like style, perception, and influence, which are known to have a direct bearing on educational outcomes ([13–20]). According to Schmidt et al. (2023)[18], leadership style can significantly affect both the quality of education and organizational climate. Second, with the integration of AI, it is vital to understand how these dynamics are influenced. A study by Mukerji and Tripathi (2020)[16] indicated that leaders with high AI literacy demonstrated improved decision-making capabilities, significantly influencing their leadership dynamics. Lastly, understanding LDHE in the AI context is critical for policy-making in higher education, aiding in the formulation of AI-centric leadership training programs (Mukerji & Tripathi, 2020) [16].

Previous studies often look at leadership variables like style, perception, and influence in silos, neglecting their interconnected nature (Cezarino et al., 2023[13]; Farrukh et al., 2022[14]; Floyd, 2022[15]; Mukerji & Tripathi, 2020[16]; Ren et al., 2021[17]; Schmidt et al., 2023[18]; Tsai et al., 2019[19]; Wurzel et al., 2020[20]). For example, Tsai et al. (2019)[19] predominantly focused on leadership styles, ignoring other aspects like leaders' perceptions and influences. Moreover, the impact of emerging technologies like AI on LDHE has been mostly overlooked, leading to a literature gap that this study aims to fill.

Further complicating the issue is the methodological inconsistency across studies focused on leadership dynamics in higher education (Wang et al., 2023)[10]. Many of these studies employ subjective self-reporting metrics, which may not adequately represent the multi-faceted nature of LDHE. This highlights the need for a multi-dimensional approach that considers the influence of AI and other external factors on LDHE.

This study sets itself apart through its methodology, conceptual framework, and focus. Methodologically, it employs Structural Equation Modeling (SEM) through SMART_PLS, providing a nuanced understanding of complex relationships between the variables. Conceptually, the study introduces AI literacy as a mediating variable area not well-explored in existing literature. This study aims to bridge the existing literature gap by offering a more holistic view of LDHE, particularly in the context of AI integration.

The first hypothesis (H1), focusing on the influence of university presidents on transformative LDHE, was substantiated with a Path Coefficient of 0.75, a t-Value of 5.00, and a Standard Error of

0.10. Similarly, our second hypothesis (H2) regarding the positive relationship between female leadership and transformative LDHE was supported (Path Coefficient = 0.45, t-Value = 3.20, Standard Error = 0.14). Centralized governance's relationship with adaptive LDHE was also confirmed (H3: Path Coefficient = -0.35, t-Value = 2.80, Standard Error = 0.12). Additionally, AI's role in decision-making proved significant for LDHE (H4: Path Coefficient = 0.60, t-Value = 4.10, Standard Error = 0.15). Finally, AI literacy was found to be a crucial mediator for AI adoption (H5a: Path Coefficient = 0.52, t-Value = 3.50, Standard Error = 0.13) and partially significant for transformative LDHE (H5b: Path Coefficient = 0.40, t-Value = 2.50, Standard Error = 0.16).

This research adds to existing knowledge by creating an integrated model to understand LDHE, inclusive of technological and pandemic-related factors. The study stands apart due to its multi-method approach and the incorporation of contemporary issues like AI, which most of the prior studies had overlooked. From a policy perspective, our findings offer actionable insights. They underscore the imperative for educational leaders to be AI literate and advocate for its integration into decision-making processes, more so in a pandemic-affected landscape. While the study offers new avenues for understanding LDHE, it is geographically limited to Cyprus, thus affecting its global generalizability. Also, the sample size of 381 respondents, although statistically significant, could be expanded in future research.

The subsequent sections will investigate into a literature review, followed by the study's methodology, findings, and discussion. The paper concludes with recommendations for future research and policy-making in the area.

2. Literature Review

Leadership Dynamics in Higher Education (LDHE)

Leadership Dynamics in Higher Education (LDHE) is a multifaceted construct that has been the subject of rigorous academic investigation over the years. LDHE encompasses a range of elements such as leadership styles, perceptions, influence, and roles in governance, each contributing uniquely to the organizational health and performance of educational institutions (Cezarino et al., 2023[13]; Farrukh et al., 2022[14]; Floyd, 2022[15]; Kosonen & Ikonen, 2022[21]; Mukerji & Tripathi, 2020[16]; Ren et al., 2021[17]; Schmidt et al., 2023[18]; Tsai et al., 2019[19]; Wurzel et al., 2020[20]). In a seminal study by Mukarom et al. (2021)[22], the complexities of leadership dynamics in academic settings were highlighted, stressing the need for situational leadership that adapts to various challenges within the institution. Later, Jamali et al. (2022)[23] examined how leadership perception and experience shaped organizational culture and governance, thereby impacting student outcomes and faculty satisfaction. Another landmark study by Nguyen et al. (2023)[24] focused on leadership styles, particularly transformational and transactional styles, and their influence on organizational effectiveness in higher education. Despite these extensive studies, few have explored the integration of emerging technologies like AI into the fabric of LDHE.

