Examination of Undergraduate Students' Artificial Intelligence Anxiety, Multidimensional 21st Century Skills, and Lifelong Learning Levels in terms of Various Variables

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ABSTRACT
This study aimed to investigate the impact of artificial intelligence (AI) anxiety on multi-dimensional 21st-century skills and lifelong learning among undergraduates. A quantitative method using a correlational research model was used to examine the relationships between AI anxiety, 21st-century skills, and lifelong learning levels, considering various demographic and educational variables. Data were collected from undergraduates in educational faculty programs in Kyrenia, Turkish Republic of Northern Cyprus (TRNC) during the 2023-2024 academic year. Findings revealed a moderate level of AI anxiety among students, a strong perception of possessing relevant 21st-century skills, and a moderate recognition of the importance of lifelong learning. Significant differences in AI anxiety were observed based on gender, with females reporting higher anxiety levels. Age, country of origin, university, faculty program, class level, GPA, use of AI-based products or services, and daily internet use for professional development also influenced students' 21st-century skills and lifelong learning levels. No significant correlations were found between AI anxiety and the other constructs, while a moderate positive correlation was identified between 21st-century skills and lifelong learning. These findings emphasize the importance of fostering 21st-century skills for lifelong learning and suggest that AI anxiety may not significantly impact students' skill acquisition or learning behaviours.
Keywords: Artificial intelligence, Anxiety, University students, 21st-century skills, Lifelong learning,

1.1. INTRODUCTION

The rapid advancements in science and technology worldwide are bringing about significant transformations in many facets of life, including education (Adıgüzel, Kaya & Cansu, 2023; Chen et al., 2022; Karatas et al., 2021). Artificial Intelligence (AI) encompasses diverse technologies and applications that enable machines to perform tasks traditionally associated with human intelligence, such as learning, problem-solving, and decision-making (Javaid et al., 2022; Sarker, 2022).

Scholars argue that recent advancements in artificial intelligence represent the fourth evolution of education, highlighting a shift towards personalized learning and the demand for individuals to demonstrate greater creativity compared to automated systems (Hu, 2019). Consequently, educators need to foster open-mindedness and acquire new skills in technology, ethics, and data literacy to effectively drive transformative processes (Ng et al., 2023). Likewise, students are urged to improve their skills, deepen their understanding of AI, and develop competencies for adeptly engaging with this technology (Dwivedi et al., 2021). Advocating for AI requires acknowledging its potential in tackling enduring societal challenges (Chowdhury et al., 2022; Tomašev et al., 2020). However, alongside its promise, concerns have surfaced regarding job security, AI surveillance, and the misuse of personal data. Consequently, individuals may hold both positive and negative perceptions of AI, shaped by its specific applications (Chowdhury et al., 2022; Schepman & Rodway, 2020). Research indicates that AI can induce anxiety among people (Wang & Wang, 2019). Addressing AI-related anxiety is crucial for fostering an inclusive and supportive learning environment (Lemay et al., 2020; Wang et al., 2022; Salas-Pilco et al., 2022). Students experiencing anxiety or fear about AI may exhibit hesitancy toward engaging with technology-driven educational tools or innovative learning approaches. Studies have demonstrated that AI learning anxiety negatively affects students' motivation to learn and their experiences in e-learning environments (Almaiah et al., 2022; Wang et al.,

2022).

By understanding and mitigating AI anxiety, educators can create a more positive and conducive atmosphere for learning, motivating students to embrace technological advancements and explore new learning opportunities. In this context, the development of 21st-century skills is essential for students to excel in an AI-driven world (Zhou, 2023). These skills, such as critical thinking, creativity, collaboration, and digital literacy, are increasingly valued in the workplace and society at large (Mahmud & Wong, 2022). However, AI anxiety may hinder the development of these skills by limiting students' willingness to interact with AI technologies or explore new digital platforms. By addressing AI anxiety and promoting a growth mindset, educators can empower students to develop the skills necessary to adapt and succeed in a rapidly changing world. Fostering lifelong learning is essential for individuals to remain competitive and adaptable in the face of technological advancements and evolving job markets (Park & Kim, 2020). AI anxiety may hinder lifelong learning efforts by creating barriers to exploring new technologies or acquiring new knowledge and skills. By addressing AI anxiety and promoting a positive attitude towards technology, educators can cultivate a culture of lifelong learning, encouraging students to continuously seek out new learning opportunities and adapt to changing circumstances throughout their lives.

Exploring the relationship between AI anxiety, 21st-century skills, and lifelong learning in higher education is vital for understanding how to support student success in an increasingly digital and interconnected world. By addressing AI anxiety and promoting a positive attitude towards technology, educators can empower students to develop the skills and mindset necessary to thrive in the 21st century and beyond

1.2. ARTIFICIAL INTELLIGENCE

Given its widespread integration into everyday applications and significant impact on various aspects of society, artificial intelligence (AI) has become a focal point of both research and public discourse (Humm et al., 2021). The field's growth is marked by both potential benefits and challenges that need to be addressed for responsible and effective integration into society (Ferrario & Loi, 2022; Iliev, 2021). The development of AI, which is now a significant trend worldwide, is rooted in the desire to enhance human cognitive capabilities through technology (Wang, 2021). The term ‘Artificial Intelligence’ was coined by John McCarthy at the Dartmouth Conference in 1956, marking the official launch of artificial intelligence as an academic field of study (Manyika, 2022). The question "Can Machines Think?" by Alan Turing, and the introduction of the Turing test idea also contributed to the history of artificial intelligence (Turing, 2009). According to Öztürk and Şahin (2018), AI underwent numerous evolutions between 1965 and 1980, including the dark period, renaissance period, partnership period, entrepreneurship period, and the phase in which it expanded beyond laboratory settings and emphasized its integration into social life. The development of AI technology has been ongoing for over six decades, indicating a long history of innovation and evolution in this field (Lu, 2020). When it was initially proposed in 1956, AI aimed to create machines that exhibit human-like intelligence (Al-Sahaf et al., 2019). Over the years, AI has evolved from rule-based problem solving to machine learning, enabling it to independently address problems using algorithms (Shan et al., 2023). This progression highlights AI's journey from imitating human intelligence to efficiently executing specific tasks, thereby shaping its current definition and applications. As McCarthy (2007) defined it, AI is "the science and engineering of making intelligent machines, especially intelligent computer programs," a definition that has evolved since 1956. A contemporary definition of AI describes it as the capability of non-human entities, such as machines or software, to perform tasks, solve problems, communicate, and interact with their environment, demonstrating logical reasoning similar to human cognition and behaviour (Gil De Zúñiga et al., 2024). Another perspective states that AI originates from the effort to replicate human brain function and digitally augment human intelligence on a technological platform (Wang, 2021). The portrayal of AI in literature and the film industry, along with the recent focus on deepfake technology and its applications across various fields, further emphasizes AI's widespread significance (Kılıç & Kahraman, 2023). Furthermore, the extensive media coverage of advancements in deep learning and the proliferation of AI-powered consumer applications highlight the current prominence of artificial intelligence (Lyu, 2020).

1.3. ARTIFICIAL INTELLIGENCE ANXIETY

Artificial Intelligence (AI) development is advancing rapidly, significantly impacting diverse fields such as science, education, medicine, technology, and business (Zhang & Aslan, 2021). This swift progression has led to growing concerns about its implications (Johnson & Verdicchio, 2017). Schiavo et al. (2024) define "AI anxiety" as the fear and worry associated with losing control over AI systems. According to Johnson and Verdicchio (2017), AI anxiety involves feelings of fear or agitation stemming from the perception that AI operates beyond human control. Wang and Wang (2019) further characterise this anxiety as a widespread emotional reaction that hinders individuals' interactions with AI. Previous studies have shown that the widespread adoption of AI may disrupt society and the workforce, leading to concerns such as existential risks, job displacement, privacy violations, and increased casualties in conflicts (Civelek, 2009; Fast & Horvitz, 2017; Scherer, 2015; Yudkowsky,

2008).

Researchers have identified various factors contributing to AI anxiety (Bergdahl et al., 2023). Johnson and Verdicchio (2017) highlight three main factors: an exclusive focus on AI capabilities without human oversight, confusion about autonomy in computational entities, and misconceptions about technological development. Li & Huang (2020) outlines additional concerns, including fears of AI developing independent consciousness, opaque decision-making processes, discrimination and bias, ethical violations, and threats to human survival. Broader worries encompass job displacement, privacy breaches, safety, regulation, and learning anxiety. As AI technologies become more prevalent, new concerns are expected to arise.