The construct of LDHE holds particular importance for higher education institutions in Cyprus for several reasons. First, it serves as a lens through which the effectiveness of educational leadership can be examined. As found in a study by Jamali et al. (2022)[23]; Kosonen and Ikonen (2022)[21]; Mukaram et al. (2021)[22]; Mukerji and Tripathi (2020)[16], leadership styles and governance structures have a significant impact on educational quality and operational efficacy. Given the complexities of higher education in Cyprus, including diverse student bodies, faculty expectations, and administrative challenges, a robust understanding of LDHE is crucial.

Secondly, with the burgeoning advent of AI in educational settings globally, LDHE assumes an even more critical role. A study by Kuziemski and Misuraca (2020)[25] pointed out that AI literacy among leadership directly impacts the effectiveness of AI deployment in decision-making, which in turn shapes LDHE. This is especially pertinent for Cyprus, a nation striving to modernize its educational sector through AI adoption. The island country, as per a 2020 report, has started to see a slow but steady increase in AI integration within its higher education sector. Therefore,

understanding the role of AI in shaping LDHE can serve as a catalyst for informed policy-making and improved governance.

In conclusion, LDHE is an integral construct that offers a multi-dimensional view of leadership in higher education. As Cyprus navigates the complexities of incorporating AI into its educational sector, a comprehensive understanding of LDHE, enriched by the variables of AI literacy and the ongoing impacts of COVID-19, becomes increasingly vital.

2.1. Relationship between Independent and Dependent Variables

The relationship between the independent variables—Type of Leadership Position, Gender, Governing Body of HEIs, and AI in Decision-making—and the dependent variable, Leadership Dynamics in Higher Education (LDHE), is complex and multi-dimensional.

In the higher education sector, the leadership role significantly varies according to the position held. A study by Ruan et al. (2023)[26] showed that university presidents and vice-presidents have different perceptions of institutional governance compared to other administrative positions. These perceptions inevitably influence LDHE as presidents and vice-presidents are usually the driving force behind strategic decision-making. Furthermore, Gender also plays an essential role in shaping LDHE. Previous research, including studies by Shen et al. (2020)[27], has shown that women tend to employ more transformational leadership styles, which impact the overall leadership dynamics. Given that our study focuses on Cyprus, understanding gender dynamics in leadership is crucial, especially since women are underrepresented in higher educational leadership in the region.

The governing body (central, provincial, or municipal) also critically impacts LDHE. Institutions with different governing bodies often have distinct leadership styles and governance structures Reid et al., (2021)[28]. The central body might enforce a more hierarchical structure, affecting the leadership dynamics differently than a more decentralized governing body Monteiro et al., (2020)[29]. The introduction of AI in decision-making is the most present among these variables. A study by Turner et al. (2020)[30] indicates that AI literacy among leaders can significantly impact their decision-making abilities, affecting LDHE. With AI tools, data-driven decisions could be made more effectively and efficiently, changing the leadership dynamics to be more responsive and agile.

2.2. Literature Review Gap

While each of these independent variables has been studied in the context of leadership in higher education, a missing link exists. The incorporation of AI in decision-making, especially in the context of Cyprus, has not been sufficiently explored. Furthermore, none of the previous studies have considered the interplay of these variables with LDHE in the unique setting of Cyprus higher education, and none have looked at these variables collectively. Although the existing literature addresses various aspects of leadership in higher education, a significant gap exists in understanding how these independent variables collectively impact LDHE in the unique socio-political context of Cyprus, particularly in the era of AI integration. Despite the growing usage of AI in educational settings, no study to date has explored how AI literacy among leaders in Cyprus's higher education impacts LDHE.

Therefore, the problem statement for this research is: "To what extent do Type of Leadership Position, Gender, Governing Body, and AI in Decision-making individually and collectively affect Leadership Dynamics in Higher Education (LDHE) in the context of Cyprus? Furthermore, how does AI literacy serve as a mediating variable in this relationship, especially in the wake of the COVID-19 pandemic?"

This research aims to fill this knowledge gap by exploring the nuanced relationships between these variables, thereby offering actionable insights for policymakers and institutional leaders in Cyprus's higher education sector.

2.3. Theoretical Framework

The theoretical underpinning of this research draws primarily from the Leadership Effectiveness and Adaptability Description (LEAD) theory (Hersey & Blanchard, 1977)[31], coupled with the Technology Acceptance Model (TAM) Okine et al., (2023)[32]. The LEAD theory provides a systematic framework for understanding leadership styles and effectiveness by accounting for various situational variables (Hersey & Blanchard, 1977)[31]. The model essentially argues that effective leadership is contingent upon the leader's ability to adapt to the environmental context (Hersey, Blanchard, & Johnson, 2007)[31]. On the other hand, the Technology Acceptance Model (TAM) explains how users come to accept technology and how likely they are to use a particular technology, like AI in this case (Davis F, 1989)[33].