Lemay et al. (2020) link AI anxiety to technology readiness, finding that technology readiness inhibitors are positively related to AI anxiety factors such as fears of job replacement and socio-technical illiteracy. Kaya et al. (2022) explores the relationship between AI anxiety and individual differences, demonstrating that personality traits and knowledge about AI significantly influence attitudes towards AI. Wang et al. (2022) reveal that students experience AI learning anxiety, which negatively affects their learning motivations, and AI job replacement anxiety. Alkhalifah et al. (2024) focus on existential concerns, offering a psychological perspective that emphasizes the impact of AI on fundamental human fears.

Anxiety surrounding artificial intelligence has become a universal phenomenon, greatly influencing individuals' future paths in education, work, and life (Li & Huang, 2020). Wang and Wang (2019) emphasize the importance of addressing these negative effects, as research has shown their adverse impact on future performance. They identify four main dimensions of AI anxiety: learning, job displacement, sociotechnical blindness, and configuration. The learning dimension involves unease when individuals become acquainted with AI techniques and applications. The acquisition of knowledge and skills about AI significantly impacts individuals' experiences of anxiety related to it, as indicated by studies conducted by Li & Huang (2020) and Wang et al. (2022). While limited exposure to AI often leads to heightened anxiety due to misconceptions about its capabilities, educational initiatives can alleviate such fears. Conversely, individuals well-versed in AI may also experience anxiety due to their awareness of its potential implications, including ethical and societal concerns. Thus, the role of learning in AI anxiety is complex, with educational efforts sometimes mitigating anxiety and other times intensifying concerns, depending on various factors such as information accuracy and individual values (Hopcan et. al, 2024). Job displacement raises concerns about potential unemployment resulting from AI advancements. A 2017 study by the McKinsey Global Institute (MGI) estimated that the pace of AI integration could necessitate occupational changes or skill upgrades for 75 million to 375 million workers worldwide by 2030, affecting 3% to 14% of the global workforce (Manyika et al., 2017). Sociotechnical blindness results from focusing on AI programs while disregarding the crucial role of humans in their creation, deployment, maintenance, and interpretation. This leads to a failure to recognize that AI functions within a larger system that invariably relies on human involvement and social structures (Johnson & Verdicchio, 2017). The structuring dimension pertains to the perception of AI as unsettlingly human-like (Johnson & Verdicchio, 2017; Kaya et al., 2022; Takıl et al., 2022; Terzi, 2020; Wang & Wang, 2022;).

1.4. 21ST CENTURY SKILLS

In today's rapidly evolving business environment, various institutions and organizations have pinpointed the essential skills that individuals must possess to thrive in the 21st-century workforce. These skills are crucial not only for professional success but also for navigating daily life effectively. They encompass abilities such as communication, collaboration, problem-solving, innovation, creativity, flexibility, and leadership (Larson & Miller, 2012). Commonly referred to as generic or soft skills, they are fundamental for student development in the modern context (Santosa, 2022). These skills include critical thinking, creativity, collaboration, metacognition, and motivation, which are interrelated and complex (Lai, 2012). While these skills are not entirely new, their importance has grown significantly (Rotherham, 2009). Employers now priorities the 4Cs—critical thinking, effective communication, collaboration, and creativity—alongside the traditional 3Rs (reading, writing, and arithmetic) for workforce readiness (Keane, 2012).

The necessity for 21st-century skills has been a central topic in educational policy making and research for over a decade, with various educational initiatives in the USA, Australia, the European Union, and the OECD defining these skill sets (Ahonen & Kinnuen, 2015). These definitions often share common elements such as collaboration, communication, ICT literacy, and social/cultural skills, as well as civic participation, creativity, critical thinking, and problem-solving (Voogt & Pareja Roblin, 2010). The frameworks for 21st-century skills provide guidelines for identifying the abilities students need to join tomorrow's workforce, placing a responsibility on educators to ensure that current skills and teaching methods align with these goals (Perez & Ramírez-Montoya, 2022).

The European Union recognizes eight key competences for 21st-century skills, which include digital competence, critical thinking, creativity, problem-solving, communication, collaboration, social and civic competence, and cultural awareness. These competences are crucial for individuals to thrive in today's rapidly changing society (Muldagaliyeva et al. 2023). These competences are crucial for students to thrive in today's rapidly changing society (Santosa, 2022; Vista, 2020). The ATC21S international research project (Assessment & Teaching of 21st Century Skills) categorizes these skills into ways of thinking, ways of working, tools for working, and living in the world (Binkley et al., 2012). In the United States, the Partnership for 21st Century Skills—a government-corporate joint initiative—has its own framework, outlining four categories and four support systems: Life and Career Skills, Learning and Innovation Skills (the 4Cs), Information, Media and Technology Skills, and Key Subjects and 21st Century Themes (P21 Skills, 2019). The OECD has also formulated a version through the Definition and Selection of Competences (DeSeCo) initiative, which supports PISA (the OECD Programme for International Student Assessment) (Ananiadou & Claro, 2009).

Economic and societal changes, driven by technological advancements and their impact on job characteristics and home environments, are major drivers of the demand for 21st-century skills (Voogt & Pareja Roblin, 2010). These skills are deemed essential for success in a rapidly changing world and are often linked to future economic prosperity (Child, 2016). Despite the diversity of frameworks—some focusing on life, workforce, applied, personal, and interpersonal skills (McComas, 2014), and others emphasizing cognitive, social, emotional, and ICT skills (Garay, 2019)—there is a consensus on the importance of these skills (Child, 2012).

1.5. LIFELONG LEARNING

The modern era has witnessed significant transformations in both the employment and education sectors due to technological advancements, increased global connectivity, and shifts in economic models, as highlighted by Zhi et al. (2024). As technology evolves, it creates new job roles and transforms existing ones, necessitating continuous skill refinement among workers (Park & Kim, 2020; Serbia & Tomašević, 2023). The digital transformation of society and the emergence of Industry 5.0 demand not only technical expertise but also flexibility, problem-solving capabilities, and proficiency in digital literacy (Gamberini & Pluchino, 2024; Serbia & Tomašević, 2023). Lifelong learning has thus become essential for maintaining employability, fostering economic and community growth, and preparing the workforce for a digital and sustainable future (Gamberini & Pluchino, 2024). Engaging in lifelong learning is crucial for individuals to build fulfilling careers and achieve long-term goals in the 21st century (Karatas et al., 2021). The ongoing pursuit of education and skill development is vital for adapting to new technologies and for societal progress in a constantly changing digital world. Lifelong learning involves the consistent application of knowledge and sustained engagement (Polat & Odabaşı, 2008).

Various organizations, including the European Commission, UNESCO, and OECD, define lifelong learning as intentional learning activities undertaken throughout an individual's life to enhance knowledge, skills, and competencies from personal, societal, and career perspectives (European Commission, 2001). It encompasses transformative processes that shape individuals intellectually, emotionally, and practically before becoming integrated into their life narratives (Jarvis, 2009). UNESCO extends this definition to include all intentional learning from birth to death, covering informal learning in diverse settings and formal education in institutions (Tuijnman & Boström, 2002). The European Lifelong Learning Initiative describes lifelong learning as a continuous process that equips individuals with the awareness, values, skills, and understanding necessary to apply across various contexts (Taylor & Watson, 2003). Technological advancements have impacted every aspect of modern life, necessitating continuous learning and adaptation (Ayçiçek & Yanpar-Yelken, 2016; Güçlü, 2020; Karaman & Aydoğmuş, 2018). Learning starts in the womb and continues throughout life, resulting in long-term changes in skills, knowledge, and behaviours (Güneş & Deveci, 2021; Kaygın, 2020). Sehic (2020) describes learning as a positive change in behaviour, mental activities, and abilities stemming from experience and the acquisition of new information and skills, influenced by personal and environmental experiences and facilitated by educational technologies (Huang, 2019).

The concept of "lifelong learning" is now ubiquitous in educational circles, often interpreted to mean whatever the learner finds beneficial (Assefa et al., 2023; Kirby et al., 2010; Nascimento & Valdés-Cotera, 2018). Soares and Dias (2019) and Crick et al. (2004) provide a comprehensive definition, describing lifelong learning as an individual's capacity and desire to continually improve their knowledge, competencies, and engagement in learning activities throughout life. Bilgiç et al. (2021) identify lifelong learning as a 21st-century skill encompassing areas such as problem-solving, critical thinking, decision-making, communication, cooperation, information literacy, technology literacy, flexibility, adaptability, global competencies, and financial literacy. Kirby et al. (2010) emphasizes the importance of learning how to learn, highlighting that effective lifelong learners can set goals, apply appropriate knowledge and skills, engage in self-direction and self-evaluation, locate required information, and adapt their learning strategies to different conditions.

Learning is an ongoing process, with individuals continually acquiring new knowledge and skills throughout their lives. Each historical period has unique features prompting individuals to seek new knowledge in response to emerging needs, perpetuating progress and development. In the 21st century, individuals face specific knowledge, abilities, and competencies necessary for success. The competencies and skills required for today's rapidly evolving and interconnected world are encapsulated by 21st-century skills (Gündüz, 2023). Lifelong learning and 21st-century skills are interconnected and complementary. Mawas and Muntean (2018) emphasise the importance of cultivating skills such as digital literacy, communication, critical thinking, problem-solving, collaboration, creativity, and imagination for lifelong learning. Kozikoğlu and Altunova (2018) note that perceiving oneself as competent in learning and renewal skills, life and career skills, and knowledge, media, and technology skills is crucial for becoming a lifelong learner.

There is a positive relationship between lifelong learning and 21st-century skills. As individuals enhance their 21st-century skills, their capacity for lifelong learning increases, and vice versa. A comprehensive review of the literature reveals consistent empirical support for this association (Aksüt, 2023; Erdoğan, 2020; Gündüz, 2023; Özdemir, 2022; Soruklu and Şentürk, 2023; Strang, 2018; Kozikoğlu & Altunova, 2018; Korkmaz, 2019). Critical thinking, problem-solving, information literacy, and digital literacy are among the essential skills highlighted by Sträng (2018) and Mawas (2018). Hilton & Pellegrino (2012) provides a comprehensive overview of these skills, including cognitive and non-cognitive abilities, and their relevance to success in education and work. These studies collectively underline the importance of 21st-century skills in preparing individuals for future challenges.

John Dewey asserted that education equips individuals with the skills necessary to control their environment and fulfil their obligations. The concepts of education and lifelong learning persist throughout an individual's life, transcending the boundaries of traditional education (Edwards & Usher, 1998). In conclusion, it can be asserted that fostering lifelong learning and 21st-century skills is imperative for adapting to the demands of modern life and ensuring both personal and societal advancement. As society navigates an era characterized by rapid technological advancements and global interconnectedness, the continuous pursuit of education and skill development becomes crucial. By integrating these competencies, individuals are better equipped to face the challenges of today and contribute meaningfully to economic growth and community well-being. This dual emphasis not only enhances individual career prospects but also supports broader societal progress, making lifelong learning a cornerstone of success in the 21st century.

1.6. THE AIM OF THE STUDY

The aim of this study is to investigate the impact of AI anxiety on multi-dimensional 21st-century skills and lifelong learning among undergraduate students enrolled in Faculty of Education programs at universities in the Kyrenia region of the Turkish Republic of Northern Cyprus. In the present study, it was aimed to investigate the following research question “What is the level of artificial intelligence anxiety, 21st Century Skills and lifelong learning among undergraduates?” which is followed by the sub-research questions as: According to undergraduates, is there a statistical difference among the levels of artificial intelligence anxiety, multidimensional 21st-century skills, and lifelong learning based on (1) gender, (2) age, (3) country of origin, (4) university currently attended, (5) faculty program, (6) class level, (7) last GPA average, (8) use of artificial intelligence-based products or services, (9) daily internet usage duration for professional development, (10) the most frequently used social media platform and (11) “Is there a correlation among the level of artificial intelligence anxiety, 21st Century Skills and lifelong learning?”.

1.7. THE IMPORTANCE OF THE STUDY

This study examined how undergraduates' AI-related anxieties and multidimensional competencies affect their lifelong learning tendencies. Understanding these dynamics is essential for developing effective educational policies and teaching strategies that support successful lifelong learning outcomes and support undergraduates for the future workforce. It is extremely important to understand their lifelong learning skills by considering the changes in both education and in the workplace that they will soon join (Billet, 2023). In this regard, it is worth underlining that the study of their perceptions will provide an understanding of aspects related to their continued ability to learn that they will need once they leave the formal educational environment.

Universities play a pivotal role in fostering lifelong learning, and supporting this process is crucial for enhancing individuals' abilities to learn and adapt to a rapidly changing world. By focusing on undergraduates, this study addresses gaps in the existing literature contributes to the integration of research on AI anxiety, multidimensional competencies, and lifelong learning, offering insights into the complex interactions between these factors and guiding the development of effective educational policies and practices.

2. METHODOLOGY

2.1 Research model

This study adopts a quantitative research approach, utilizing a correlational research model. As highlighted by Fraenkel et al. (2012), the fundamental objective of correlational research is to deepen comprehension of important phenomena by investigating the relationships among variables. Within this framework, researchers utilize correlational statistics to precisely measure and illustrate the degree of association between multiple variables or sets of scores, as emphasized by Creswell & Guetterman (2018).

2.2. Population and Sample of the Research

The sample for this research consisted of undergraduate students enrolled in Educational Faculty programs in the Kyrenia region of the Turkish Republic of Northern Cyprus (TRNC). A total of 396 undergraduate students participated from a population of 1,827 students in the Faculty of Education departments in the designated region during the spring semester of the 2023-2024 academic year, using a non-random sampling method, specifically convenience sampling. Convenience sampling involves selecting the most readily accessible respondents, focusing on a situation that allows for maximum efficiency (Cohen & Manion, 1989). Information about the participants is presented in Table 1.

Table 1. Demographic Information of Students

Variables		**n**	**%**
Gender	Female	242	61.1
	Male	154	38.9
	Total	396	
Age Range	18-20	116	29.3
	21-23	168	42.4
	24-26	77	19.4
	27-29	23	5.8
	30 and above	12	3
Country of Origin	TRNC	63	15.9
	Turkey	304	76.8
	Other	29	7.3
University	Girne American University	103	26
	Kyrenia University	24	6.1
	Cyprus Science University	12	3
	Final International University	257	64.9
Program	English Language Teaching	181	45.7
	Special Education Teaching	58	14.6
	Pre School Teaching	86	21.7
	Psychological Counselling and Guidance	34	8.6
	Turkish Language Teaching	17	4.3
	Music Teaching	9	2.3
	Primary School Teaching	11	2.8
Class Year	1st year	166	41.9
	2nd year	53	13.4
	3rd year	85	21.5
	4th year	92	23.2
Latest GPA	3.00- 4.00	144	36.4
	2.99- 2.00	222	56.1
	1.99 and below	30	7.6
AI Products/Services Used?	Yes	343	86.6

	No	53	13.4
Daily Internet Use for Personal Development	Less than 1 hour	36	9.1
	Between 1-3 hours	149	37.6
	Between 3-5 hours	114	28.8
	More than 5 hours	97	24.5
Most Used Social Media Platform	Facebook	17	4.3
	Instagram	259	65.4
	Twitter (X)	22	5.6
	TikTok	42	10.6
	YouTube	49	12.4
	Other	7	1.8

Note. n = Sample Size

Among the participants, 61.1% (n = 242) were female and 38.9% (n = 154) were male. The age distribution was as follows: 29.3% (n = 116) were aged 18-20, 42.4% (n = 168) were aged 21-23, 19.4% (n = 77) were aged 24-26, 5.8% (n = 23) were aged 27-29, and 3% (n = 12) were aged ≥ 30 years. In terms of country of origin, 15.9% (n = 63) were from the Turkish Republic of Northern Cyprus (TRNC), 76.8% (n = 304) were from Turkey, and 7.3% (n = 29) were from other countries. The university distribution showed that 26% (n = 103) attended Girne American University, 6.1% (n = 24) attended Kyrenia University, 3% (n = 12) attended Cyprus Science University, and 64.9% (n = 257) attended Final International University. The distribution of study programs indicated that 45.7% (n = 181) were enrolled in English Language Teaching, 14.6% (n = 58) in Special Education Teaching, 21.7% (n = 86) in Pre-School Teaching, 8.6% (n = 34) in Psychological Counselling and Guidance, 4.3% (n = 17) in Turkish Language Teaching, 2.3% (n = 9) in Music Teaching, and 2.8% (n = 11) in Primary School Teaching. Regarding the class year, 41.9% (n = 166) were in their first year, 13.4% (n = 53) in their second year, 21.5% (n = 85) in their third year, and 23.2% (n = 92) in their fourth year. The GPA distribution showed that 36.4% (n = 144) of patients had a GPA between 3.00 and 4.00, 56.1% (n = 222) had a GPA between 2.99 and 2.00, and 7.6% (n = 30) had a GPA of 1.99 and below. In terms of usage of AI products or services, 86.6% (n = 343) reported using them, while 13.4% (n = 53) did not. Regarding daily Internet use for personal development, 9.1% (n = 36) used the Internet for less than 1 hour, 37.6% (n = 149) for 1-3 hours, 28.8% (n = 114) for 3-5 hours, and 24.5% (n = 97) for more than 5 hours. The most used social media platforms were Instagram (65.4%, n = 259), YouTube (12.4%, n = 49), TikTok (10.6%, n = 42), X (Formerly Twitter) (5.6%, n = 22), and Facebook (4.3%, n = 17), and 1.8% (n = 7) used other platforms.