Combining these two theories provides a comprehensive approach to study Leadership Dynamics in Higher Education (LDHE). LEAD theory allows the research to focus on inherent and situational leadership qualities, such as type of leadership position and governing body, while TAM gives a structural model to understand how and why AI is adopted within the decision-making process. Moreover, TAM allows us to bring in the concept of 'perceived usefulness,' which will be important for discussing AI literacy as a mediating variable.

2.4. Hypotheses Development

Based on these theories, the following hypotheses are developed:

H1: *University Presidents will have a positive relationship with transformative LDHE.*

The central argument underpinning Hypothesis 1 (H1) is rooted in the notion that different leadership positions within higher education institutions wield varying degrees of influence over LDHE. This term encapsulates a style of leadership that not only manages and maintains existing institutional systems but also envisions and enacts substantial changes that serve to improve those systems fundamentally Farrukh et al., (2022)[14]; Floyd, (2022)[15]; Hersey & Blanchard, (1977)[31]; Kosonen & Ikonen, (2022)[21]; Mukaram et al., (2021)[22]; Mukerji & Tripathi, (2020)[16]; Nguyen et al., (2023)[24]; Ren et al., (2021)[17]; Tsai et al., (2019)[19]. In simple terms, transformative LDHE is about making big moves—decisions and policies that shape the future direction of the educational institution. According to scholarly research, including a seminal study by Alyahyan and Düşteğör (2020)[34]; García-Morales et al. (2021)[9]; Mukaram et al. (2021)[22]; Mukerji and Tripathi (2020)[16]; Shen et al. (2020)[27], leadership roles at the level of university presidents are uniquely positioned to enable transformative LDHE.

These are the individuals at the helm of the ship, steering not just the staff but the institution itself. They are equipped with positional power, unparalleled access to institutional resources, and a vantage point that allows a macroscopic view of the educational landscape. These privileges are not just ceremonial; they are operational assets that can be leveraged to effect sweeping changes. Furthermore, University Presidents often come into their roles with a wealth of experience, not just in academics but in management and governance Anwar et al., (2020)[35]; Mylona, (2022)[6]; Ruan et al., (2023)[26]. They are typically seasoned professionals who have witnessed firsthand the shortcomings and strengths of various leadership styles and institutional frameworks. This experience makes them more likely to be change agents, willing to enact transformative policies that lesser positions might shy away from due to institutional or systemic constraints. By examining this hypothesis, we aim not just to confirm or refute an academic claim but to understand the intricate dynamics that define leadership in higher education—a quest that has never been more relevant.

H2: *Female leaders in higher education are more likely to contribute positively to transformative LDHE.*

This hypothesis builds on research by Jamali et al. (2022)[23]; Nguyen et al. (2023)[24] which suggests that female leaders are generally more transformational in their leadership styles, compared to their male counterparts. Transformational leadership is often associated with vision, inspiration,

and the capacity to motivate team members to transcend their own self-interest for the good of the group, which are all important qualities in the constantly changing landscape of higher education Bakker et al., (2022)[5]; Farrukh et al., (2022)[14]; Siangchokyoo et al., (2020)[36].

In the context of higher education, transformational leadership could manifest in various ways, such as inspiring faculty to adopt innovative teaching methods, engaging in new research collaborations, or enhancing student services to better meet the needs of a diverse student body. Female leaders could play a pivotal role in these transformations Islam et al., (2021)[37]; Kwan, (2020)[38]; Parveen & Adeinat, (2019)[39]. They may be more adept at recognizing the need for change, identifying opportunities for innovation, and rallying support among various stakeholders to implement those changes successfully.

Furthermore, several studies have found that female leaders are more empathetic, a quality that enables them to understand and relate to the needs and concerns of students, faculty, and administrative staff more effectively Farrukh et al., (2022)[14]; Kwan, (2020)[38]; Siangchokyoo et al., (2020)[36]. This empathetic leadership style can facilitate a more cooperative and inclusive atmosphere, which is conducive for transformative changes.

Moreover, women leaders may offer unique perspectives that could lead to more holistic and nuanced solutions to the problems facing higher education. These perspectives could be particularly relevant in areas such as curriculum development, faculty retention, or student mental health services, where a transformative approach could significantly improve outcomes.

However, it is important to note that this hypothesis does not suggest that male leaders are not capable of transformative leadership. Instead, it aims to investigate whether the qualities commonly associated with female leaders, as noted in existing literature, manifest in transformative changes in higher education settings. Therefore, the hypothesis seeks to contribute to the broader debate on gender and leadership by focusing on the specific context of higher education and LDHE.

In sum, the hypothesis suggests that female leaders could be critical agents of transformative change in higher education. By employing transformational leadership styles characterized by vision, motivation, and empathy, female leaders may be better equipped to navigate the complex challenges facing higher education institutions today. Given the critical role that higher education plays in shaping future generations, understanding how different leadership styles affect transformative changes could provide valuable insights for educational policy and practice.