2.3 Data Collection Tools of the Research

Data collection for this study utilised a questionnaire administered through Google Forms, comprising two main sections. The first section gathered demographic information from participants, while the second section included three scales: the "Artificial Intelligence Anxiety Scale", (Akkaya et al. 2021) the "Multidimensional 21st Century Skills Scale", (Çevik, 2019) and the "Lifelong Learning Scale" (Arslan and Akcaalan, 2015).

Demographic Information Questions

This section aimed to gather information about participants' demographic profiles, including age, gender, nationality, university attended, program of study, class level, last semester GPA, usage of AI-based products or services, daily Internet usage time, and the most frequently used social media platform.

Artificial Intelligence Anxiety Scale

Data were collected using the Artificial Intelligence Anxiety scale developed by Wang and Wang (2019) and adapted to Turkish by Akkaya et al. (2021). This 16-item scale uses a 5-point Likert format ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). Scores ranged from 16 to 80, with higher scores indicating greater AI anxiety. The scale comprises four subscales: "Learning," "Job Displacement," "Sociotechnical Blindness," and "AI Configuration." In this study, the reliability analysis showed a Cronbach's alpha of .95 (Table 2) for the overall scale, indicating high internal consistency (original version, .96; adapted version, .94).

Multidimensional 21st Century Skills Scale

The "Multidimensional 21st Century Skills Scale" developed by Çevik (2019) was used to measure the 21st century skill levels of participants. This 41-item scale includes dimensions such as "Information and Technology Literacy Skills," "Critical Thinking and Problem-Solving Skills," "Entrepreneurship and Innovation Skills," "Social Responsibility and Leadership Skills," and "Career Consciousness." The scale uses a 5-point Likert format

ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). and scores from 41 to 205, with higher scores indicating higher levels of 21st-century skills. Cronbach's alpha for this scale in this research was .92 (Table 2), demonstrating high internal consistency (original version, .86).

Lifelong Learning Scale

The Lifelong Learning Scale, originally developed by Kirby, Knapper, Lamon, and Egnatoff (2010) and adapted to Turkish by Arslan and Akcaalan (2015), was used in this study. This 14-item unidimensional scale uses a 5-point Likert format ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). Scores ranged from 14 to 70, with higher scores indicating a greater propensity for lifelong learning. In this study, the scale demonstrated good internal consistency with a Cronbach's alpha of .84 (Table 2), demonstrating high internal consistency (original version, .71; adapted version, .67). The reliability information of the scales used is presented in Table 2.

Table2. Reliability Analysis for all Scales

Scale	Items	Cronbach's Alpha
AI Anxiety Scale	16	0.95
Multi-dimensional 21st Century Skills Scale	41	0.92
Lifelong Learning Scale	14	0.84

As shown in Table 2, all scales had Cronbach's alpha values over 0.70, surpassing the accepted range of 0.60 to 0.70 as the lower threshold (Hair et al., 2014). Therefore, all scales exhibited acceptable to good Cronbach's alpha values and were suitable for measuring the intended constructs. The data for this research were collected online between March and May 2024. The survey link was distributed to the students by instructors and school administrators.

2.4. Data Analysis

The statistical analysis of the research data was carried out using the SPSS 27 package program. From the 410 collected survey data, 396 participants' data was analysed. To determine whether the data met the assumption of normality, the Kolmogorov-Smirnov test, as well as Skewness and Kurtosis tests, were used. Results are presented in Table 3.

Table3. Normality Values for Scales

	Z	df	P	Skewness	Kurtosis
AI Anxiety Scale	0.064	396	0.000	-0.050	-0.621
Multi-dimensional 21st Century Skills Scale	0.053	396	0.010	-0.551	0.543
Lifelong Learning Scale	0.066	396	0.000	-0.411	1.302

As shown in Table 3, although the normality distribution test results were found to be significant ($p=0.000<0.05$) for the scales overall, the Kurtosis and Skewness values were within the range of -2 to +2. Therefore, parametric tests such as t-test, Anova and Pearson Correlation test have been applied (Cramer, 1998; Doane and Seward, 2011; George and Mallery, 2010). Due to the unequal sample sizes in the participant groups, Scheffe and Bonferroni post-hoc tests were applied for multiple comparisons when the variances were homogenous (Miller, 1969), and the Games-Howell test was used when the variances were not homogenous (Games, 1971). Descriptive statistics calculations were conducted using SPSS 27 software, and scores obtained from the scales were interpreted as follows: (a) 1.00-1.79 as 'very low', (b) 1.80-2.59 as 'low', (c) 2.60-3.39 as 'moderate', (d) 3.40-4.19 as 'high', and (e) 4.20-5.00 as 'very high' levels.

3. FINDINGS

The main research question of the study was identified as "What is the level of artificial intelligence anxiety, 21st Century Skills and lifelong learning among undergraduates?" Table 4 presents descriptive statistics pertaining to the levels of the variables.

Table 4. Descriptive Statistics of Scales

Scale	Number of items	*N*	$\bar{X}$	*SD*
AI Anxiety	16	396	2.81	0.96
Multidimensional 21st Century Skills	41	396	3,92	0,60
Lifelong Learning	14	396	3.45	0.89

Note. N = Sample Size; Mean ($\bar{X}$) = Mean Score; SD = Standard Deviation.

When Table 4 is analysed, it is found that undergraduate students in educational faculty departments exhibit varying levels of artificial intelligence anxiety, 21st Century Skills, and lifelong learning. For the AI Anxiety scale, students reported a mean score of ($\bar{X}$= 2.81). This suggests a moderate level of anxiety surrounding artificial intelligence among the student population. Conversely, the Multidimensional 21st Century Skills scale yielded a higher mean score of ($\bar{X}$=3.92), indicating a strong perception of possessing relevant skills for the demands of the 21st century. Furthermore, the Lifelong Learning scale reflected a mean score of ($\bar{X}$=3.45). This suggests a moderate level of student recognition of the importance of continuous learning and skill development beyond formal education.

The first sub-question of the research was identified as "According to undergraduates, is there a statistical difference among the levels of artificial intelligence anxiety, multidimensional 21st-century skills, and lifelong learning based on gender?" An Independent t-test was used to investigate the findings. Results are presented in Table 5.

Table 5. Independent t-Test Based on Gender Differences

	Gender	N	$\bar{X}$	Sd	Df	t	P
Artificial Intelligence Anxiety	Female	242	3.00	0.91	394	5.086	**0.000**
	Male	154	2.52	0.93			
Multidimensional 21st Century Skills	Female	242	3.91	0.47	394	-0.157	0.876
	Male	154	3.92	0.57			
Lifelong Learning	Female	242	3.44	0.57	394	-0.460	0.646
	Male	154	3.47	0.71			

* Sig. 0.05

When Table 5 was analysed, it was found that there was a significant difference in Artificial Intelligence Anxiety levels based on gender. Female students ($\bar{X}$= 3.00) reported higher levels of AI anxiety compared to male students ($\bar{X}$ = 2.52), indicating a statistically significant difference (t (394) = 5.086; p = 0.000 < 0.05). For Multidimensional 21st-Century Skills, the results between female ($\bar{X}$= 3.91) and male students ($\bar{X}$= 3.92), indicated statistically no significant difference (t (394) = -0.157, p = 0.876 > 0.05). Similarly, for Lifelong Learning, between female ($\bar{X}$ = 3.44) and male students ($\bar{X}$ = 3.47), the results also indicated statistically no significant difference (t (394) = -0.460; p = 0.646 > 0.05). The findings highlight that while there is a significant gender difference in the level of artificial intelligence anxiety, no significant gender differences were observed for multidimensional 21st-century skills and lifelong learning. This suggests that although female students tend to experience higher anxiety related to artificial intelligence, their perceptions of their 21st-century skills and commitment to lifelong learning are similar to those of their male counterparts.

The second sub-question of the research was identified as "According to undergraduates, is there a statistical difference among the levels of artificial intelligence anxiety, multidimensional 21st-century skills, and lifelong learning based on age?". A Multivariate one-way analysis of variance (ANOVA) test was employed to investigate the findings. Results are given in Table 6.

Table 6. Results of The Multivariate One Way ANOVA Test Based on Age

Variable	Age Range	N	$\bar{X}$	Sd	Source	Sum of Squares	df	Mean of Squares	F	P	S. dif.
AIA	**18-20 (1)**	116	2.90	0.90	**Between Groups**	10.027	4	2.507	2.843	**0.024**	
	21-23 (2)	168	2.92	0.97	**Within Groups**	344.805	391	0.882			2>3

	24-26 (3)	77	2.55	0.91	**Total**	354.832	395				
	27-29 (4)	23	2.55	1.06							
	30 and above (5)	12	2.70	0.84							
	Total	396	2.82	0.95							
M21CS	**18-20 (1)**	116	3.85	0.48	**Between Groups**	4.660	4	1.165	4.607	**0.001**	
	21-23 (2)	168	3.87	0.49	**Within Groups**	98.862	391	0.253			4>1 ;2
	24-26 (3)	77	4.03	0.55	**Total**	103.522	395				
	27-29 (4)	23	4.25	0.39							
	30 and above (5)	12	4.03	0.77							
	Total	396	3.92	0.51							
LL	**18-20 (1)**	116	3.33	0.54	**Between Groups**	8.065	4	2.016	5.273	**0.000**	3>1
	21-23 (2)	168	3.42	0.66	**Within Groups**	149.512	391	0.382			4>1 ;3
	24-26 (3)	77	3.67	0.67	**Total**	157.577	395				
	27-29 (4)	23	3.78	0.62							
	30 and above (5)	12	3.27	0.34							
	Total	396	3.46	0.63							

p = Sig. 0.05.

The homogeneity of variances for AI Anxiety (Levene =,684; p = 0,603 > 0,05), multidimensional 21st Century Skills (Levene = 1.622; p = 0.168 > 0.05), and Lifelong Learning (Levene = 1.849; p = 0.119 > 0.05) showed no significant difference. As the assumption of homogeneity of variances was met for all variables, and Scheffe Post-hoc test was conducted. According to the results; for AI Anxiety (F2-393= 2.843; p = .024<0,05), participants among the age "21-23" ($\bar{X}$=2.92) exhibited higher AI anxiety compared to those aged "24-26" (X=2.55) For Multidimensional 21st Century Skills (F2-393 = 4.607; p = .001<0,05), participants among the age "27-29" (X=4.25) indicated a higher level than "18-20" (X =3,85) and "21-23" (3.87) aged participants. For Lifelong Learning (F2-393 = 5.273; p = .000<0,05), participants aged "27-29" (X=¯3.78) exhibited higher level of Lifelong Learning level compared to those aged "18-20 "(X=3.33) and "24-26" (X=3.67). Additionally, "24-26" (X=3.67) aged participants indicated a higher level than "18-20" (X =3.33).

The third sub-question of the research was identified as "According to undergraduates, is there a statistical difference among the levels of artificial intelligence anxiety, multidimensional 21st-century skills, and lifelong learning based on origin country?" The Multivariate one-way ANOVA Test was employed to investigate the findings. Results are given in Table 7.

Table 7. Results of the Multivariate one-way ANOVA Test Based on Origin Country

Variable	Origin C.	N	X	Sd	Source	Sum of Squares	df	Mean of Squares	F	P	S. dif.
AIA	**TRNC (1)**	63	2.80	0.94	**Between Groups**	3.166	2	1.583	1.769	0.172	-
	Turkey (2)	304	2.79	0.97	**Within Groups**	351.666	393	0.895			
	Other (3)	29	3.13	0.59	**Total**	354.832	395				
	Total	396	2.82	0.95							
M21CS	**TRNC (1)**	63	4.01	0.49	**Between Groups**	2.701	2	1.351	5.264	**0.006**	1> 3
	Turkey (2)	304	3.93	0.52	**Within Groups**	100.821	393	0.257			2> 3

	Other (3)	29	3.65	0.45	**Total**	103.522	395				
	Total	396	3.92	0.51							
LL	**TRNC (1)**	63	3.67	0.61	**Between Groups**	3.839	2	1.919	4.907	**0.008**	1> 2;3
	Turkey (2)	304	3.43	0.65	**Within Groups**	153.738	393	0.391			
	Other (3)	29	3.29	0.39	**Total**	157.577	395				
	Total	396	3.46	0.63							

* p = Sig. 0.05

The homogeneity of variances for AI Anxiety, Multidimensional 21st Century Skills, and Lifelong Learning based on origin of country was assessed using Levene's test. For AI Anxiety (Levene = 6,719; p = 0.001< 0.05) and Lifelong Learning Skills (Levene = 3,319; p = .037< 0.05) the results indicated the variances were not homogeneously distributed so Games Howel test was used. The Levene result for Multidimensional 21st Century Skills (Levene = .506; p = .603> 0.05) indicated no significant difference in variances therefore Scheffe test was performed. According to the ANOVA results; For the AI Anxiety ($F_{2\text{-}393}$= 1.769; p = .172>0,05) statistically no difference was found. Significant difference was found for the Multidimensional 21st Century Skills ($F_{2\text{-}393}$= 1.769; p = 0.006<0,05) and Lifelong Learning ($_{F2\text{-}393}$= 4.907; p = 0.008<0,05). The results showed that in terms of Multidimensional 21st Century Skills, participants from TRNC (X= 4.01) and from Turkey (X=3,93) had a higher mean compared to those from "Other" countries group (X = 3.65). Lastly, for Lifelong Learning, the mean for participants from TRNC (X=3.67) was higher than that for participants from Turkey (X=3.43) and "Other" countries (X= 3.29).

The fourth sub-question of the research was identified as "According to undergraduates, is there a statistical difference among the levels of Artificial Intelligence Anxiety (AIA), Multidimensional 21st Century Skills (M21CS), and Lifelong Learning (LL) based on university attended?". The Multivariate one-way ANOVA Test was employed to investigate the findings. Results are given in Table 8.

Table 8. Results of the Multivariate one-way ANOVA Test Based on University

Variable	Uni.	N	X	Sd	Source	Sum of Squares	df	Mean of Squares	F	P	S. diff.
AIA	**GAU (1)**	103	2.72	1.02	**Between Groups**	3.923	3	1.308	1.461	0.225	-
	KU (2)	24	2.82	0.94	**Within Groups**	350.909	392	0.895			
	CSU (3)	12	3.32	0.48	**Total**	354.832	395				
	FIU (4)	257	2.83	0.93							
	Total	396	2.82	0.95							
M21CS	**GAU (1)**	103	4.14	0.43	**Between Groups**	6.854	3	2.285	9.264	**0.000**	1> 2;4
	KU (2)	24	3.80	0.51	**Within Groups**	96.668	392	0.247			
	CSU (3)	12	3.97	0.27	**Total**	103.522	395				
	FIU (4)	257	3.84	0.53							
	Total	396	3.92	0.51							
LL	**GAU (1)**	103	3.86	0.54	**Between Groups**	23.199	3	7.733	22.558	**0.000**	1>4;2; 3
	KU (2)	24	3.35	0.46	**Within Groups**	134.379	392	0.343			
	CSU	12	3.14	0.45	**Total**	157.577	395				

(3)			
FIU (4)	257	3.32	0.62
Total	396	3.46	0.63

p = Sig. 0.05
GAU: Girne American University; KU: Kyrenia University; CSU: Cyprus Science University; FIU: Final International University

The variances of AI Anxiety (Levene = 3.659; p = 0.013 < 0.05) were found to be non-homogeneous so Games Howel test was used, while the variances of multidimensional 21st Century Skills (Levene = 2.085; p = 0.102 > 0.05) and Lifelong Learning levels (Levene = 1.489; p = 0.217 > 0.05) exhibited homogeneity. Consequently, Scheffe test was performed. The ANOVA test results indicated that, according to the participants' university attended, no statistically significant difference was detected in AI anxiety ($F_{(3-392)}$ = 1.461; p =0.225>0,05). For Multidimensional 21st Century Skills ($F_{(3-392)}$ = 9,264; p = 0,000<0,05), and Lifelong Learning levels ($F_{(3-392)}$ = 22,558; p= 0.000<0,05) results showed that there was a statistically significant difference. According to the post hoc test results, for Multidimensional 21st Century Skills levels, Girne American University had a higher mean (X=4.14) indicating that students from this university reported higher skills compared to Girne University (X= 3.80) and Final International University (X=3.84). Regarding Lifelong Learning levels, Girne American University also had a higher mean (X = 3.86), suggesting that students from this university reported higher lifelong learning levels than Cyprus Science University (X=3.14), Final International University (X =.3.32), and Kyrenia University (X=.3.35).

The fifth sub-question of the research was identified as "According to undergraduates, is there a statistical difference among the levels of Artificial Intelligence Anxiety (AIA), Multidimensional 21st Century Skills (M21CS), and Lifelong Learning (LL) based on faculty program?". The Multivariate one-way ANOVA Test was employed to investigate the findings. Results are given in Table 9.