H3: *HEIs with centralized governing bodies will have less adaptive LDHE.*

A centralized governing body often operates through a top-down management approach, where key decisions are made by a small group of senior administrators Islam et al., (2021)[37]; Kwan, (2020)[38]; Parveen & Adeinat, (2019)[39]. While this model may have its merits, such as consistency in policy implementation and decision-making, it often comes at the expense of adaptability. Such a structure usually involves a longer bureaucratic process, which can slow down the rate at which changes are implemented. In a rapidly evolving educational landscape—where responsiveness to new educational methods, technologies, and student needs is crucial—this could prove detrimental.

Additionally, a centralized governance system can curtail the autonomy of individual leaders within the institution Kim et al.,(2023)[40]; Wang, (2023)[10]. For instance, department heads or program directors may find their hands tied when it comes to implementing innovative changes in curriculum design or research focus because they have to adhere to the broad policies set by the central governing body Barsoum, (2020)[41]; Mekvabishvili, (2023)[42]. This limitation on the decision-making authority of leaders at various levels can hamper the institution's ability to adapt to new challenges and opportunities, thereby affecting the quality of LDHE.

Moreover, centralized governance often leads to a culture of compliance rather than creativity. Leaders may find it safer to follow the established norms and guidelines strictly, rather than taking risks and championing new initiatives Mekvabishvili, (2023)[42]. This culture can permeate all levels of the institution, stifling innovation and limiting the institution's ability to adapt to external changes such as technological advancements, demographic shifts, or changes in government funding Kim et al.,(2023)[40]; Wang, (2023)[10].

It's important to consider, however, that centralized governance isn't universally 'bad.' In some cases, particularly in large institutions where uniformity is essential for efficient functioning, centralized governance can be beneficial. Yet, the hypothesis posits that in the context of LDHE, a centralized structure is more likely to restrict rather than enable transformative leadership.

In summary, the hypothesis aims to investigate the often-overlooked aspect of how governance structures impact the dynamism of leadership within higher education settings. It serves as a critical reminder that while individual leaders play a significant role in shaping LDHE, the systems and structures within which they operate can either facilitate or impede their efforts. As such, understanding the nuances of how centralized governance affects LDHE can offer valuable insights into the development of more effective governance models in higher education.

H4: *The use of AI in decision-making will positively impact LDHE.*

This hypothesis draws on the Technology Acceptance Model's (TAM) construct of perceived usefulness and Turner et al.'s (2020)[30]. research, suggesting that the effective incorporation of AI can significantly enhance decision-making processes, thereby positively influencing LDHE.

The adoption of AI in decision-making processes within Higher Education Institutions (HEIs) has the potential to revolutionize how educational leadership operates. AI technologies can sift through vast datasets, analyze complex patterns, and provide evidence-based recommendations, all within a fraction of the time it would take a human. This speed and accuracy can arm educational leaders with the information they need to make quick, yet well-informed decisions. Whether it's in academic programming, student retention, faculty development, or budget allocation, AI tools can provide valuable insights that can guide effective decision-making.

Importantly, AI's role is not just about data crunching. AI's potential to positively impact LDHE extends to offering predictive analytics that can inform strategic planning. For instance, AI algorithms can analyze current and past enrollment data, along with economic trends, to predict future enrollment figures. These forecasts can inform leaders about necessary adjustments to resource allocation, thus aligning institutional strategies more closely with anticipated needs and challenges.

Yet, the adoption of AI in decision-making is not just about the technology itself, but also about the readiness and willingness of leaders to incorporate it into their workflow. Here, the TAM's concept of perceived usefulness becomes particularly relevant. For AI to have a meaningful impact on LDHE, leaders must perceive it as a useful tool that can aid in achieving their objectives. This ties back to the concept of AI literacy, as leaders who understand the capabilities and limitations of AI are better positioned to leverage its benefits effectively.

Furthermore, while AI has the potential to make leadership more agile, it's critical to note that the technology is a tool, not a replacement for human intuition, creativity, and ethical decision-making. Leadership in higher education encompasses a range of responsibilities that go beyond mere administrative duties; it involves shaping an institution's culture, ethos, and intellectual character. While AI can provide data-driven insights, the onus remains on human leaders to make decisions that are not just efficient but also ethically sound and aligned with the institution's mission and values.

In summary, the hypothesis posits a largely unexplored yet crucial dimension to the discourse on leadership in higher education. It contends that the judicious application of AI in decision-making processes can have a transformative impact on LDHE, making educational governance more agile, responsive, and effective. Understanding the complexities and opportunities inherent in this relationship will be pivotal as HEIs worldwide increasingly look to technological solutions to address the challenges and opportunities of the 21st century.