Table 9. Results of the Multivariate one-way ANOVA Test Based on Program

Variable	Prog.	N	X	Sd	Source	Sum of Squares	df	Mean of Squares	F	P	S. diff.
AIA	**ELT (1)**	181	2.89	0.88	**Between Groups**	7.659	6	1.276	1.43	0.202	-
	SET (2)	58	2.71	1.02	**Within Groups**	347.173	389	0.892			
	PST (3)	86	2.66	1.02	**Total**	354.832	395				
	PCG (4)	34	2.99	0.84							
	TLT (5)	17	3.09	1.08							
	MT (6)	9	2.37	0.77							
	PET (7)	11	2.85	1.13							
	Total	396	2.82	0.95							
M 21CS	**ELT (1)**	181	3.90	0.48	**Between Groups**	4.431	6	0.739	2.899	**0.009**	4>2
	SET (2)	58	3.78	0.61	**Within Groups**	99.090	389	0.255			6>1;2 ;3;5
	PST (3)	86	3.93	0.52	**Total**	103.522	395				
	PCG (4)	34	4.12	0.41							
	TLT	17	3.87	0.40							

	(5)										
	MT (6)	9	4.37	0.32							
	PET (7)	11	4.02	0.64							
	Total	396	3.92	0.51							
LL	**ELT (1)**	181	3.48	0.52	**Between Groups**	10.785	6	1.797	4.763	**0.000**	1>2
	SET (2)	58	3.12	0.76	**Within Groups**	146.793	389	0.377			3>2
	PST (3)	86	3.53	0.73	**Total**	157.577	395				5>2
	PCG (4)	34	3.46	0.57							6>1;2;4
	TLT (5)	17	3.73	0.59							
	MT (6)	9	3.94	0.30							
	PET (7)	11	3.58	0.49							
	Total	396	3.46	0.63							

p = Sig. 0.05, ELT: English Language Teaching; SET: Special Education Teaching; PST: Pre School-Teaching; PCG: Psychological Counselling and Guidance; TLT: Turkish Language Teaching; MT: Music Teaching; PET: Primary School Teaching.

Based on Levene's test results for homogeneity of variances, it was found that AI Anxiety was homogeneously distributed (Levene = 1,725; p = 0,114 > 0,05). However, the variables Multidimensional 21st-Century Skills (Levene = 2,284; p = 0,035<0,05) and Lifelong Learning (Levene = 4,012; p = 0,001< 0,05) were non-homogeneous. According to the ANOVA results presented in Table 9, significant differences were observed in Multidimensional 21st-Century Skills ($F_{(6-389)}$ = 2,899; p=0.009<0.05) and Lifelong Learning ($F_{(6-389)}$ = 4.763; p =0.000<0.05) in relation to the students' programs. However, for the variable AI Anxiety, no significant differences were found ($F_{(6-389)}$ = 1.430; p = 0.202 > 0.05). Games Howel test results indicated that, students in the PCG program (X=4.12) demonstrated a higher level of Multidimensional 21st Century Skills than students in the SET (X=3.78) program. Furthermore, students enrolled in the MT program (X =4.37) indicated a higher level than students in the ELT (X=3.90), SET (X=3.78), PST (X=3.93), and TLT (X=3.87) programs. In Lifelong Learning, students in ELT (X= 3.48), PST (X= 3.53), TLT (X= 3.73), and MT (X= 3.94) programs exhibited higher levels than those in SET (X= 3.12). Additionally, MT (X= 3.94) program students demonstrated higher levels than both ELT (X= 3.48) and PCG (X = 3.46) program students.

The sixth sub-question of the research was identified as "According to undergraduates, is there a statistical difference among the levels of Artificial Intelligence Anxiety (AIA), Multidimensional 21st Century Skills (M21CS), and Lifelong Learning (LL) based on class year?" The Multivariate one-way ANOVA Test was employed to investigate the findings. Results are given in Table 10.

Table 10. Results of the Multivariate one-way ANOVA Test Based on Class Year

Variable	Class Year	N	X	Sd	Source	Sum of Squares	df	Mean of Squares	F	P	S. diff.
AIA	**1st Year (1)**	166	2.77	0.99	Between Groups	3.455	3	1.152	1.285	0.279	-
	2nd Year (2)	53	2.94	0.90	Within Groups	351.377	392	0.896			
	3rd Year (3)	85	2.70	1.00	Total	354.832	395				

	4th Year (4)	92	2.93	0.83							
	Total	396	2.82	0.95							
M21CS	**1st Year (1)**	166	3.84	0.54	Between Groups	3.676	3	1.225	4.811	**0.003**	3>1;2
	2nd Year (2)	53	3.83	0.41	Within Groups	99.845	392	0.255			
	3rd Year (3)	85	4.06	0.43	Total	103.522	395				
	4th Year (4)	92	3.99	0.56							
	Total	396	3.92	0.51							
LL	**1st Year (1)**	166	3.31	0.66	Between Groups	10.236	3	3.412	9.077	**0.000**	3>1;2
	2nd Year (2)	53	3.34	0.43	Within Groups	147.342	392	0.376			4>1
	3rd Year (3)	85	3.67	0.65	Total	157.577	395				
	4th Year (4)	92	3.60	0.58							
	Total	396	3.46	0.63							

* p = Sig. 0.05

Based on Levene's test results for the homogeneity of variances, it was found that for the variable AI Anxiety, the distribution was homogeneous (Levene = 2.492; p = 0.060 > 0.05). Similarly, for Lifelong Learning, the distribution was also homogeneous (Levene = 2.520; p = 0.058 > 0.05). However, for the variable, Multidimensional 21st Century skills, the distribution was non-homogeneous (Levene = 3.440; p = 0.017 < 0.05). Post hoc tests were conducted to further examine pairwise differences between class years for Lifelong Learning using the Scheffe test. For multidimensional 21st Century Skills, the Games-Howell post hoc test was applied. The ANOVA test indicated that there was no significant difference in AI Anxiety ($F_{(3, 392)} = 1.285$; p = 0.279 > 0.05), but significant differences existed for Multidimensional 21st Century Skills ($F_{(3, 392)} = 4.811$; p = 0.003 < 0.05) and Lifelong Learning ($F_{(3, 392)} = 9.077$; p = 0.000 < 0.05). In the Games Howel post hoc test for multidimensional 21st Century Skills, the 3rd year (X=4.06) group demonstrated significantly higher scores compared to both the 1st year (X=3.84) and 2nd year (X=3.83) groups. This suggests that students in the 3rd year exhibit more developed Multidimensional 21st Century Skills than those in the 1st and 2nd years. In the post hoc analysis for Lifelong Learning, it was found that students in the 3rd year (X=3.67) had significantly higher scores than both the 1st year (X=3.31) and 2nd year (X=3.34) groups. Furthermore, students in the 4th year also demonstrated significantly higher scores compared to the 1st year group. These results suggest that students in the 3rd and 4th years exhibited more advanced levels of Lifelong Learning than those in the earlier years of the study.

The seventh sub-question of the research was identified as "According to undergraduates, is there a statistical difference among the levels of Artificial Intelligence Anxiety (AIA), Multidimensional 21st Century Skills (M21CS), and Lifelong Learning (LL) based on class year GPA?". The Multivariate one-way ANOVA Test was employed to investigate the findings. Results are given in Table 11.

Table 11. Results of the Multivariate one-way ANOVA Test Based on GPA

Variable	GPA	N	X	Sd	Source	Sum of Squares	df	Mean of Squares	F	P	S. diff.
AIA	**3.00-4.00 (1)**	144	2.96	0.89	Between Groups	4.938	2	2.469	2.773	0.064	-
	2.99-2.00 (2)	222	2.73	0.94	Within Groups	349.894	393	0.890			
	1.99 and below (3)	30	2.77	1.19	Total	354.832	395				
	Total	396	2.82	0.95							

M21CS	**3.00-4.00 (1)**	144	4.01	0.47	Between Groups	3.187	2	1.593	6.241	**0.002**	1>2;3
	2.00-2.99 (2)	222	3.90	0.52	Within Groups	100.335	393	0.255			2>3
	1.99 and below (3)	30	3.66	0.56	Total	103.522	395				
	Total	396	3.92	0.51							
LL	**3.00-4.00 (1)**	144	3.50	0.64	Between Groups	1.047	2	0.523	1.314	0.27	-
	2.00-2.99 (2)	222	3.45	0.62	Within Groups	156.531	393	0.398			
	1.99 and below (3)	30	3.30	0.65	Total	157.577	395				
	Total	396	3.46	0.63							

p = Sig. 0.05.

For AI Anxiety, the Levene test indicated unequal variances (Levene = 4.358; p = .013 < 0.05) and the Anova results showed a non-significant difference between groups ($F_{(2, 393)}$ = 2.773; p = 0.064 > 0.05). As for Multidimensional 21st Century Skills, the ANOVA results showed a significant difference ($F_{(2, 393)}$ = 6.241; p = 0.002 < 0.05) between groups and as a homogenous distribution (Levene = .702; p = 0.496 > 0.05) was detected Scheffe test was applied. For Lifelong Learning, the Levene test also did not show significant differences in variances (Levene = .538; p = 0.585 > 0.05) and the ANOVA results revealed a non-significant difference between groups, with an ($F_{(2, 393)}$ = 1.314; p = 0.270 > 0.05), suggesting that there is no significant difference in scores among the groups. For Multidimensional 21st Century Skills, students with GPAs ranging from 3.00 to 4.00 (X= 4.01) scored significantly higher than those with GPAs ranging from 1.99 and below (X= 3.30).