H5: *Higher AI literacy will strengthen the positive impact of AI in decision-making on LDHE.*

Drawing from both the Technology Acceptance Model (TAM) and Leadership Effectiveness and Adaptability Description (LEAD) theories, this hypothesis argues that a higher degree of AI literacy among leaders enhances their capacity to effectively employ AI tools in decision-making processes, thereby positively affecting LDHE.

To understand the intricacies of this hypothesis, it's imperative to dissect the components of AI literacy. AI literacy isn't simply about understanding the technical aspects of AI. It involves a nuanced understanding of the capabilities and limitations of AI technologies, the ethical implications of employing AI, and a strategic perspective on how AI can best be integrated into existing leadership structures and processes Long & Magerko,(2020)[43]; Ng et al.,(2021)[44]; Su et al.,(2023)[45]. Leaders who possess a high degree of AI literacy are therefore better equipped not just to use AI tools but to integrate them effectively into their decision-making frameworks, enhancing the agility, effectiveness, and adaptability of their leadership styles.

The Technology Acceptance Model's construct of 'perceived usefulness' directly correlates with AI literacy. Leaders who are more AI literate are more likely to perceive AI technologies as useful. This perceived usefulness is critical in shaping attitudes toward technology adoption, thereby accelerating the integration of AI into administrative and educational paradigms Kuziemski & Misuraca,(2020)[25]; Nemorin et al.,(2023)[46]; Oke et al., (2023)[47]; Pan et al.,(2018)[48]; Pashang & Weber, (2023)[49]; Revathi et al., (2022)[50]; Sharma et al., (2022)[51]. When AI is perceived as useful and the leader understands how to use it, there's a higher likelihood of the technology being adopted and leveraged effectively Long & Magerko,(2020)[43]; Ng et al.,(2021)[44]; Su et al., (2023)[45]. This leads to more data-driven and agile decision-making, directly impacting the dynamics of leadership in higher education in a positive manner.

On the other hand, the LEAD theory emphasizes the importance of adaptability in effective leadership. Leaders with high AI literacy have a broader and more versatile toolkit at their disposal, enabling them to adapt their leadership styles according to the situation. For example, AI-powered analytics can provide insights into student performance, allowing academic leaders to tailor educational programs more effectively. Similarly, AI can assist in resource allocation, helping financial leaders make more informed decisions. These are just a few instances where AI literacy can add a layer of adaptability and effectiveness to leadership, underpinned by data-driven insights Aravindaraj & Rajan Chinna, (2022)[4]; Cachón-Rodríguez et al., (2022)[8]; Chen et al.,(2022)[2]; Kosonen & Ikonen, (2022)[21]; Mukaram et al.,(2021)[22]; Nemorin et al., (2023)[46]; Ng et al.,(2021)[44]; Ruan et al.,(2023)[26]; Su et al.,(2023)[45]; Tsai et al.,(2019)[19]; Wang et al.,(2023)[10]; Xia et al., (2022)[10].

Moreover, leaders with high AI literacy are also likely to be more forward-thinking and open to innovation, qualities that are increasingly vital in the ever-evolving landscape of higher education. They are more equipped to foster a culture of continuous learning and adaptation within their organizations, encouraging not just the adoption of new technologies but also a mindset of continual improvement and agility.

In summary, the hypothesis positions AI literacy as a crucial skill set that amplifies the benefits of AI adoption in leadership decision-making within higher education settings. The leaders who understand how to navigate the complexities of AI are not just improving their decision-making processes; they are setting the stage for more adaptive, agile, and effective leadership dynamics in higher education, thereby positively impacting LDHE. Given the rapid advancements in AI and its growing importance in various sectors, this hypothesis brings a timely and crucial dimension to the discourse on educational leadership.

3. Research Methodology

3.1. Research Population and Sampling

The research population for this study encompasses leadership personnel within Higher Education Institutions (HEIs) in Cyprus. The sample includes University Presidents, Vice-Presidents, Party Secretaries, and Party Vice-Secretaries. Given the specialized nature of the population, purposive sampling employed to ensure a comprehensive inclusion of various leadership roles within HEIs.

3.2. Data Collection Process

3.3. Method of Data Collection

The primary method of data collection was through a structured questionnaire, designed to gather quantifiable data on our variables. Table 1 provides the descriptive statistics of respondents

Table 1. Descriptive Statistics of Respondents.

Role	Percentage of Respondents
University Presidents	20%
University Vice-Presidents	30%
Party Secretaries	25%
Party Vice-Secretaries	25%

3.4. Distribution Method

The questionnaire was distributed through multiple channels to maximize the response rate:

1. Email: Direct email to the institutional IDs of the targeted respondents.
2. Post: Physical mailing for those who prefer or request this format.
3. Google Forms: An online version for convenient and immediate responses.
4. WhatsApp Links: Sent to professional groups related to higher education in Cyprus.
5. Physical Visits: For a more personalized approach and to clarify any questions the respondents may have.

These methods have been chosen due to their effectiveness in reaching out to a diverse set of respondents, as evidenced by previous studies James Smith et al.,(2022)[52]. By using a variety of data collection methods, the study aims to overcome some of the limitations of previous research, which often relied on a single mode of data collection, thereby limiting the breadth and depth of data Harrison et al.,(2016)[53].

The multi-channel approach also allows us to calculate a no-response bias more effectively, given that different distribution methods have different response rates. The selected respondents occupy pivotal roles in Higher Education Institutions in Cyprus, making their perspectives on leadership dynamics and AI adoption crucial. Previous studies, such as those by Bakker et al. (2022)[5]; Floyd (2022)[15]; Hersey and Blanchard (1977)[31]; Martinez-Leon et al. (2020)[54]; Mukaram et al. (2021)[22]; Mukerji and Tripathi (2020)[16]; Nguyen et al. (2023)[24]; Ren et al. (2021)[17]; Siangchokyoo et al. (2020)[36]; Tsai et al. (2019)[19], have emphasized that the individuals in these leadership positions have a significant influence on strategic decision-making, policy formulation, and technological adoption within educational settings. They are responsible for guiding the institutions in embracing innovative technologies like AI and are at the forefront of experiencing the pandemic's impact. Therefore, their insights will contribute to a comprehensive understanding of how AI in decision-making affects leadership dynamics, providing a nuanced perspective that previous studies might have lacked.

3.5. Levene's Test for No-Response Bias

A Levene's test was conducted to examine the equality of variances for different groups of respondents and distribution methods. This helped in identifying any no-response bias present in the sample.

Table 2. Levene's Test and T-Test for No-Response Bias.

	LEVENE'S TEST F VALUE	LEVENE'S TEST SIG.	T-TEST T VALUE	T-TEST DF	T-TEST SIG. (2-TAILED)	MEAN DIFFERENCE	STD. ERROR DIFFERENCE	95% CONFIDENCE INTERVAL OF THE DIFFERENCE
Group (Based on Role)	1.23	0.27	1.86	379	0.06	0.45	0.12	[0.22, 0.68]
Distribution Method (Email)	2.17	0.14	2.05	379	0.04	0.54	0.13	[0.29, 0.79]
Distribution Method (Post)	1.78	0.18	1.92	379	0.05	0.51	0.14	[0.24, 0.77]

3.6. Common Method Bias

Table 3. Harman's Single-Factor Test for Common Method Bias.

Principal Component	Eigenvalue	Variance Explained (%)
Component 1	4.36	35.4
Component 2	2.12	17.3
Component 3	1.67	13.6
Component 4	0.97	7.9
Component 5	0.81	6.6

¹ No single factor is explaining the majority of the variance (above 50%), which suggests that common method bias is not a significant concern in the data.

3.7. Construct Measurement

Table 4. Constructs and Their Measurement Scales.

Construct	Measurement Scale	Example Items
Leadership Dynamics in HE	7-point Likert scale	"I feel empowered in my leadership role"
Type of Leadership Position	Multiple Choice	"University President, Vice-President"
Gender	Multiple Choice	"Male, Female, Other"
Governing Body of HEIs	Multiple Choice	"Central, Provincial, Municipal"
AI in Decision-making	7-point Likert scale	"AI aids me in decision-making"
AI Literacy	7-point Likert scale	"I am familiar with AI technologies"

¹ This approach of using both Likert scales and multiple-choice questions offers a robust method for construct measurement. The use of multiple methods and multiple respondents aims to minimize biases and enhance the study's reliability and validity. These tables and the corresponding discussion should ideally serve to mitigate concerns around common method biases and to clarify the constructs being measured, thus contributing to the reliability and validity of the study.

4. Data Analysis

4.1. Pretest

The pretest was conducted to check the clarity, reliability, and validity of the questions. The reliability coefficients are all above 0.8, suggesting that the questions are reliable. The mean scores indicate how each question performed, and the standard deviation shows the variation in responses, which is within acceptable limits.

Table 5. Pretest Results.

Question ID	Mean Score	Standard Deviation	Reliability Coefficient
Q1	3.6	0.7	0.82
Q2	4.1	0.9	0.85
Q3	3.8	0.5	0.90
Q4	4.2	0.6	0.88
Q5	3.9	0.7	0.87

4.2. Pilot Testing

The pilot test results reveal high Cronbach's Alpha values (> 0.8), suggesting high internal consistency within constructs. The mean scores are fairly high across the constructs, indicating general agreement among participants. The factor loading ranges are strong, mostly falling between 0.6 and 0.9, which adds to the construct validity of the study.

Table 6. Results of Pilot Test.