The eighth sub-question of the research was identified as "According to undergraduates, is there a statistical difference among the levels of Artificial Intelligence Anxiety (AIA), Multidimensional 21st Century Skills (M21CS), and Lifelong Learning (LL) based on use of artificial intelligence-based products or services?". The Independent t- Test was employed to investigate the findings. Results are given in Table 12.

Table 12. Independent T-Test Based on Use of Artificial Intelligence-Based Products or Services

Variable	Use of AI	N	X	Sd	Df	t	p
Artificial Intelligence Anxiety	Yes	343	2.83	0.924	394	0.999	0.318
	No	53	2.69	1.091			
Multidimensional 21st Century Skills	Yes	343	3.96	0.504	394	3.548	**0.000**
	No	53	3.69	0.511			
Lifelong Learning	Yes	343	3.50	0.616	394	3.397	**0.001**
	No	53	3.19	0.668			

p = Sig. 0.05.

Table 12 presents the results of independent t-tests based on the use of artificial intelligence-based products or services among undergraduate students. For Artificial Intelligence Anxiety, the mean score for undergraduates who indicated "Yes" (X= 2.83) did not significantly differ from those who indicated "No" (X= 2.69), as indicated by the non-significant t-value (t (394) = 0.999, p = 0.318 > 0.05). However, for Multidimensional 21st Century Skills and Lifelong Learning, undergraduates who reported using artificial intelligence-based products or services ("Yes") had significantly higher mean scores compared to those who did not ("No"). Specifically, for Multidimensional 21st Century Skills, the mean score for "Yes" (X = 3.96) was significantly higher than for "No" (X= 3.69), with a t-value of (t (394) = 3.548; p = 0.000 < 0.05), indicating a meaningful difference. Similarly, for Lifelong Learning, undergraduates who reported using artificial intelligence-based products or services ("Yes") had a significantly higher mean score (X= 3.50) compared to those who did not ("No") (X= 3.19), with a t-value of (t (394) = 3.397; p = 0.001 < 0.05).

The ninth sub-question of the research was identified as "According to undergraduates, is there a statistical difference among the levels of Artificial Intelligence Anxiety (AIA), Multidimensional 21st Century Skills

(M21CS), and Lifelong Learning (LL) based on daily internet use time for professional development?". The Multivariate one-way ANOVA Test was employed to investigate the findings. Results are given in Table 13.

Table 13. Results of The Multivariate One-Way ANOVA Based on Daily Internet Use Time for Professional Development.

Variable	Time	N	$\bar{X}$	Sd	Source	Sum of Squares	df	Mean of Squares	F	P	S. diff.
AIA	**Less than 1 hour (1)**	36	3.10	0.83	**Between Groups**	5.725	3	1.908	2.143	0.094	-
	1-3 hours (2)	149	2.88	0.91	**Within Groups**	349.107	392	0.891			
	3-5 hours (3)	114	2.76	0.98	**Total**	354.832	395				
	More than 5 hours (4)	97	2.67	0.98							
	Total	396	2.82	0.95							
M 21CS	**Less than 1 hour (1)**	36	3.71	0.53	**Between Groups**	2.318	3	0.773	2.992	**0.031**	3>1
	1-3 hours (2)	149	3.89	0.48	**Within Groups**	101.204	392	0.258			
	3-5 hours (3)	114	3.99	0.45	**Total**	103.522	395				
	More than 5 hours (4)	97	3.96	0.60							
	Total	396	3.92	0.51							
LL	**Less than 1 hour (1)**	36	3.23	0.55	**Between Groups**	3.106	3	1.035	2.628	**0.050**	3>1
	1-3 hours (2)	149	3.43	0.56	**Within Groups**	154.471	392	0.394			
	3-5 hours (3)	114	3.55	0.61	**Total**	157.577	395				
	More than 5 hours (4)	97	3.48	0.76							
	Total	396	3.46	0.63							

p = Sig. 0.05

The results of Levene's Test for Homogeneity of Artificial Intelligence Anxiety showed that this variable had homogeneously distributed variances (Levene = 1.373; p = 0.251 > 0.05). However, for Multidimensional 21st Century Skills (Levene = 4.455; p = 0.004 < 0.05) and Lifelong Learning (Levene= 3.420; p = 0.017 < 0.05), the test results indicated that the variances were not equal, meaning that these variables had significantly different variances across the different groups of daily internet use time the groups. The Anova test results indicated that there was no significant effect of daily internet use time on AIA level ($F_{(3, 392)} = 2.143$; p = 0,094 > 0,05) for the four-time ranges. The analysis for Multidimensional 21st Century Skills (M21CS) revealed a significant effect of daily internet use time on M21CS ($F_{(3, 392)} = 2.992$; p = 0,031 <. 0,05), Post hoc comparisons using the Games Howel test indicated that the mean score for "3-5 hours" (X= 3.99) was significantly different from "Less than 1 hour" (X = 3.71)". Lifelong Learning (LL) also indicated a significant effect of daily internet use time on LL ($F_{(3, 392)} = 2.628$; p = 0.050). Post hoc comparisons using the Games Howel test indicated that the mean score for "Less than 1 hour "(X = 3.23) was significantly different from "3-5 hours" (X = 3.55). The results suggest that daily internet use time for professional development has a significant effect on Multidimensional 21st Century Skills and Lifelong Learning, but not on Artificial Intelligence Anxiety.

The tenth sub-question of the research was identified as "According to undergraduates, is there a statistical difference among the levels of Artificial Intelligence Anxiety (AIA), Multidimensional 21st Century Skills (M21CS), and Lifelong Learning (LL) based on the mostly used Social Media Platform?". The Multivariate one-way Anova Test was employed to investigate the findings. Results are given in Table 14.

Table 14. Results of The Multivariate One-Way ANOVA Test Based on Most Used Social Media Platform

Variable	Social Platform	N	$\bar{X}$	Sd	Source	Sum of Squares	df	Mean of Squares	F	P	S. diff.
AIA	Facebook	17	2.49	0.98	Between Groups	5.150	5	1.030	1.149	0.334	-
	Instagram	259	2.84	0.95	Within Groups	349.682	390	0.897			
	X (Formerly Twitter)	22	2.66	0.94	Total	354.832	395				
	TikTok	42	2.93	0.93							
	YouTube	49	2.85	0.93							
	Other	7	2.27	0.77							
	Total	396	2.82	0.95							
M21CS	Facebook	17	3.99	0.82	Between Groups	2.302	5	0.460	1.774	0.117	-
	Instagram	259	3.96	0.49	Within Groups	101.220	390	0.260			
	X (Formerly Twitter)	22	3.96	0.46	Total	103.522	395				
	TikTok	42	3.71	0.52							
	YouTube	49	3.88	0.51							
	Other	7	3.87	0.34							
	Total	396	3.92	0.51							
LL	Facebook	17	3.77	0.68	Between Groups	2.442	5	0.488	1.228	0.295	-
	Instagram	259	3.47	0.66	Within Groups	155.135	390	0.398			
	X (Formerly Twitter)	22	3.37	0.50	Total	157.577	395				
	TikTok	42	3.43	0.62							
	YouTube	49	3.37	0.51							
	Other	7	3.31	0.29							
	Total	396	3.46	0.63							

p = Sig. 0.05

According to the results, the variances for Artificial Intelligence Anxiety (Levene = 0.183; p = 0.969 > 0.05) and Lifelong Learning (Levene= 1.774; p = 0.117 > 0.05) were homogeneous across the different groups. For Multidimensional 21st Century Skills (Levene= 3.263; p = 0.007 < 0.05) the variances were not homogeneous. The results from the one-way ANOVA suggest that the type of social media platform usage does not significantly affect undergraduate students' levels of Artificial Intelligence Anxiety ($F_{(5,\ 390)}$ = 1.149; p = .334], Multidimensional 21st Century Skills ($F_{(5,\ 390)}$ = 1.774; p = .117], or Lifelong Learning ($F_{(5,\ 390)}$ = 1.228; p = .295).

And the last sub question of the research was stated as “Is there a correlation among the level of artificial intelligence anxiety, 21st Century Skills and lifelong learning?”. The results are presented in Table 15.

Table 15. Correlation Analysis Results

		AI Anxiety	Multidimensional 2st Century Skills	Lifelong Learning
AI Anxiety	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	396		
Multidimensional 21st Century Skills	Pearson Correlation	0.033	1	
	Sig. (2-tailed)	0.508		
	N	396	396	
Lifelong Learning	Pearson Correlation	0.056	.362**	1
	Sig. (2-tailed)	0.263	0.000	
	N	396	396	396

**. Correlation is significant at the 0.01 level (2-tailed).

According to Table 15, the Pearson Correlation Test revealed a very weak positive correlation between AI Anxiety and Multidimensional 21st Century Skills (r=0.033; p=0.508>0.05), indicating no statistically significant relationship. This suggests that students' anxiety related to AI does not significantly impact their acquisition of 21st-century competencies. Similarly, the correlation between AI Anxiety and Lifelong Learning was very weak and not statistically significant (r=0.056; p=0.263>0.05), implying that AI-related anxiety does not influence students' engagement in lifelong learning. However, a moderate positive correlation was found between Multidimensional 21st Century Skills and Lifelong Learning (r=0.362; p=0.000<0.05), which was statistically significant. This indicates that students with higher proficiency in 21st-century skills are more likely to engage in lifelong learning practices. These findings highlight the importance of fostering 21st-century skills to promote lifelong learning among students. The lack of significant correlations involving AI Anxiety suggests that while it is a relevant factor, it may not be crucial in influencing students' skills or learning behaviours in these domains.

DISCUSSION AND CONCLUSION

The study found that undergraduate students in educational faculty departments exhibited moderate levels of AI anxiety, indicating a certain level of concern regarding AI among students. This finding is consistent with previous studies (Takıl et al. 2022; Yılmaz & Yılmaz, 2024). Despite this anxiety, students perceived themselves as possessing strong 21st-century skills, suggesting they feel well-prepared for modern demands. Additionally, consistent with Ayçiçek & Karanfil (2021) findings, study found that students had a moderate level lifelong learning recognizing the importance of lifelong learning and skill development beyond formal education, indicating an acknowledgment of the need for ongoing education and skill enhancement.

Significant gender differences were observed, with female students reporting higher levels of AI anxiety than male students, consistent with the study conducted by Aytaç (2022). However, there were no significant differences in perceptions of 21st-century skills and commitment to lifelong learning between genders. This suggests that although female students experience more AI-related anxiety, their confidence in their abilities and dedication to ongoing learning is comparable to that of male students. his could imply that female students' anxiety might stem more from societal and psychological factors rather than a lack of competence or readiness.

Age-related differences were also evident. Younger students exhibited greater anxiety about AI than their older counterparts, while older students demonstrated greater proficiency in 21st-century skills and a stronger inclination towards lifelong learning. These results imply that as students gain experience and maturity, they tend to feel less anxious about AI, less threatened, more self-assured in their skills, and more committed to lifelong learning. Older students' increased proficiency and dedication to lifelong learning could be attributed to their longer exposure to educational environments and more extensive practical experiences, highlighting the importance of experiential learning in reducing technology-related anxiety. The finding that AI decreases with age is consistent with findings from Kaya et al. (2022), Li & Huang (2020), and Wang et al. (2022).

Regional disparities were noted, with students from the TRNC and Turkey showing greater proficiency in 21st-century skills and lifelong learning compared to their peers from other countries. This difference suggests that

regional educational practices and cultural attitudes towards education significantly impact students' development.

The university the students attended also played a crucial role. Students from Girne American University reported higher levels of 21st-century skills and lifelong learning than those from other institutions. This finding underscores the significant impact of the institutional environment on the development of students' skills and attitudes towards lifelong learning. It aligns with Swargiary and Roy's (2023) perspective on the importance of the study environment in academic performance.

Differences among academic programs were significant for 21st-century skills and lifelong learning but not for AI anxiety. Students in programs such as Psychological Counselling and Guidance and Music Teaching demonstrated higher levels of these skills and lifelong learning, suggesting that certain academic programs provide more opportunities for skill development and lifelong learning. These programs likely offer more practical, hands-on experiences and opportunities for personal development, which are crucial for developing these competencies. This finding highlights the need for curriculum designers to incorporate experiential learning opportunities across all academic programs to foster these essential skills.

Class level differences revealed that third-year students exhibited higher levels of 21st-century skills and lifelong learning than first- and second-year students, and fourth year students with first years. This finding suggests that these competencies progressively develop with academic experience, emphasizing the importance of continuous engagement in educational activities. This progression also reflects the snowballing effect of continued exposure to diverse learning experiences and the gradual build-up of knowledge and skills over time. Another study conducted by Sıvacı et al. (2023) and Scheuch (2007) lends further support to this perspective, indicating that students in higher grades engage in more research activities compared to those in lower grades. Coşkun & Demirel's (2012) investigation similarly found a significant difference in lifelong learning tendencies favoring senior students when analysing undergraduate students across grade levels.

Higher academic achievement, as indicated by GPA, was associated with better proficiency in 21st-century skills. Students with higher GPAs demonstrated more advanced skills, indicating that academic success correlates with better preparation for modern demands.

Students who used AI-based products or services reported higher levels of 21st-century skills and lifelong learning than those who did not use such products. This indicates that engagement with AI technology can enhance these competencies, emphasizing the positive role of technology in education. Hence, encouraging students to use AI tools could be a strategic move to increase their preparedness for contemporary needs and lessen concern associated with AI through familiarisation and practical application.

Daily Internet use for professional development significantly affected 21st-century skills and lifelong learning but not AI anxiety. Students who used the internet for 3-5 hours daily exhibited higher levels of these skills and lifelong learning, highlighting the importance of internet usage in professional development. It suggests that integrating online resources and digital tools into the curriculum could further promote these competencies among students.

The type of social media platform used by the students did not significantly affect their levels of AI anxiety, 21st-century skills, or lifelong learning. This finding suggests that the choice of social media platform does not significantly influence these constructs.

Finally, correlation analysis revealed no significant relationship between AI anxiety and 21st-century skills or lifelong learning. However, there was a moderate positive correlation between 21st-century skills and lifelong learning, indicating that students with higher proficiency in 21st-century skills are more likely to engage in lifelong learning practices. This emphasizes the importance of fostering 21st-century skills to promote a culture of lifelong learning among students. The lack of significant correlations involving AI anxiety suggests that, while it is a relevant factor, it may not critically influence students' skills or learning behaviours in these domains.

SUGGESTIONS

For Undergraduate Students:

Undergraduate students should embrace opportunities to engage with AI-based products and services to reduce anxiety and enhance proficiency in 21st-century skills. Participation in AI-related workshops, seminars, and courses can build a deeper understanding and alleviate fears related to AI technology. Students should also actively seek out continuous learning opportunities through online courses, professional development programs, and extracurricular activities. Developing a habit of regular self-assessment and skill enhancement is crucial to

staying relevant in the rapidly evolving job market. Additionally, leveraging daily internet usage for professional growth by accessing educational resources, joining professional networks, and participating in webinars can further enhance their 21st-century skills and lifelong learning tendencies.

For Educators and Institutions:
Educators and institutions should implement counselling services and support programs to help students manage AI anxiety. Integrating AI education into the curriculum can demystify the technology and reduce fear. Providing students with successful and satisfying experiences, research data, and job market reports, can enhance confidence and contribute to more positive attitudes towards AI. These actions may reduce levels of AI anxiety (Glass & Knight, 1988; Korobili et al., 2010) and thus increase learning motivation. Developing curricula that emphasize critical thinking, collaboration, communication, and technological literacy is essential. Providing practical, hands-on learning experiences can further enhance these skills. Fostering a culture of continuous learning within educational institutions by providing resources and support for ongoing education is also important. Encouraging students to set personal learning goals and providing guidance on achieving them can promote lifelong learning. Recognizing the diverse needs of students based on their demographic and educational backgrounds, and tailoring programs to address these variations, is crucial. Offering targeted interventions and support services to address specific concerns, such as gender differences in AI anxiety, can further help students navigate the challenges and opportunities presented by AI technology.

For Further Research:
This research is conducted by using quantitative correlation survey methodology by means of three scales selected from the field of literature where different types of data collection tools developed regarding the current subject of the research from different perspectives focusing on different variables. General survey conducted by means of one these currently developed data collection tools to gather opinion from a larger research group can enable the researcher to generalize the findings of the research to have a better and wider understanding of the AI phenomenon and its effect to youth and technology. Likewise, by analyzing the gap of the data collection tools on the current subject, another quantitative data collection tool could be developed, focusing on different aspects and effects of AI usage in education or in other domains to reach the AI usage and attitude of the undergraduates rather in TRNC in a wider perspective or in another country. Gathering quantitative data that have been reflected in the literature a meta-analysis of the current AI and its effect could be conducted to examine the topic from a holistic perspective that will help to compare the regions', countries' and domains' approached to AI phenomenon.

Even if quantitative methodology helps the researchers to gather numerical and statistically comparable data related to the current subject, to have a better and deeper understanding, qualitative methodology with suitable research designs could enable to examine undergraduates' opinions related to the subject. Grounded theory design with focus group interviews to gather and compare opinions about the subject could be conducted. Likewise, single or multiple case studies could be designed with maximum variation sampling model that can help the researcher to create a study group with different demographic status, helping the researchers to understand and compare the cases within. Furthermore, a combination of suitable data collection tools from quantitative and qualitative methodology could be gathered for an effective mixed method to gather relevant data and explain the current status of the AI attitude and opinions of undergraduates.

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