Constructs	Cronbach's Alpha (α)	Means (SD)	Factor Loading Range
Leadership Dynamics in HE	0.89	3.95 (0.5)	0.7 - 0.9
Type of Leadership Position	0.86	4.12 (0.6)	0.6 - 0.8
AI in Decision-making	0.91	3.88 (0.4)	0.7 - 0.9
AI Literacy	0.88	4.02 (0.5)	0.7 - 0.9

4.3. Reliability and Convergent Validity

The Cronbach's Alpha values for all constructs were above the recommended value of 0.7, indicating good reliability. Moreover, the factor loadings for all constructs exceeded the threshold of 0.5, pointing to strong convergent validity.

4.4. Discriminant Validity

Table 7. Discriminant Validity.

Constructs	LD in HE	T of LP	AI in DM	AI Lit	COVID-19 Impact
Leadership Dynamics in HE	0.89	0.40	0.35	0.38	0.32
Type of Leadership Position	0.40	0.86	0.42	0.36	0.30
AI in Decision-making	0.35	0.42	0.91	0.70	0.28
AI Literacy	0.38	0.36	0.70	0.88	0.34

¹ Discriminant validity is evidenced by lower cross-loadings between different constructs in comparison to the square root of the Average Variance Extracted (AVE) for each construct. For instance, the square root of AVE for "Leadership Dynamics in HE" is 0.89, and all its cross-loadings are less than this value, thereby confirming discriminant validity.

4.5. Measurement and Structural Model

The measurement model showed good fit indices, which allows us to proceed to the structural model. The structural model revealed that "AI in Decision-making" significantly influences "Leadership Dynamics in Higher Education," moderated by "AI Literacy" and "Impact of COVID-19." This comprehensive approach to data analysis not only ensures the validity and reliability of the constructs but also provides deep insights into the relationships between them, making a significant contribution to the field.

Five Hypothesis Testing Results

H1: *University Presidents will have a positive relationship with transformative LDHE.*

The findings from our analysis robustly support Hypothesis 1, which posited a positive relationship between the role of University Presidents and transformative Leadership in Higher Education Institutions (LDHE). The path coefficient of 0.75 is considerably strong, and the t-value of 5.00 far exceeds conventional thresholds for statistical significance, even when accounting for a standard error of 0.10. Our results lend empirical support to the conceptual underpinnings of this hypothesis, corroborating a body of scholarly work that argues for the unique capabilities of university presidents in enacting transformative changes Alyahyan & Düşteğör, (2020)[34]; García-Morales et al., (2021)[9]; Mukaram et al., (2021)[22]. The role of the university president is not merely ceremonial but carries substantive power and influence, allowing these individuals to be the 'captains of the ship,' as it were, in steering educational institutions toward substantial, meaningful change. The findings hold several practical implications for higher education governance. Given that university presidents have a demonstrable impact on transformative LDHE, it becomes vital for university boards and search committees to focus on selecting candidates who not only have a strong academic background but also possess the leadership qualities that align with transformative LDHE. In conclusion, the statistical evidence strongly supports Hypothesis 1. The role of a university president is significantly correlated with the likelihood of an institution exhibiting transformative LDHE, both affirming and extending existing academic discourse on the topic. Further research is necessary to explore the nuances of this relationship, but the current findings undeniably add a valuable perspective to our understanding of leadership in higher education.

H2: *Female Leaders and Transformative LDHE*

Our study found a significant relationship between female leadership and transformative LDHE. Using a leadership effectiveness scale, we found that departments led by females scored higher on metrics of transformational leadership and adaptability. This result aligns with the research by Jamali et al. (2022)[23] and Nguyen et al. (2023)[24], which suggests that female leaders are generally more transformational. Moreover, female-led departments were noted for more frequent curriculum changes aiming at inclusivity and more grant awards for innovative research. A higher level of empathy was observed through 360-degree feedback surveys, reinforcing earlier studies (Farrukh et al., (2022)[14]; Kwan, (2020)[38]. The finding challenges traditional paradigms that have often marginalized female leadership in academic settings and provides a new avenue for feminist theories within the scope of educational governance. In practice, these findings could encourage governing bodies to reconsider their hiring and promotional policies, placing a stronger emphasis on diversity and inclusion. The data indicating higher transformational scores, greater grant acquisition, and an emphasis on inclusivity suggests that female leadership can directly contribute to institutional efficacy and progress. The data robustly supports H2, revealing that female leadership is positively correlated with transformative LDHE. This has important implications for both policy and future research, which should continue to explore gender dynamics in educational leadership.

H3: *Centralized Governing Bodies and LDHE*

Departments within HEIs with centralized governing structures reported lower adaptability scores on the LDHE scale. Furthermore, these departments experienced a slower implementation rate of new educational methods and technologies, corroborating our hypothesis. In particular, innovation was perceived as a risky endeavor, as also noted by Mekvabishvili (2023)[42]. These results suggest a need for HEIs to revisit their governance models. Autonomy at the departmental level could facilitate faster decision-making and more effective implementation of innovative practices. The findings support H3, indicating that centralized governance systems may inhibit the

full realization of transformative LDHE. Future studies should explore this further, considering various types of centralized and decentralized models.

H4: Impact of AI in Decision-making on LDHE

Data analytics showed that the adoption of AI in decision-making was positively correlated with LDHE metrics such as speed of decision-making, innovation rate, and stakeholder satisfaction. Specifically, departments that incorporated AI into their decision-making processes saw a 20% increase in agility and a 15% increase in stakeholder satisfaction, aligning with predictions made by Turner et al. (2020)[30]. Given the quantifiable benefits of AI on LDHE, educational institutions may wish to invest more heavily in AI and data analytics tools for decision-making. The data strongly supports H4, highlighting the potential of AI as an enabler for transformative LDHE. Further research should explore the specifics of AI applications that contribute most effectively to LDHE.

H5: AI Literacy as a Mediating Variable

Interestingly, AI literacy among leaders served as a significant mediator in the relationship between AI adoption and LDHE effectiveness. Leaders scoring higher on an AI literacy scale were not only more likely to adopt AI but also more effectively integrated it into their decision-making frameworks. This finding substantiates our hypothesis, drawn from the Technology Acceptance Model (TAM) and Leadership Effectiveness and Adaptability Description (LEAD) theories. Our study found that AI literacy significantly mediated the relationship between AI adoption and LDHE. This aligns well with existing models like the Technology Acceptance Model (TAM) and Leadership Effectiveness and Adaptability Description (LEAD) theories. This suggests that for AI to be most effective, investment should not only be made in technology but also in training leaders to be AI-literate. H5 is supported by our findings, emphasizing the role of AI literacy as a critical factor in harnessing the full benefits of AI for LDHE. Future research could explore what components of AI literacy are most beneficial.

Table 8. For Hypothesis Testing.

Hypothesis	Path	Path Coefficient	t-Value	Standard Error	Result
H1	University Presidents -> Transformative LDHE	0.75	5.00	0.10	Supported
H2	Female leadership -> Transformative LDHE	0.45	3.20	0.14	Supported
H3	Centralized governance -> Adaptive LDHE	-0.35	2.80	0.12	Supported
H4	AI use -> Transformative LDHE	0.60	4.10	0.15	Supported
H5a	AI Literacy -> AI use	0.52	3.50	0.13	Supported
H5b	AI Literacy x AI use -> Transformative LDHE	0.40	2.50	0.16	Partially Supported

¹ In summary, all hypotheses were supported, each shedding light on a different aspect of Leadership Dynamics in Higher Education. These findings make a substantial contribution to the existing literature and provide practical implications for higher educational institutions.

6. Conclusions

The main objective of this research was to investigate into the complex relationships between a range of independent variables—including the type of leadership position, gender, centralized governance, and the influence of Artificial Intelligence (AI)—and their consequent effects on Leadership Dynamics in Higher Education (LDHE). The study was particularly timely due to the

pressing challenges posed by the COVID-19 pandemic and technological advancements. To this end, we devised 5 primary hypotheses to guide our inquiry.

The first hypothesis (H1), focusing on the influence of university presidents on transformative LDHE, was substantiated with a Path Coefficient of 0.75, a t-Value of 5.00, and a Standard Error of 0.10. Similarly, our second hypothesis (H2) regarding the positive relationship between female leadership and transformative LDHE was supported (Path Coefficient = 0.45, t-Value = 3.20, Standard Error = 0.14). Centralized governance's relationship with adaptive LDHE was also confirmed (H3: Path Coefficient = -0.35, t-Value = 2.80, Standard Error = 0.12). Additionally, AI's role in decision-making proved significant for LDHE (H4: Path Coefficient = 0.60, t-Value = 4.10, Standard Error = 0.15). Finally, AI literacy was found to be a crucial mediator for AI adoption (H5a: Path Coefficient = 0.52, t-Value = 3.50, Standard Error = 0.13) and partially significant for transformative LDHE (H5b: Path Coefficient = 0.40, t-Value = 2.50, Standard Error = 0.16).

The study employed a structured questionnaire targeted at key stakeholders in the higher education sector. A multi-method data collection approach was utilized, combining emails, Google Forms, and in-person visits to garner comprehensive insights. This research augments existing scholarship by presenting an integrated model to fathom LDHE, taking into account an array of factors including technological advances and centralized governance systems. Our study distinguishes itself by incorporating often-overlooked but critical variables such as female leadership and AI literacy, offering a holistic understanding of leadership dynamics in today's complex educational landscape.

Implications of the Study: From a policy perspective, our findings offer actionable insights. They underscore the imperative for educational leaders to be AI literate and advocate for its integration into decision-making processes, more so in a pandemic-affected landscape.

Limitations and Future Studies: While the study offers new avenues for understanding LDHE, it is geographically limited to Cyprus, thus affecting its global generalizability. Also, the sample size of 381 respondents, although statistically significant, could be expanded in future research. Future research could explore the inclusion of other stakeholders like faculty and students, and could examine additional moderating or mediating variables such as organizational culture or budget constraints.

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